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A Cost/Benefit Analysis of Future Options for Bovine Tuberculosis Control

S.J. Sheehy and K.H. Christiansen

Background
The Bovine Tuberculosis Eradication (BTE) Scheme has succeeded in reducing the level of bovine Tb in the Irish herd to the point where 99.0% of animals in the herd are free of the disease. By reducing the disease to this level the Scheme has benefited the national economy through enhanced access to markets and through improved livestock productivity. These benefits have been shown to be very substantial compared with the costs of achieving them, so the Scheme has been highly profitable to the nation. However, all of the success of the Scheme occurred in the first 10 years between 1954 and 1964. The failure of the Scheme since then to further reduce the level of disease has frustrated the participants in the Scheme and has attracted widespread criticism.

Since 1988, the BTE Scheme has been under the management of the ERAD Board. Those responsible for funding the Scheme are now faced with a number of choices as to its future, its targets and the means of attaining them. For this purpose, a cost/benefit analysis of future options was undertaken to determine the most cost-effective approach to the control of bovine Tb. The following report is extracted from the Executive Summary to the full report "Cost/Benefit Analysis of Irish Bovine Tuberculosis Eradication Schemes" by Professor S.J. Sheehy, University College Dublin, and Dr. K.H. Christiansen, Tuberculosis Investigation Unit, December 1991.

Analysis of the Future Options
The future options analysed consist of two schemes which would be more intensive than the current ERAD programme and two schemes which would be less intensive. These are designated by the number of reactors in thousands removed in the early years of the scheme which is also an index of the intensity of the scheme. They are:

- the 55 Scheme
- the 50 Scheme
- the ERAD Scheme (which would remove 40,000 reactors in the first year)
- the 30 Scheme, and
- the 25/35 Scheme.

Compared with the ERAD Scheme, the 50 Scheme would have allocation of all testing under District Veterinary Office control to ensure alternate testing among private veterinary surgeons. In addition, movement control would be more rigorously enforced using the more severe "export interpretation" of the tuberculin test and requiring this test to be carried out within 30 days prior to movement; a computerised permit system would be installed to improve the monitoring of movement and the tracing of infected animals back to their herds of origin; and a "singleton policy" would be used to enable herds with only a single reactor to be derestricted more rapidly.

The 55 Scheme is the most intensive of the five alternatives. It would have three important additional features over and above those in the 50 Scheme. The country would be divided into clearance zones; all tests in those clearance zones would involve dual tests using the comparative tuberculin test in conjunction with a laboratory based test, the purpose being to improve the detection of infected animals; and farmers would be given an added incentive to protect their herds by contributing to and managing a compensation fund which would be disbursed in a manner which would encourage good disease control practices.

The 30 Scheme differs essentially from the ERAD Scheme in that testing beyond the annual...
round would be minimised. High risk areas (black spots) and extended restriction would be abandoned, and testing of herds contiguous to restricted herds would be greatly reduced. Under this option the ERAD programme would be cut back and the scheme would revert more or less to the pre-ERAD approach.

Finally, the 25/35 Scheme would differ from the 30 Scheme in that responsibility for the annual round test would be devolved to farmers themselves who would be licensed to trade and would have to renew their licence annually by a herd test. Associated with this, pre-movement testing would be strictly enforced using the export interpretation on a test carried out by DVO veterinarians within 30 days prior to movement.

The Data
The five alternatives were evaluated over a 20 year period to 2010. To do so required a projection of herd and price trends over this lengthy period as well as an assessment of the disease impact of each of the options. Herd structures and prices were projected forward according to past trends. The cost of the schemes includes on-farm losses incurred by the removal of reactor animals and the restriction of animal movement out of and into herds, the salaries and fees paid to administrative and veterinary personnel, and materials, travel, rents etc. involved in the Schemes. They are budgeted into the future. There are no additional benefits to be realised under market access or animal productivity as the level of disease is already so low that no extra gains can be realised. Therefore, the analysis reduces to a comparison of costs only.

The critical part of the analysis was the specification of the projected impact on the disease level of the five schemes. This projection was done by the Study Group. The dynamics of bovine Tb is still poorly understood and the assumptions used in this study reflect the current understanding of the process. That view has a number of key elements which are decisive for the outcome of the analysis.

Bovine Tb schemes, even of the most intensive and efficient type, can be little more than cropping programmes under the conditions prevailing in Ireland. Each year many reactors are removed while many infected animals are left behind, some unavoidably and some avoidably. These together with wildlife seed new infection which grows to produce the next crop of reactors. This cropping through testing is complemented by the cropping occurring through the sale of animals from the national farm, some of which would also be reactors if tested on the day. The seed infection being left behind in this cropping process has three components, wildlife, false negative cattle and reactors missed due to imperfect testing.

The role of wildlife in the transmission of bovine Tb was not appreciated up to the 1970s, but in the 1980s informed opinion increasingly accepted that the role was a very significant one. The precise magnitude of infection caused by wildlife is not known but the number is estimated by the Study Group to be some 10,000 cattle infected annually both directly and indirectly. This wildlife contribution is not materially affected by any of the schemes studied here because its curtailment is not feasible technically and, even if it were, it would be resisted by public opinion.

The false negative cattle are a reflection of the fact that some infected animals do not react to the tuberculin test, no matter how well performed, and therefore go undetected. The magnitude of this effect is put at 5,000 false negative cattle each year, and again this magnitude is not affected by any of the schemes studied.

The existence of wildlife infection and of false negative cattle, both of which are untouched by bovine Tb schemes, means that bovine Tb cannot be eradicated with present technology.

Missed reactors due to imperfect testing are the third component of continuing reinfection. The nature of the test is such that even with the best of intentions, its administration in farmyard conditions cannot be perfect. Therefore, some
reactors have to be missed because of imperfect testing. Furthermore, having allowed for the genuine difficulties of administering the test, there is convincing evidence of carelessness beyond the unavoidable. The number of reactors missed because of carelessness is of course influenced by the manner in which testing is organised and supervised and this is an important differentiation among the alternative schemes.

Given the preceding facts the impact of any bovine Tb scheme is constrained. Even a perfectly designed and administered scheme must leave a high reservoir of reinfection behind and cannot reduce the level of recurring reactors below a minimum threshold. There is even a further complication in the form of false positive reactors which are animals that do not carry bovine Tb infection but which nevertheless react to the test. These add to the expense of any scheme and confound the impact of a scheme because they inflate the number of reactors. Based on a reported test specificity of 99.9%, a full annual programme of 10 million tests would be expected to yield some 10,000 false positive reactors and that number would increase as the volume of testing and the severity of the test interpretation increased.

The Results

The 55 Scheme would be the most expensive of the five schemes being some 40% more costly than the ERAD Scheme in the early years. The 50 Scheme would be some 10 to 15% more expensive than the ERAD Scheme in those years, and the 30 and 25/35 Schemes would be some 10% less expensive.

Comparing the present value of the costs of the five alternative schemes over a 20 year period shows that intensification of the schemes per se is not cost effective. This surprising result derives from the existence of a minimum threshold of reinfection which even the most intensive schemes cannot penetrate. While it is easy to increase the cost of schemes by increased testing and increased regimentation, the pay-off in terms of reduced disease is truncated by the minimum threshold. Therefore, the less intensive schemes, such as the 30 Scheme which operated pre-ERAD and the partly privatised version of this, the 25/35 Scheme, are more cost effective than more intensive schemes.

Furthermore, this conclusion is robust with respect to the assumptions employed in the study. It would not be changed if the EC decided as part of the Single Market regulation that beef from reactor animals and milk from restricted herds were not saleable for human consumption or if market forces lead to an equivalent penalty. It would not be changed if the real prices of agricultural produce in the years ahead deviated greatly from those assumed in the basic analysis. Nor would it be changed by any re-specification of the minimum threshold within a range acceptable to the Study Group.