



SUPPORTING DOCUMENT FOR BVA's *BOVINE TUBERCULOSIS (bTB)* POLICY STATEMENT, STRATEGY DOCUMENT AND LIST OF RECOMMENDATIONS

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ANNEX A: Glossary of terms and definitions

Note: This supporting document should be read in conjunction with the attached BVA *bTB* Strategy Document, Policy Statement and List of Recommendations. The relevant statements and recommendations have been copied and grouped into the appropriate sections below for ease of reference. BVA has produced this policy document in view of the current circumstances and knowledge available (October 2005). It will be revised in light of new developments as they arise.

1. Background information

1.1 What is *bovine Tuberculosis*?

Bovine Tuberculosis (bTB) is a complex infectious zoonotic disease of animals and man, caused by the bacterium *Mycobacterium bovis (M. bovis)*. *bTB* presents a significant risk to animal health and welfare due to an increasing prevalence of the disease in UK cattle herds (5.6% subject to restrictions in 2004*) and other mammalian species, particularly badgers. Approximately 22,000 cattle were slaughtered in the UK as part of the national *bTB* control scheme in 2004 costing the taxpayer approximately £88 million for the year and placing adverse pressure on the farming industry. *bTB* is not currently a significant threat to human health due to strict public health control measures, however it has the potential to become a threat if it is not kept in check.

1.2 What is being done to control the disease?

Prior to the 1930s the main source of *bTB* infection in humans was through the consumption of infected un-pasteurised milk. The national eradication scheme brought in to protect human health in the 1940s and 50s reduced this threat considerably and the prevalence of *bTB* has stayed low in both human and cattle populations until the recent increase. Current cattle-based measures (see Box 1) have helped to eradicate *bTB* in other countries but the disease has increased significantly over the last 20 years in the UK, which some have attributed to the prevalence of *bTB* in the badger population. It is important to recognise that successful control of *bTB* in countries where both cattle and wildlife reservoirs exist has only been achieved by addressing the infection in both wildlife and cattle populations. The outbreak of FMD suspended *bTB* testing in 2001 and many culled out herds were restocked without knowledge of the *bTB* status of the replacement animals. This is also thought to have contributed to the increased geographic spread and incidence of *bTB* in the last few years.

In addition to cattle controls, various forms of badger control have been trialled over the years (see Box 2), and have produced inconclusive results. In 2005, after extensive consultation, the Government announced its new TB Strategic Framework, outlining a number of goals for the sustainable control of TB in Great Britain, including consideration of options for wildlife intervention and options to reduce the risk of disease spread through cattle movements. Defra is expected to make a decision on policies for wildlife intervention methods in 2006 after consideration of the results of the Randomised Badger Culling Trials (RBCT) (see Box 2).

Box 1: Current Cattle Control Measures

The current cattle test and slaughter scheme to help reduce the spread of *bTB* is now determined by a European Council Directive 64/432/EEC.

The scheme includes:

- Regular herd testing for *bTB*
- Early removal and slaughter of infected animals
- Restrictions on the movement of cattle identified as infected
- Inspection of carcasses for *bTB* lesions

(These were augmented by the introduction of the Autumn Package of Controls introduced in November 2004.)

1.3 What do we know?

At present very little is known about many areas of this complex disease. It is known that *M. bovis* is naturally transmissible between animals and man by aerosols (transmitted through the air) from infected animals and by consumption of infected meat or un-pasteurised milk and dairy products from infected cows. The main route of infection for cattle is also by aerosols, when mixing occurs within a herd, but infection by the ingestion of contaminated material may also occur (e.g. contaminated feed).

Early detection and removal of infection therefore are crucial for effective control. A skin test has been used for many years to diagnose *bTB* in cattle herds, however it is not a very sensitive test for individual cattle and more sensitive tests, such as the Gamma-Interferon test are being developed for future use.

1.4 What don't we know?

Although research has been carried out, so far it has not been possible to:

- Determine the exact infection mechanism in cattle or work out how it is transmitted between and within different species.
- Determine how to diagnose *bTB* infection in live badgers to a high degree of sensitivity, which causes problems for surveillance and control.
- Develop an effective vaccine for *bTB* in cattle or badgers.
- Determine the most effective control method for the disease in badgers.
- Determine a direct link to show that badgers are a quantitatively significant reservoir of *bTB* for cattle, and therefore determine if culling of badgers significantly reduces infection of cattle.

Various trials have been carried out to try to determine the answer to the last question above (see Box 2). Professor John Krebs' independent report to Government in the 1990s concluded that the evidence that badgers were a significant source of *bTB* infection in cattle was compelling. He also concluded that it was not possible to tell how much of the disease in cattle has an origin in badgers because the relevant data had not been collected and analysed, therefore it was impossible to say how effective badger culling would be in controlling *bTB*. The RBCT trials were set up to answer these questions.

Box 2: Badger Control Trials and Strategies include:

- The Thornbury Trial (1970s): complete badger removal was carried out using gassing in selected areas.
- Clean Ring Strategy (1982-1985): applied where areas were cleared of infected badgers (where a badger carcase tested positive for *bTB*) and kept clear for six months around a breakdown farm.
- Interim Strategy (1986-1996): involved the removal and culling of badgers only from farms where a *bTB* incident had been confirmed and where, following investigation, it was thought that badgers were the most likely cause of the disease.
- The Randomised Badger Culling Trial (1996 -present): involves cage-trapping and consists of three treatment types:
 - reactive - where badgers are culled on and around farms following *bTB* outbreaks but not elsewhere (now ceased);
 - proactive - where as many badgers as possible are culled in the whole area and badger numbers are kept as low as possible; and
 - survey - where no badgers are culled but the land is surveyed for details of badger activity.

1.5 Further Information

The Government Strategic Framework for the sustainable control of bovine Tuberculosis in Great Britain and a summary of the current scientific evidence on *bTB* can be found on the Defra website: <http://www.defra.gov.uk/animalh/tb/strategy/newstrategy.htm>

(* Statistics available on the Defra Website)

2. Public Health

Statement: *BVA believes that the current rising prevalence of *bTB* in managed livestock, wildlife and companion animals can only increase the risk to public health, and strengthens the need for effective surveillance and control.*

In the UK during the 1930s and 1940s *bTB* was a significant cause of TB in man. A report to Parliament in 1934 estimated that more than 2500 human deaths each year, and much more illness, were caused by *bTB*. More than 40% of dairy cows were infected with some 10% of milk churn samples testing positive. People were infected primarily through milk and to a lesser extent meat, although person to person spread also occurred. This situation has improved significantly with fewer than 30 cases of *M. bovis* infection in people now being diagnosed each year in the UK. This has been achieved by the introduction of firstly, the voluntary testing of cattle followed by the compulsory eradication scheme, and secondly, the introduction of pasteurisation of milk and effective meat inspection and hygiene, these measures have been and continue to be exceptionally effective in protecting public health.

3. Animal Health and Welfare

Statement: *The continuing spread of *bTB* within cattle and wildlife has an unacceptable impact on animal health and welfare. Efforts to control the disease must be humane and should apply established veterinary principles of disease control. Veterinary surgeons must take a pivotal role in surveillance, diagnosis, control and eradication of *bTB*. Their advice to farmers and animal keepers is an essential element of the Animal Health and Welfare Strategy.*

The Government's Animal Health and Welfare Strategy (AHWS), introduced in 2004¹, aims to:

"Develop a new partnership in which we can make a lasting and continuous improvement in the health and welfare of kept animals while protecting society, the economy, and the environment from the effect of animal diseases."

The need to develop robust and sustainable policies for *bTB* control is crucial to the success of the Strategy as a whole. The challenge is to bring together all stakeholders, including: the farming industry, the veterinary profession, scientists, conservationists, environmentalists and Government into a successful partnership to combat the disease.

Government has a duty of care to ensure that this disease is controlled and eradicated, and that duty of care extends to wildlife populations due to the established link between *bTB* in cattle and badger populations². This duty does not, however, absolve others involved from their share of the necessary burden of process, and beneficiaries should contribute fairly to the costs of control programmes in the interests of a truly successful partnership.

The presence of an uncontrolled debilitating disease in either domestic animals or wildlife populations is unacceptable from a health and welfare point of view. Disease is the primary threat to animal welfare and attention should therefore be focussed upon enhancing the health status of animals in order to protect their welfare. To allow disease to exist unchecked in one population, whilst imposing control measures in another, is highly illogical, particularly if the two populations inevitably mix in a complex manner.

The welfare implications of any disease control strategy should always be seriously considered. Cattle welfare is rarely compromised specifically by *bTB* in that reactors are identified in advance of the onset of significant clinical signs. However, welfare can be compromised by the imposition of *bTB* movement restrictions on the whole herd and the knock-on effects these have upon management practices, facilities and resources available on a farm to manage cattle numbers which often increase above the ideal numbers for that

farm. There are also welfare implications with repeated 60 day testing of cattle that are not used to being handled and imposed health and safety issues for operatives.

A different clinical picture is seen in the badger. Infected badgers commonly experience more extensive development of tuberculous lesions, with cutaneous and respiratory abscesses and renal infection, weight loss and debilitation³. Many conservationists believe that such signs are acceptable in a wildlife species experiencing natural exposure to disease, and therefore nature should be allowed to take its course. However BVA believes that, due to the transmission of *bTB* between species², badgers suffering from clinical *bTB* are experiencing compromised welfare at levels above those naturally present. Efforts therefore should be made to reduce these effects in both the cattle and badger population. Any control measures introduced for badgers should also take into account welfare implications to minimise any identified adverse effects.

Other wildlife species are also known to suffer compromised welfare due to *bTB*. The British Deer Society, for example, has shown that deer suffer tremendous weight loss, leading to emaciation and serious debilitation⁴ and measures should be in place to protect their welfare against infection with this disease.

4. Disease Surveillance and Control

Statement: *Control measures in cattle must be accompanied by simultaneous and appropriate measures in wildlife and other susceptible species such as deer. Failure to tackle wildlife sources of infection has prolonged the presence of the disease in all affected species populations. The eradication of *bTB* from cattle and wildlife populations must be the ultimate aim, with initial steps being taken immediately to control the spread of infection.*

*The enhanced Government Strategy for *bTB* control is a positive step forward, but is inadequate, particularly in the high prevalence areas. Action must be taken now to prevent further *bTB* spread.*

Recommendations:

- *Increased surveillance and controls for *bTB* are proposed below, based on a regional approach within the UK cattle and wildlife populations.*
- *Control and surveillance measures are detailed in the attached Strategy Document and vary depending on the prevalence of *bTB* within the local populations.*
- *These regional categories proposed are: High Prevalence Areas, *bTB* 'Free' Areas and Emergent Areas.*
- *These three categories require different approaches for the successful control of *bTB* by applying the principles of disease control outlined below, and should be applied to cattle, badgers and other wildlife species populations.*
- *Increased efforts should be made to control *bTB* in hotspot areas.*
- **bTB* should be notifiable in all species, and BVA supports Defra's intention to make this the case.*

European Directive 64/432/EEC governs the Community requirements for controlling *bTB* in cattle. BVA believes that more stringent *bTB* controls should also be considered within the UK should they be required to gain control of the disease in the short to medium term, particularly with reference to herd TB testing intervals and the number of times inconclusive cattle are retested.

Progress towards the goal of total eradication can only be achieved by a co-ordinated approach involving all stakeholders resulting in the collective ownership of the chosen strategy. For this to be successful, recognition must be made of the different scenarios in which *bTB* is found. A regional approach to control will reflect the regional variations of this complex disease.

At present *bTB* is only notifiable in cattle and deer. BVA believes that it should be notifiable in all species and welcomes the Government's recently stated intention of implementing this suggestion. There are concerns however that this status will only be restricted to the positive culture of *M. Bovis* within a laboratory. Where sufficient evidence exists, consideration for some other forms of notification or alert should be given.

4.1 A Regional Approach

Statement: *A region-by-region approach for methods of control and eradication must be taken to reflect regional differences in the prevalence of the disease.*

Recommendations: *BVA has identified 3 regional categories to be addressed: High Prevalence Areas, *bTB* 'Free' Areas and Emergent Areas. These three categories require different approaches for the successful control of *bTB* through application of the disease control principles outlined below. (see Strategy Document for detailed breakdown.)*

Different measures will be needed in different circumstances depending upon the local epidemiology of *bTB*. Whereas some of the measures recently introduced by Defra under amendments to Directive 64/432/EEC and the Tuberculosis Order (<http://www.defra.gov.uk/animalh/tb/abouttb/legis.htm>) are welcomed in *bTB* 'free' areas, there is little to encourage those in endemic and hotspot areas to show that something new will be introduced to help them. Some recognition must be made of the specific needs of those areas in which it is obvious that cattle controls alone have been ineffective for some time. This is particularly poignant in *bTB* breakdowns in closed herds, where cattle movements are not a factor.

Regionalisation and the granting of local ownership in the control of this disease are essential to engender the partnership approach promoted by Defra. Boundaries created for political purposes, county or country, must not act as artificial barriers to a control and eradication policy, disease recognises no such boundaries.

4.1.1 High Prevalence Areas - Definition

Those areas in which:

- There is a high prevalence of restricted herds reacting to the bovine skin test.
- There is a pool of infection in wildlife, particularly the local badger population.
- The infection is endemic and currently persistent.

At present, annual testing of all cattle herds is standard in these areas except for those under *bTB* restrictions which experience more frequent testing. Herds which have achieved *bTB*-free status often suffer recurrence of infection due to either; undisclosed infection from previous testing, or introduction from cattle or wildlife sources. Instances exist where closed herds have been shown to be infected implicating the role of wildlife and, in particular, local badger populations as the source³.

4.1.2 *bTB* 'Free' Areas - Definition

Those areas in which:

- Cattle herds are attested free of *bTB*
- Experiencing only sporadic herd breakdowns, many of which will only have a single reactor.
- Translocation of an infected animal onto the breakdown farm can occur with little evidence of local spread.
- The prevalence of *bTB* in other species, including badgers, is largely unknown.

At present, the vast majority of herds are tested at intervals of greater than 1 year, with 2, 3 and 4 yearly intervals being determined by legislation and local interpretation by Divisional Veterinary Manager (DVM) and State Veterinary Service central office.

Those herds in these areas on annual or more frequent testing occur in isolated pockets where infection is readily removed and recurrence of infection is not a feature.

Efforts should be focussed on removing any infection identified as quickly as possible and reducing any potential for the infection to become established. The risk of *bTB* introduction by the translocation of disease in cattle moved from high prevalence areas should be addressed, as should the prevention of subsequent transmission to other cattle and wildlife.

4.1.3 Emergent Areas - Definition

Those areas in which:

- *bTB* has recently been identified in cattle or,
- where there is a risk of local spread with an increased rate of herd breakdown, increasing the risk of the area becoming a high prevalence area.

These are areas previously free of *bTB* in which sporadic herd breakdowns have become more common, often coalescing in specific groups. The infection is resilient to the control measures applied, with farms having difficulty achieving free status or suffering repeated breakdown after doing so. The boundaries of these areas may be extending as infection is progressively identified on neighbouring farms and transition to an endemic, high prevalence area is a risk.

Annual or more frequent herd testing is standard.

Efforts should be focussed on containing the spread of disease, addressing the potential roles of cattle and wildlife translocation and the transmission of disease with the aim to return the area to a *bTB* 'free' area.

4.2 Cattle Surveillance and Control

Statement: *Practical and effective biosecurity at national, regional and farm level is essential for the control, prevention of spread, and eventual eradication of bTB.*

Specific advice on bTB control in cattle:

- *Infected cattle transmit the disease to other susceptible animals and farmers must meet their responsibility to take measures to prevent the spread of infection.*
- *The movement of high-risk cattle from high to low prevalence areas and within high prevalence areas must be tightly controlled to reduce the translocation of infection.*
- *Pre- and post-movement testing for high-risk cattle has an important role to play in the control of the disease but cannot be guaranteed to prevent the spread of infection.*
- *The application of veterinary herd health plans, including farm-specific biosecurity action plans, can reduce the risk of introducing infection to susceptible farms.*

Recommendations:

- *It is imperative for traditional control measures, defined by European legislation, to be implemented effectively. It is also believed that additional measures should be taken, if necessary, to control the disease in the UK.*
- *BVA recommends that a series of measures should be implemented to help control the spread of bTB within the cattle population. These measures will vary*

*according to the prevalence of *bTB* within the region (see Strategy Document for detailed breakdown by region). These measures include:*

- *Changing tuberculin testing intervals of herds in lower risk or *bTB* 'free' areas from 4 yearly to biennially, and from 3 and 2 yearly to annually (with the completion of a Regulatory Impact Assessment).*
- *The isolation and speedy removal of reactors, within 10 working days.*
- *The removal of inconclusive reactors (IRs) by applying the European Directive requirement to remove cattle after the second successive IR result in the interests of due diligence.*
- *Backwards and forwards tracing exercises should be completed with appropriate skin *bTB* testing arranged and completed within 30 days of the identification of infection.*
- *Further development of the Cattle Tracing System and the British Cattle Movement Service should also be undertaken to facilitate robust tracing.*
- *Maintenance of the current meat inspection protocols and the addition of similar surveillance for carcasses not entering the human food chain.*
- *Movement restrictions on cattle identified as 'high risk', which should be subject to either a total ban on movement or to a severely restricted range of options for movement. Appropriate restrictions include the following:*
 - *Movements from/to restricted herds should be banned with exemptions applied as current recent policy allows, namely: direct to slaughter, movement to other approved or restricted units, particularly for calf rearers/finishers, restocking of restricted herds with clean cattle in the interests of farm viability.*
 - *The restriction of herds overdue or refusing to carry out the Single Intradermal Comparative Cervical Test (SICCT).*
 - *Pre-movement testing of high risk cattle to reduce the risk of translocation of *bTB*.*
 - *Post-movement testing of high risk cattle to identify those animals translocating disease as early as possible.*
- *Herd Health Plans should include the development of farm specific biosecurity plans designed by the farm's veterinary surgeon to reduce the risk of disease introduction. These plans should address the risks of animals from multiple sources and areas mixing and should identify the potential for infection that exists from, for example, livestock markets, mixed contract rearing, mixed batch over wintering and common grazing.*

BVA accept that, with the current prevalence, eradication of *bTB* can only be achieved in the longer term. Eradication is not a realistic short-term objective in the face of increasing incidence, but BVA are convinced that a more rigorous application of existing cattle surveillance and control techniques can reverse the current trend.

4.2.1 Tuberculin Testing of Herds

The SICCT test of cattle should be maintained as the herd screening test of choice as prescribed by European legislation governing *bTB* control.

BVA believes that prevention is better than cure, and in the face of increasing prevalence of infection the current herd testing intervals in lower risk or *bTB* free' areas are too long. The perceived benefits of reducing the intervals are:

- Firstly, the earliest possible identification of translocated or newly introduced disease on farms;
- Secondly, the uncovering of previously undisclosed infection.

Despite the recalculation and redistribution of Parish testing intervals by Defra in the autumn of 2004, the risk of infection establishing a more resilient foothold is too great in herds testing at 4 yearly intervals. To mitigate this risk BVA propose that:

- 4 yearly testing herds should be tested biennially
- 3 and 2 yearly testing herds should be tested annually.

Previous representations by the BVA regarding this proposal have resulted in Defra stating that such options would be prohibitively expensive for the benefit achieved; yet no regulatory impact assessment (RIA) has been seen. An RIA should be prepared for consultation investigating this proposal.

4.2.2 Isolation and Speedy Removal of Reactors

An animal that has reacted to the bovine skin test is one that carries a risk of transmitting infection to other susceptible animals on the farm. Reactors should be isolated from other livestock and removed from the farm as quickly as possible. BVA welcomes the streamlined valuation system for compensation payments as a method of speeding up this removal process, and proposes a target of 10 working days to be achieved by Defra for the removal of reactors.

There has been some improvement in the ways that new herd breakdowns are dealt with, but reports from the field suggest that the speed of reactor removal, consistency of control measure application and communication could all be improved further to achieve the target.

4.2.3 Removal of Inconclusive Reactors (IRs)

EC Directive 64/432/EEC should be complied with in terms of IR removal. Current Defra policy is to wait until the third successive IR result to the SICCT, whereas the Directive instructs removal after the second result. Defra defend this decision by stating that sufficient animals go clear after the second test to question the value of the EC policy. What remains unclear is how many of those animals going clear at the third test subsequently remain clear or again fail at a subsequent test. Defra should therefore apply the EC Directive requirement to remove cattle after the second successive IR result in the interests of due diligence.

4.2.4 Tracing and Associated Testing

BVA recognise Defra's recent efforts to improve performance in the area of backwards and forwards tracing exercises. Further development of the Cattle Tracing System and British Cattle Movement Service should be undertaken to facilitate robust and more rapid tracing.

4.2.5 Slaughterhouse Surveillance

It is agreed that meat inspection protocols aimed at detecting *bTB* in cattle carcasses should be maintained in the interests of public health as well as cattle surveillance.

The post-mortem examination of cattle however will only identify those infections that have developed discrete abscesses visible to the naked eye. More diffuse infections will remain undetected. Despite the inherent limitations, this information does provide essential information for the identification of *bTB* herd breakdowns.

Similar surveillance to meat inspection protocols should be in place for those carcasses not entering the human food chain, especially for cattle slaughtered under the Over Thirty Months (OTM) scheme or its successor.

4.2.6 Movement Restrictions on Cattle

The potential for translocation of *bTB* through cattle movements⁵ must be minimised. Cattle identified as 'high risk' should therefore be subject to either a total ban on movement or to a severely restricted range of options for movement.

BVA supports pre- and post-movement testing carried out as part of an overall strategy for control, and in particular supports the recent work of the Pre-Movement Testing Sub-Group of the TB Core-Strategy Group⁶. The spread of disease from high prevalence to low prevalence areas must be tightly controlled and the introduction of a pre-movement testing scheme for cattle will go some way towards this⁷. There are limitations to skin *bTB* testing however, and these are discussed in the Diagnostics section below.

4.2.7 Herd Health Plans

BVA supports the extension of Herd Health Planning principles to include the development of farm specific biosecurity plans, which will be designed by the farm's veterinary surgeon to reduce the risk of disease introduction. The plans should address the risk of animals sourced from different areas and should also identify the potential for infection that exists when these animals are mixed. Defra should investigate possible ways to provide incentives for the uptake of herd health plans and biosecurity measures.

There is a serious human and animal welfare risk in the placing of restrictions on herds subject to pre-movement testing prior to selling up or dispersal. These risks should not outweigh the potential risk for disease translocation, and testing should still be undertaken. Defra should therefore ensure that, in the absence of a future management plan to deal with the animals in that herd, measures are in place to alleviate potential problems arising from restriction.

4.3 Badger Surveillance and Control

Statement: *Control measures in cattle must be accompanied by simultaneous and appropriate measures in wildlife and other susceptible species such as deer. Failure to tackle wildlife sources of infection has prolonged the presence of the disease in all affected species populations.*

*There is sufficient scientific evidence to conclude that the presence of *M. bovis* in the badger population is presenting a wildlife reservoir of infection that inevitably increases the risk of cross infection to other susceptible species, particularly cattle^{2, 3, 8, 9, 10}. It is in the interests of both wildlife and domesticated animals that the spread of *bTB* from infected badgers be contained. Targeted humane culling of badgers must be an integral part of any control policy in the short-term, in conjunction with the development and use of an effective vaccine in the longer term. The recent Government announcement of the badger vaccine trial is very welcome. This should not exclude further innovative use or the development of vaccines in the interim.*

Recommendations:

- **bTB* should be controlled within the badger population in the UK and Defra is encouraged to develop policies now in advance of the results of the Randomised Badger Culling Trial (RBCT).*
- *BVA supports a targeted humane culling policy aimed at eradicating *bTB* where sufficient evidence exists to classify a sett or social group as infected.*

- *It is recommended that a long-term strategy for control should include both culling and vaccination.*
- *In order to achieve a healthy badger population free of *bTB*, first principles of disease control state that where the disease is identified it should be removed to reduce the possibility of further infection. Specific surveillance and control measures are recommended, depending on the prevalence of *bTB* within a region (see Strategy Document for detailed breakdown on controls by region). These measures include:*
 - *The removal of infected badger.*
 - *The removal of animals in close contact with infected animals due to the high risk of infection.*
 - *The maintenance of *bTB* 'free' populations.*
 - *Surveillance to enable appropriate decision making in the holistic control of *bTB*.*
 - *Extension of the Road Traffic Accident (RTA) survey (and examination of other badger carcasses) to emergent areas and *bTB* 'free' areas in an attempt to estimate the level of infection in the population.*
- *Badger Removal Orders (BROs), issued under the current legislation, should be granted after consideration of evidence by an expert panel for the need of such removal. This will involve:*
 - *The utilisation of the most appropriate culling method judged by an expert panel, assigned to assess the need for the individual BRO application.*
 - *The enactment of BROs by the employment of specifically trained and competent persons to supervise all Orders.*
 - *The appropriate collection of epidemiological material for further analysis.*
 - *An attempt to estimate the level of infection in the badger population, based on the figures of recent trials and other data available, such as RTA data.*

Badgers are a protected species and BVA support the continued protection of the badger from those elements of society that might wish harm on the species in the name of sport or recreation. However, badgers are not an endangered species and in the right conditions will breed prolifically³. The current population is estimated to be around 300,000 and there is no immediate risk to the overall numbers of badgers should culling be an integral part of any control policy. There is still a shortage of truly accurate information as to the level of infection of badgers with *bTB* both in the risk areas and outside. Further research in this area should be encouraged¹¹.

4.3.1 The Need for Badger Controls

Professor John Krebs⁹ stated that the link between cattle and badgers in the epidemiology of *bTB* is 'compelling'. The problem, however, is that there is a lack of absolute scientific evidence to prove the link one way or another. There have been a number of trials undertaken that suggest positive benefits from the removal of badgers in infected areas on the incidence of *bTB* in cattle including the Thornbury Trial, the Steeple Leeze Trial, the Hartland Trial, the Offaly Trial and the Irish Four Area Trial³. Critics damn much of this work as being scientifically unsound by virtue of deviations from standard scientific protocol. The reality is that scientific study inevitably leads to the generation of further questions and further scientific study rather than the provision of absolute answers.

Even the so-called Krebs' Trials are already being criticised by entrenched factions on both sides of the fence in preparation for which way the results will fall, with criticisms of the efficacy of removal in the reactive areas and consistency of protocol implementation being questioned.

In a situation where the control of an animal-based disease is critical, yet absolute science is absent, the application of first principles of disease control by the

veterinary profession is essential. The eradication of Rinderpest at the turn of the 1900s and the identification and implementation of control measures for BSE in the 1990s were both undertaken with success by the application of such principles without a pre-emptive diagnostic test. In order to achieve a healthy badger population first principles of disease control state that wherever the disease is identified it should be removed to reduce the possibility of further infection.

A surveillance system for badgers that applies similar diagnostic principles to badger social groups in known high prevalence areas as those applied to cattle is vital. BVA encourage Defra to develop a surveillance system for badgers to enable appropriate decision making in the holistic control of *bTB*.

4.3.2 Badger Culling Procedures

Arguments over the various methods for culling badgers have been outlined in papers by the National Farmers Union and the Badger Trust (previously known as the National Federation of Badger Groups)^{12, 13}. Defra has also carried out an audit of the methods of culling used in the RBCT¹⁴. The authors of the Irish 4 area trial also pass comment upon the appropriateness of the methods used¹⁰. BVA does not seek to specify the method of culling to use, and would suggest that the most appropriate method might vary according to the specific requirements of the exercise.

4.3.3 Badger Culling Policy

Where sufficient evidence exists to classify a sett or social group as infected then that social group should be removed. An example of this would be where a herd breakdown occurs but there is no evidence of the introduction of disease from infectious cattle. Widespread area removal of badgers cannot be supported in agreement with the Bern Convention.

The results of the reactive trials, now suspended, provide evidence that badgers are associated with the epidemiology of *bTB* in those areas and under those circumstances. The suspension of the reactive trials following the reported 27% increase in herd breakdown, after reactive culling, was deemed premature by an independent scientific panel¹⁵. The results mirror the observations seen in the early part of the Thornbury Trial where herd breakdowns initially increased prior to a dramatic decrease.

A number of uninfected badgers may be culled in sett-wide or social group control. Evidence indicates that this would be necessary to prevent the high risk of disease spread. Close proximity, underground and wet conditions mean the spread of *bTB* within a sett is highly likely³. This is in keeping with current cattle control measures.

It is also important to note that badger setts can cover substantial areas of land. The young will mature within a year and will usually seek to extend the existing sett or migrate to new areas to dig new setts or re-enter older vacated setts, so the potential for spread of the disease from infected setts to new areas is present as long as infected setts or animals remain active. Equally the risk of a peripherally infected sett or social group members moving back into vacated or culled out previously infected areas is high. Therefore, any control policy involving culling of badgers will have to be radical and repeated to be effective. It will be important to have the support of all stakeholders if it is to work.

A culling policy associated with ring vaccination of badgers would be a logical extension of veterinary principles and collecting evidence of infection on restricted farms prior to removal would make epidemiological sense.

4.3.4 The Culled Sett

Conflicting science and anecdote surround the behaviour of badgers with respect to an empty sett. Some evidence suggests that nomadic badgers may be infected with *bTB*, having been expelled from their own sett through disease, and are therefore more likely to colonise setts vacated by other badgers as they are too weak to dig their own¹⁶. The concept of the 'hospital sett' comes from this hypothesis. Others argue against this, suggesting that healthy badgers are more likely to have the energy to roam and that studies leave the hypothesis unproven¹³. This raises a dilemma of how to treat culled out infected setts.

BVA proposes that setts in high prevalence areas should be left open, arguing that there is a higher chance of local badger infection and, should the hypothesis be true, it would be better to attract *bTB* infected animals to a central point and repeatedly cull recolonisers. BVA does not support the translocation of badgers under any circumstances due to the welfare issues surrounding translocation and the biosecurity risk of unknown disease status.

The policy in *bTB* 'free' areas should be to deny access to infected setts in recognition of the reduced likelihood of local badger infection. By denying access, nomadic healthy badgers will be unable to recolonise and their exposure to infection will be prevented.

4.4 Other Wildlife Species Surveillance and Control

Statement: *Control measures in cattle must be accompanied by simultaneous and appropriate measures in wildlife and other susceptible species such as deer. Failure to tackle wildlife sources of infection has prolonged the presence of the disease in all affected species populations.*

Recommendations:

- *Formalisation of a system of surveillance in deer and the development of a culling policy.*
- *BVA would like to see further studies undertaken to understand what role, if any, other species play in the transmission of the disease.*

Little is known about the prevalence of *bTB* in wildlife species other than the badger. Deer are the group currently causing the greatest concern, and the British Deer Society recently highlighted the need for *bTB* control in a paper on the prevalence of *bTB* in deer on Exmoor⁴. The current surveillance system for wild deer revolves around the awareness and astuteness of those undertaking the dressing of deer carcasses. Culling of deer that are present in an emaciated and weak state is already undertaken, but this is far from a proactive policy to identify and cull infected deer.

It has been noted that *bTB* is becoming more prevalent in companion animals and eradication of the disease would benefit the health and welfare of domestic and wild animals, as well as cattle. An increased prevalence of *bTB* in domesticated species increases the risk of zoonotic infection of humans due to increased exposure to infection. It is important to note that although the substantive diet of badgers is cereals, worms and vegetation, they will take other species opportunistically or in times of food shortage. Such animals are known to include at least rabbits, mice, voles and hedgehogs. A review of the possibility of indirect transmission of diseases via these species may have to be considered, although it is unlikely to be a major risk^{16, 17}.

5. Diagnostics

Statement: *Veterinary surgeons must take a pivotal role in surveillance, diagnosis, control and eradication of *bTB*. Their advice to farmers and animal keepers is an essential element of the Animal Health and Welfare Strategy.*

*The control and eradication of *bTB* must be based on the application of sound scientific research. The current research programme must be reviewed with renewed urgency to ensure that new diagnostics and vaccines are developed.*

Recommendations: *With regards to the use and development of effective diagnostics, BVA recommends that:*

- *Tuberculin testing should continue to be undertaken by veterinary surgeons.*
- *When the SICCT is used on farm it should be accompanied by a full education package regarding the pros and cons of its use to ensure the limitations are understood by both the veterinary surgeon and the farmer. This is particularly relevant for pre- and post-movement testing.*
- *Mycobacterium bovis isolates should be further identified by spoligotyping and the information used in any epidemiological investigation of the pattern of *bTB* infection.*
- *The Gamma Interferon Test should be used on farms suffering repeated SICCT failure in *bTB* 'free' areas, and more extensively on farms in emergent areas to halt the spread of disease.*
- *Circulating antibody ELISA tests should be used in the *bTB* surveillance system applied to badger populations.*
- *Badgers reacting positively to the circulating antibody ELISA test should be removed and subject to post-mortem examination for further epidemiological evidence. Should there be a high incidence of positive ELISA tests over time, epidemiological assessment should be made of the need to remove social groups of badgers due to the high risk of infection. Badgers testing negative should, before release, be vaccinated and microchipped for future identification.*
- *The Gamma Interferon Test should be further validated by investigating the potential role of different antigens to increase the specificity.*
- *Further validation work should be done on the Polymerase Chain Reaction (PCR) test.*

For a control and eradication policy to be viable, there is a basic requirement to diagnose the disease and to identify which animals to remove or place under restriction. There are a number of methods available for the diagnosis of *bTB*, each with their own pros and cons.

5.1 The Single Intra-dermal Comparative Cervical Test (SICCT)

This test, or variations of it, is the standard test used around the world to diagnose *bTB* infection. A positive result indicates exposure and likely infection, but not the extent to which an animal is infected, or whether it is infectious.

Whilst parts of the testing procedure are undeniably routine and repetitive in nature, and some argue that it lends itself to testing by lay-personnel (lay-testing), the interpretation of the reaction caused by the injection requires professional judgement and is an act of veterinary surgery. BVA believes therefore that this is a test to be undertaken by veterinary surgeons. Delegation to lay-testers is felt to conflict with other Government objectives under the AHWS, including aims to improve disease surveillance on farm for both animal and public health purposes. BVA is concerned about the legal status of lay-testers within the European legislation, particularly as it applies to trade. Government is asked to tread very carefully with the recently announced pilot of lay-testing, and BVA awaits the results of the pilot with interest.

In some cases the *bTB* test is the only time that a veterinary practitioner will visit a farm and the Association believes that the Government should take greater advantage of this statutory

on-farm veterinary presence. This will assist with further veterinary surveillance for other diseases and will lead to the development of control strategies including biosecurity and farm specific health plans. This would allow veterinary time and skills to be used to provide advice and control strategies to prevent, as well as detect, disease and other welfare problems. It would also demonstrate a practical commitment by the Government to improve veterinary surveillance as emphasised in the Follett Report (Royal Society 2002), consistent with the Government Veterinary Surveillance Strategy and the AHWS.

5.1.1 SICCT in Cattle

This test has been used for many years in the control of *bTB* in cattle. Whilst it is a highly specific test which has been very effective at controlling *bTB* in many countries where the only significant reservoir of *bTB* has been in the cattle population, its sensitivity is variable. Recently infected and infectious cattle are often missed by the test, as are some that have been infected for some time and have developed fulminant clinical lesions and are highly infectious; this latter group being of importance in the 3 and 4 year testing areas. Cattle exposed to repetitive testing may also show a reduced reaction to the test⁶. These features mean that the test acts as a good screen for the presence of disease in larger numbers of animals, providing it is repeated at suitable intervals to overcome the limitations with sensitivity. However it is a questionable indicator of infection when used as a one-off test to determine the status in individual animals or small groups. Over reliance on this test for pre- and post-movement testing is questionable in small groups, as animals testing negative could, in fact, be infected. The effectiveness of pre-movement SICCT is further reduced in high prevalence areas in the presence of uncontrolled infection within the badger population.

5.1.2 SICCT in Deer

The SICCT is also used in farmed deer. Specific training in its use in this species is a necessity due to the nature of deer skin and the resultant reactions seen.

5.2 Post-mortem Examination of Carcasses and Isolation of *bTB*

5.2.1 Cattle

All cattle entering the food chain are subject to meat inspection by Meat Hygiene Service Inspectors. Amongst other things, this systematic inspection of carcasses, through the abattoir, looks at the most likely sites for the establishment of *bTB* lesions in all species. This is to reduce the risk of *bTB* infecting humans. Any cases of suspect *bTB* lesions in cattle are reported to Defra and investigations then ensue.

On-farm reactors to the SICCT are removed, slaughtered and their carcasses inspected for lesions in a similar manner. They are then classified as Visible Lesions (VLs) or Non-Visible Lesions (NVLs) as appropriate, but still remain classified as Reactors even if no lesions are found. Gross post-mortem examination will only find those lesions that have developed to a size visible to the naked eye; those carcasses with less developed lesions will go unnoticed.

Lesions must then be cultured to confirm diagnosis, with classification of culture +ve or -ve resulting. This is usually done by collecting lesions and lymph nodes from carcasses, macerating them together, and then culturing them. A confirmed herd breakdown will only be recorded on the isolation of *M. bovis*. Some NVLs will also result in the growth of *M. bovis* from strategically collected samples in the absence of lesions.

This system is reliant upon the development of lesions to such a level that they can be seen by the naked eye of meat inspectors or veterinary surgeons on the abattoir line. Lesions that are very tiny or aberrant in nature, and infected carcasses that have as yet not developed lesions will therefore be missed. Some countries have incentive schemes for the notification of suspect *bTB* lesions by meat inspectors and in those countries the rate of abattoir notification of suspect disease is much higher. The UK falls short of these rates of notification and BVA suggest that an incentive scheme be considered to enhance the current meat inspection process.

The incidence of NVL culture –ve animals leads the farming industry to question the credibility of the SICCT in cattle. NVL culture –ve animals are not necessarily free of *bTB*; they have tested positive and are likely to harbour infection somewhere in the carcass. Confirmation rates can be improved by the sequential sectioning of the whole carcass but this would be too costly a method to apply to all cases.

5.2.2 Badger

The post-mortem examination of badger carcasses carries the same risk of false negative diagnosis as the test for cattle. Lesions must be large enough to be seen or infection sufficiently disseminated to allow swabs to pick it up at culture. There are two scenarios where information from badger post-mortem examination is of use;

- Road kill badgers: The recent RTA survey published by the Independent Scientific Group on Cattle TB showed that on average 1 in 7 (14%) badgers were found to be infected with *bTB* across the survey range. This is a significant level of infection and gives a guide as to the likelihood of infection in the local badger population.
- Badger carcasses from culled setts provide useful epidemiological information regarding the prevalence of infection. This information is vital in *bTB* 'free' areas and emergent areas where less is known about local prevalence. The need to recover epidemiological evidence would also have influence upon the methods of culling employed in a given situation.

5.2.3 Deer

Hunted deer are carefully eviscerated or "gralloched" soon after being shot. Any suspicious lesions should be reported to the authorities and further investigations initiated. Again, this method of diagnosis is only of use if lesions have developed sufficiently.

5.2.4 Culture Results

M. bovis isolates should be further identified by spoligotyping and the information used in any epidemiological investigation of the pattern of *bTB* infection.

5.3 Clinical Examination

In cattle the clinical examination of herds is not carried out. This is because any infection is usually detected early on, when cattle react to the SICCT, which is prior to the development of clinical signs such as emaciation and respiratory distress. Infected cattle can show signs of abscessation in the udder and exhibit a high milk somatic cell count. Farmers in high prevalence areas should be made aware of the potential risks to human and animal health of feeding untreated milk from such cows.

Clinical examination of badgers can also be inconclusive. The development of cutaneous abscesses in some animals aids a tentative diagnosis of *bTB*, and some suggest that suspicions of infection should be raised in the presence of thin or emaciated badgers³.

Deer infected with *bTB* have been reported to develop emaciation in the later stages of the disease, but otherwise there are few signs that help with diagnosis on examination alone⁴.

5.4 Blood Sampling

Variations of two particular types of blood test are available for the diagnosis of *bTB*. However, they are not considered to have been validated sufficiently to be used as the base-line diagnostic test by the EC.

5.4.1 The Gamma Interferon (gIF) Test in Cattle

The Gamma Interferon (gIF) Test is a highly sensitive test which can result in some animals testing positive yet actually being uninfected (false positives)¹⁸. Experience from around the world would indicate that it is best used to speed up the clearance of infection on farms reacting to the SICCT. The greater sensitivity of the gIF test identifies those animals that the SICCT misses, reducing the time the farm spends under restriction. This would also reduce the risk of spread to wildlife. A Defra pilot study looking at the potential use of the gIF test in the UK is underway, but the ISG have seriously criticised the structure of this study and the potential information it will yield. BVA supports the Independent Scientific Group on Cattle TB's position.

The best use of this test would be on farms where there is a need to remove all infected animals as quickly as possible, even at the expense of losing some uninfected animals as false positive reactions.

The use of the gIF test in herds in high prevalence areas is questionable. The removal of false positive animals from the herd in order to achieve free status, while leaving an uncontrolled reservoir of disease in the local wildlife as a source of reinfection, cannot be justified.

This test is not internationally accepted as the standard for control and eradication schemes, and cannot be used as the baseline test for *bTB* for this reason. Further work should be undertaken to validate the test using a variety of antigens to improve specificity.

5.4.2 ELISA (Enzyme-Linked Immunosorbent Assay) Tests

A badger side blood test (the Brock test) and variations upon it have previously been trialled to diagnose *bTB* in live badgers¹⁸. BVA's understanding of the work undertaken is that whilst the test was only up to 50% sensitive, depending on the age of the badger, it was highly specific for *bTB* infection. This draws parallels with the SICCT used in cattle. There is also an ELISA test for cattle which could be useful for diagnosing some cases of Non-Specific Infections (NSIs) and reactions to the SICCT in cattle.

5.5 Polymerase Chain Reaction

This is a test that can be applied to the various secretions and excretions of badgers to assess infection^{19, 20}. The test picks up minute levels of *bTB* in faeces and sputum. It has been proposed that the results of tests on badger faeces found on infected farms or around setts can be used to assess the level of local infection and provide evidence of the need for removal operations.

Whilst being highly specific for *bTB*, the test results in a high false negative rate due to the unpredictable patterns of excretion exhibited.

6. Vaccination

Statement: *The control and eradication of *bTB* must be based on the application of sound scientific research. The current research programme must be reviewed with renewed urgency to ensure that new diagnostics and vaccines are developed.*

Recommendations: *With regard to the development of effective vaccines, BVA recommends that:*

- *Further vaccine development work should be done.*
- *Research should urgently be undertaken into the development of specific cattle *bTB* vaccines that both protect against infection and are 'marked' in some way to differentiate vaccinated from infected animals.*
- *A further large-scale trial should be carried out to investigate ring vaccination of badgers testing negative to infection around a culled area.*

A detailed report on the use and potential development of *bTB* vaccines was published by the ISG in 2003²¹. The BCG would seem to be the best available vaccine with the greatest potential for use, particularly in badgers. Vaccination with BCG in any species does not necessarily protect from infection with tuberculosis organisms. Its greatest effect is to activate the immune system to deal with infection in such a way as to stem the development of clinical signs and reduce bacterial shedding, which in turn reduces the potential for further transmission of infection.

6.1 Cattle Vaccination

European legislation governing *bTB* states that those animals found to be infected must be removed from the herd. After vaccination two particular scenarios may exist:

- Cattle may still become infected after vaccination, but develop less severe clinical signs. They will react to the SICCT, as the test cannot differentiate between vaccinated animals and those naturally infected.
- Cattle may also react positively to the SICCT if they were infected prior to vaccination, as the test cannot differentiate between vaccinated animals and those naturally infected and vaccination will not tackle the presence of infection in an already infected animal.

Both of these situations make the use of BCG in cattle inappropriate.

It is important that an appropriate vaccine be developed and made available as quickly as possible. Work has progressed to the extent that a sub-unit vaccine in combination with BCG has now been achieved.

6.2 Badger Vaccination

BCG vaccination does show promise for tackling *bTB* in badgers, as a vaccinated population excreting less *bTB* reduces the overall pool of infection for transmission to other badgers and other species.

BVA welcomes the BCG vaccination trial announced by Defra, to start in 2006, looking particularly into the safety of injectable BCG. This particular trial will take some time to reach a conclusion and additional work is in progress. Work underway in the Republic of Ireland should also be monitored with interest.

BVA would like to emphasise that the development of an effective badger vaccine should not be seen as a replacement for culling of infected animals, and a combined culling and vaccination strategy should therefore be developed. As in cattle, badgers known to be

infected should be culled in the interests of biosecurity for both wildlife and cattle populations and in the interests of welfare.

7. Scientific Evidence/Research

Statement: *The control and eradication of *bTB* must be based on the application of sound scientific research. The current research programme must be reviewed with renewed urgency to ensure that new diagnostics and vaccines are developed.*

Recommendations: *Three specific areas of research should be progressed immediately:*

- *Vaccination research – as detailed above.*
- *Cattle diagnostics – as detailed above (specifically work on various gamma-interferon antigens to improve the specificity of the blood test in cattle).*
- *Badger diagnostics – as detailed above (specifically work on diagnostic tools to address badger infection and work on the badger side blood tests (e.g. the augmented/modified Brock test)).*

Any new strategy needs a sound scientific base and it is acknowledged that the development of more effective diagnostics is important for the long-term strategy of *bTB* control. Although better application of the control techniques already available will reduce the prevalence of *bTB*, successful eradication will depend on the identification and application of new control methods, requiring a significant investment in research.

Improved diagnostic tests are considered to be essential to aid the identification of *bTB* in individual animals. It is also essential to develop an effective vaccine and a suitable delivery route to protect badgers (and possibly cattle), and to develop a better understanding of the transmission of infection to and from cattle and between species.

7.1 Vaccination Research

The development of an effective *bTB* vaccine is perennially considered to be at least 10 years away. Research should be continued into this long-term goal, but in the meantime, strategies must be developed that make best use of the vaccines available.

A large-scale badger vaccination study under UK field conditions should be progressed with urgency, particularly addressing the potential for ring vaccination. Should wide-scale badger removal be found to be effective but not politically acceptable, the importance of badger vaccination increases tremendously to reduce the overall pool of infection in the environment. Modelling work encourages the development of badger vaccination protocols²². Work should be undertaken now to evaluate various delivery mechanisms for vaccine use. However, BVA continues to stress that a combined strategy of culling and vaccination should be progressed.

7.2 Cattle Diagnostics

Work undertaken with various gamma-interferon antigens should also be progressed with speed to improve the specificity of the blood test in cattle, reducing the disincentive for the industry to employ the test. It should be recognised that cattle are currently being culled on the basis of a less than perfect test (SICCT), which is doing little in the long term to address *bTB* in high prevalence areas.

7.3 Badger Diagnostics

Diagnostic tools to address badger infection should be progressed, and work on the badger side blood tests should be revisited (e.g. the augmented/modified Brock test).

8. Scientific Advice

Recommendation: *BVA supports the creation of the National Advisory Body for *bTB* and recommends that veterinary practitioners and scientists be employed to aid in the preparation of practical risk-based independent advice.*

It is essential that decisions for disease control are based upon sound science. The approach to badger control specifically must be scientific and logical, with the aim to achieve a healthy badger population.

BVA fully supports the creation of a new national advisory body and would like to recommend that this should be modelled on the Spongiform Encephalopathy Advisory Committee (SEAC) rather than the TB forum or the ISG. The body would carry out the majority of its work in open session and be able to call on scientists and research workers to present papers for its consideration.

9. Concluding Remarks

The final aim of any policy should be the pursuit of conditions in which healthy populations of both domestic and wildlife species can thrive in a balanced environment.

To achieve this some awkward choices will have to be made regarding the removal of significant populations of cattle and badgers from specific areas of the countryside and the commitment to resources required for effective vaccine development.

BVA strongly supports whatever measures are necessary to control *bTB* in wildlife so long as they are shown to be effective and humane. The welfare and survival of a healthy population of all the wildlife species involved are dependent on the acceptance of such measures being taken.

Whilst eradication of *bTB* might not be a realistic, achievable, goal within 10 years, measures introduced should be aimed at achieving eradication in the long term. The escalating costs of *bTB* to the industry, Government and taxpayer make investment in further diagnostics and control measures an attractive option. The most efficient long term spend of money and time must be by moving towards the eradication of *M. bovis* now.

ANNEX A

GLOSSARY

Badger Removal Orders (BROs)	Orders granted under the Protection of Badgers Act 1992 to allow the removal of badgers from specific setts for reasons of disease protection or other nuisance. This includes relocation as well as culling depending upon the reasons cited.
BCG	Bacille Calmette-Guerin, the vaccine for human TB actually derived from <i>M. bovis</i> .
Bern Convention	The Bern Convention is a binding international legal instrument in the field of nature conservation, which covers the whole of the natural heritage of the European continent and extends to some States of Africa. Its aims are to conserve wild flora and fauna and their natural habitats and to promote European co-operation in that field.
Brock Test	The only validated immunological test for bTB infection in badgers to detect antibodies in the blood stream.
Clean Cattle	Those attested free of bTB in line with Defra's current testing policy.
Closed Herd	No cattle from other herds are bought in or otherwise introduced by the farmer and contact with neighbours cattle is minimal or non-existent.
DVM	Divisional Veterinary Manager
ELISA test	The Enzyme-Linked Immunosorbent Assay (or EIA for short) is a method used to detect if a certain substance is present in a sample. It utilizes antibodies or antigens specific to the substance being testing for; these antibodies are linked to an enzyme which causes a measurable signal to be produced.
Endemic Disease	Disease is present and regularly diagnosed in a defined population or area.
Epidemiology	The study of the occurrence of a disease in a population.
Galloched	The removal of intestines from a carcass.
Notifiable Disease	A disease, the diagnosis of which, must be notified to the relevant national authorities. Diseases considered for notifiable status are those with a high risk of serious zoonotic potential, serious animal health implications, damaging economic potential, or diseases which are often difficult to control.
Herd Testing Interval	The interval between cattle skin tests within a specific herd. This is defined by the local DVM and the State Veterinary Service with reference to the EC Directive 64/432/EEC.
High Risk Cattle	Those animals judged to have a high risk of infection with the potential to translocate <i>bTB</i> to other areas or farms. There should be a gradation of risk in line with the following, starting with highest risk: <ul style="list-style-type: none">- SICCT Reactor or otherwise diagnosed <i>bTB</i> infected animals.- SICCT Inconclusive Reactor animals.- Animals in restricted herds.- Animals in herds contiguous to or within 3 km of a restricted herd.

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- Animals from herds subject to annual or more frequent testing but otherwise unrestricted.

Incidence	The number of events occurring over a given time.
Inconclusive reactors (IRs)	See 'Reactors'
Krebs' Trials	See RBCTs
OTMS	Over-Thirty-Months Scheme introduced to remove those cattle over 30 months of age from the food chain to protect human health from the perceived risks of Bovine Spongiform Encephalopathy (BSE) infection.
Parish Testing Interval	The authoritative unit in the UK to which the local testing interval applies as defined by EC Directive 64/432/EEC. Herds within the parishes should be divided accordingly to ensure a degree of annual surveillance throughout the parish.
Prevalence	The proportion of a given population with infection at a specific time.
RBCTs	The Randomised Badger Culling Trials. A series of experiments designed by the Independent Scientific Group for <i>bTB</i> under the chairmanship of Sir John Bourne to follow the Krebs report advice to design trials to clarify the link between <i>bTB</i> in cattle and badgers. The trials test a culling strategy of entrapment and removal, applied across comparable 10 km diameter triplet areas: Proactive (badgers repeatedly removed), Reactive (badgers removed once on restricted farms) and Control (no badgers removed).
Reactors	Cattle which give a positive reaction to the Comparative Cervical Skin Test (SICCT). These cattle are removed from the herd and sent for post-mortem examination. Inconclusive reactors are those showing a lesser reaction to such a level that the result is drawn into question. These animals are isolated and retested to assess their status. The interpretation can be standard or severe; the latter will make some IRs into Reactors and is used in problem herd areas.
Restricted Herd	A cattle herd subjected to movement restrictions by virtue of failing an SICCT or by extension of tracing investigations restricting the movement of specific cattle.
Skin Test (SICCT)	The Single Intradermal Comparative Cervical Test. Bovine and Avian Tuberculin are injected into the skin on the neck of cattle. The immunological reaction to this is measured by comparing the thickness of the skin at the injection site prior to the injection and again 72 hours later. A positive reaction is assessed by comparison of the bovine against avian reaction with referral to Defra's acceptable limits.
Spoligotyping	A Polymerase Chain Reaction (PCR)-based technique used in laboratories for the detection and differentiation of <i>bTB</i> .
Tracing	The analysis of herd movement records and the British Cattle Movement System data to trace the movement of reactor and other cattle diagnosed with infection in a backwards (to herds of origin) and forwards (to herds of destination) manner.
Translocation	<i>bTB</i> is moved to a new site within an infected animal. The movement of

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of disease	infected cattle or infected badgers from high prevalence areas to free areas would achieve this, for example.
Transmission of disease	<i>bTB</i> passes from an infected animal to a susceptible animal at the same site.
Tuberculin	A purified protein derivative (PPD) of a protein product of <i>Mycobacteria sp</i> . Each species produces a specific tuberculin; <i>M. avium</i> and <i>M. bovis</i> PPDs are used.
Zoonotic Disease	A disease that can be transmitted between animals and man.

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