

Comments on the Eradication of Bovine Brucellosis

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Any discussion of bovine brucellosis usually evokes a philosophical debate on eradication and control. Eradication and control differ in definitions and application. Eradication is total; it cannot be local or regional (without effective barriers), Certified-Free (less than a given percentage) or partial. Eradication is a popular concept but the word is abused and the concept misapplied. Eradication of diseases is only achieved when opportunity for re-introduction has also been eliminated. Control of diseases is to reduce or maintain disease at an acceptable level; a trade-off between costs and results. Control is not an unacceptable philosophy. Few diseases or conditions can be eradicated.

Some have suggested that any disease which can be eliminated from a herd can also be eradicated from a region and a nation. However illogical this conclusion, it is safe to state that the opposite is true. To eradicate disease, when possible, is surely wiser and ultimately cheaper. But, to promise eradication and fail to accomplish it results in cynicism and backlash. The promises of an early end of human venereal disease failed to consider the effects of changing sexual mores, drug resistant microbes, and inadequate reporting. The promises of eradication of brucellosis also failed to consider many factors which influence persistence of the disease.

It is unfair to suggest that eradication of one disease can be equated with eradication of another or that comparisons can be made between one region or an entire country to others. Conditions, including the technology of diseases, are often vastly different and these will prevent achievement of goals. The nature of a disease must be known and the methods for its manipulation must be based upon all available facts such as transmission, reservoirs, vaccines, economics, etc. There are many negative aspects in brucellosis control and eradication and some of these are further examined in this paper.

Proceedings of the U.S. Livestock Sanitary Assoc. and U.S. Animal Health Assoc. meeting 1960-1979 and Congressional Record.

Current Status

The cooperative brucellosis eradication program began in 1930's and was accelerated in the early 1950's. A system of county and state certification was established to reflect program progress. Minimum standards known as Uniform Methods and Rules (UMR) were published by the USDA and are revised periodically. The announced goals of eradicating cattle brucellosis by 1972 and later by 1975 proved to be overly optimistic.

The intensive efforts to reduce the incidence of brucellosis in the United States were very successful in regions where herd size, climatic conditions and economic considerations were favorable. However, conditions in other regions (mostly southern and southeastern states) have proven to be difficult to overcome. There has been little reduction in the percentage of reactors among cattle tested, an increase in total reactors, and a large increase in expenditures of program funds in the last 20 years (see Table 1).

Table 1. Status of Brucellosis Eradication Program, 1960 - 1979

FY	Reactors (%)	Reactors (in thousands)	USDA Dollars (in millions)
1960	1.19	148	16.6
1961	1.04	140	19.4
1962	1.06	127	19.2
1963	1.17	132	19.4
1964	1.15	135	19.5
1965	1.12	129	20.5
1966	1.04	121	20.6
1967	1.24	147	21.0
1968	1.24	149	21.7
1969	1.20	130	20.5
1970	1.16	119	21.7
1971	1.10	116	16.6
1972	1.05	124	18.8
1973	1.16	158	21.5
1974	1.34	196	30.8
1975	1.46	250	32.5
1976	1.29	283	40.5
1977	1.14	236	55.2
1978	1.16	241	65.2
1979	1.11	199	77.9

Psychological Influences

The increasing incidence of brucellosis in the mid-70's stimulated requests for an independent appraisal of the eradication program. A Brucellosis Technical Commission (BTC) was formed in 1976 and a report was published in 1978.¹ Some of the recommendations and conclusions of the BTC are listed below:

- a. local control leading to local eradication is biologically feasible if all affected parties assume their responsibility
- b. governments should support a program through investment of funds since this is cost-beneficial
- c. the shift in responsibility from industry to governments should be reversed
- d. the UMR are inadequate to achieve eradication
- e. there is inadequate knowledge, poor program performance, and inadequate incentives to achieve local control leading to local eradication.

The controversy surrounding brucellosis eradication is rooted in psychological, logistical, and technical factors. Before elaborating these, some criteria for disease eradication should be listed.

Eradication Criteria

1. *Commitment* — Resolutions, philosophical talks, and regulations are insufficient. The commitment must be complete by all affected parties since the minority can prevent success. This commitment is not now present in brucellosis as even minimal standards are resisted and evaded.

2. *Knowledge* — It is not necessary to know everything about a disease but what is lacking cannot be important. The BTC found that levels of knowledge are so low as to constitute a barrier to achievement of goals. They further concluded there has been a real failure to assume responsibility for adequate training and public information programs by those in leadership positions.

3. *Complete Control Measures* — Loopholes, evasion and inadequate application assure failure to control diseases. Brucellosis does not respect birthdates or dental formulas.

4. *Trained Staff* — These must be adequate in quantity and quality. Expertise cannot be eliminated from any successful disease control effort. The BTC found both the quality and quantity of program services to be inadequate.

5. *Money* — Locating and eliminating the last foci of infection will be very expensive. There can be no false premises and an acceptance that dollars will not purchase program confidence.

6. *Administrative Flexibility* — Disease eradication is a very serious managerial and scientific challenge. Program administrators must balance strength with flexibility. Rigidity leads to evasion and resistance.

There are aspects of organized eradication or control efforts which affect program acceptance by all participants. An important factor is the duration of the program. A goal which requires decades to complete leads to reduced confidence, suspicion or distrust, especially when announced goals are unrealistic or are not achieved.

The most important factor is that cattle owners perceive the program is cost-beneficial. Farmers do not exist to prove they can attain or maintain a seronegative herd; they exist to produce food and hopefully make a profit. Programs based upon compulsion will fail if there are methods for evasion. Compulsion suggests that the benefits can be economically justified, services are at public expense, there are penalties for non-compliance and there is effective enforcement. Confrontation and antagonism lead to resentment. Persuasion is far more effective in beneficial participation.

The system of area classification which is used to reflect prevalence and for regulating cattle commerce is often misleading and inaccurate. When used as a basis for threats and for procurement of funds, there is an erosion of confidence in program administration. The BTC suggested that the image of government involvement should be minimized since producers seem sufficiently unenthused about government to cause them to either discount or avoid it as a source of information.

The UMR reflect a conflict in local conditions, biology, and producer psychology with the concept of uniformity. There is little which is uniform in the cattle industry and a natural aversion to rules. Regulations are negative incentives for disease control. The lack of cattle owner interest in animal health, regulations which have large negative economic impacts, and the lack of knowledge contribute to poor herd management. Conflicting advice on vaccination, inconsistency in interpretation of regulations, and misleading or insufficient information about the program lead to suspicion and distrust.

Brucellosis is often a subtle disease, requiring a herd test to establish its presence as opposed to clinical symptoms. Cattle owners find it difficult to understand the concept of long incubation periods, why a test cannot establish an early and totally accurate diagnosis, differences among diagnostic tests and their interpretations and a health certificate that may not reflect the true status of cattle it represents. They often perceive vaccines as "cure-alls" or fully effective. They may be reluctant to use them if this results in false positive diagnosis, restrictions on the herd or in cattle commerce or if public informants suggest they are unnecessary and expensive.

Veterinary practitioners may not suspect brucellosis in a diagnostic situation such as abortions or be reluctant to initiate involvement of a cattle owner in a program which they perceive not to be beneficial. Other practices such as the use of fictitious names, "herd-splitting", pretesting before sale of cattle, and refusal to sell cull cattle prevent detection of infected herds.

Logistical Influences

The evolutionary changes in the cattle industry have created enormous barriers to effective disease control programs. They are often greater influences than any organized efforts. The trends toward larger herds, increased cattle commerce, and increased cattle density have severe impacts on prevalence of diseases.² The growth of the cow-calf industry in the southern and southeastern states has contributed heavily to the incidence of brucellosis in a variety of ways. Many of the farm owners have off-farm employment. Animal health is not a major concern especially if the disease(s) is chronic. Many herds are very large and difficult to assemble for disease control activities.

Cattle commerce in the US is very large and diseases often move with livestock. The most important obstacle to disease control is the wheel. The BTC made several recommendations which would have enormous impacts upon livestock commerce. These included requirement for a non-duplicative identification system, a warranty on breeding cattle changing ownership, and a 60-120 day quarantine and retest of herd replacements. It is unlikely that these can be accepted and implemented by the affected segments of the industry. Severe restrictions in existing marketing practices are likely to be acceptable only for short periods of time in emergency situations.

The current limitations on the use of Strain 19 vaccine cause serious problems. Calf vaccination is restricted to an age at which beef calves are difficult to assemble and their future is uncertain. Vaccination at older ages can result in severe restrictions due to the effects of regulations, diagnostic tests, or both. Qualifications of vaccinated cattle to be sold on the basis of age can result in transmission of brucellosis by those which are not yet 'test-eligible'. Lowering the age for tests may identify some infected cattle but can also result in false positive serologic reactions especially when sensitive tests such as the card test are used. Many "exposed" cattle may be condemned which are not infected and this condemnation is a serious economic practice.

Technical Influences

Infection and disease is a complex relationship between the host, parasite, and the environment. The outcome of this interplay depends upon many factors such as exposure, virulence, vaccination status, age, sex, and management practices. Disease control is far more complex than identification of seropositive cattle and removing them from herds. The brucellosis eradication program concentrates attention upon reactors. When identified these may have already made their major contribution to transmission. Thus, the concept that removal of reactors to 'clean up' the herd is the most effective form of eradication may be erroneous. In terms of transmission potential, infected cows that will become reactors are most important and as yet

there is now no satisfactory means for their identification. This is surely the most important technical limitation to the control and eradication of brucellosis.

1. *Incubation Period* — The variable and often long period between exposure and any evidence (clinical or serologic) of infection permits movement of infective cattle into healthy herds, frustrates efforts to eliminate the infection from herds, and frequently results in pre-identification transmission. A recent study³ found that 13.3% of culture positive abortions occurred in seronegative cows.

2. *Surveillance* — It is a simple truism that disease cannot be eliminated until it is located. There is a large difference in the two major methods now used for surveillance. The milk ring test surveys a herd product and a marketed individual surveys a small part of the population.⁴ The latter method is slow and permits cattle in the incubative stage of the disease to be moved before the infected herd is identified. A recent report⁵ suggested approximately seven of a thousand herds in the US were infected and that these serve as the primary source of infection for other herds at risk. While the true herd incidence is unknown (probably several times what is reported), brucellosis is spread largely by cattle from infected herds which have not been identified. There is no difference in the exposed cow in a known infected herd and another in an infected but unknown herd. It is estimated that over half the breeding cows which change ownership are outside the marketed cattle surveillance. Thus, there is no surveillance method for beef cattle which is compatible with brucellosis eradication.

3. *Diagnostic Tests* — While there are surely more methods to diagnose possible brucellosis than any other disease, this situation can also be a liability. Tests are performed in a variety of ways, vary in sensitivity and specificity, and interpretation of results may be inconsistent. Some serologic tests react with certain antibody classes while others measure total levels. Culture methods vary from simple to complex. As with most diagnoses, all available methods and information should be used. Epidemiologic data can be very helpful, however, it is often missing or ignored. It is puzzling why some states spend hundreds of thousands of dollars on indemnities and surveillance without spending a few thousand to upgrade diagnostic capabilities and services.

4. *Latency* — The permanency of infections of calves born to infected dams remains a controversial subject. There is, however, a growing opinion that the percentage is small but its occurrence and the inability to practically diagnose the infection until during or after the first parturition make latent infections of serious importance. The factors which contribute to latency and the effects of vaccination are unknown. The UMR do not consider latent infections in recommendations.

While the technology of burcellosis has improved in the past three quarters of a century, much remains to be known. Perhaps additional research will discover improved

diagnostic methods, increase our understanding of host responses, develop superior immunization techniques, and discover a satisfactory therapy.

Further Observations and Recommendations

It is a natural human response to criticize statements we do not like and those who made them. Criticism should be accompanied by suggestions and supported by data and knowledge.

The future of the brucellosis eradication program is ultimately a political decision. The level of government involvement in any disease control effort will be based upon many factors, but livestock owners will eventually determine the success of the program. Eradication of brucellosis is an enormously heavy price in money, patience, and inconveniences and it is long overdue that the livestock industry and taxpayers be truthfully informed of its implications.

The UMR permits movement of cattle from herds "not known to be infected". Brucellosis cannot be eradicated until cattle are sold from herds known **not** to be infected. The present rules provide an incentive to avoid brucellosis control activities rather than maintaining disease-free herds. Any program which evolves into a game of skills for evasion cannot succeed.

The most effective disease control programs are those motivated by social or industry changes rather than those of individual acts on individuals within a population. The test and slaughter method of disease eradication is a form of therapeutic approach. Indemnities are purchases of failure of prevention. Herd depopulation may reduce herd quarantine lists but does little to prevent spread to other herds and is very expensive. It is impossible to eradicate titers found by diagnostic tests.

The future emphasis on brucellosis should be in prophylactic measures. This can best be accomplished by herd immunization and reducing the incidence of infection in the 'dirty' states through herd options which are economically sound. Brucellosis is a herd disease and control measures should begin with this concept.

The notion that vaccines are incompatible with disease eradication is erroneous. The use of Strain 19 has been restricted due to the limitations of diagnostic tests. The problem of post-vaccinal titers can largely be solved by reducing the vacinal dose, use of supplemental serologic and bacteriologic tests, herd and animal history, and proper interpretations of these data. Vaccine usage should be shifted away from age restrictions and penalties. It is very effective on a herd basis.

Veterinary practitioners should have greater involvement in brucellosis control. They are trusted by cattlemen and have knowledge of disease behavior and local conditions.

They should work in concert with specialists who have advanced training in diagnostic methods. This greater involvement carries with it the responsibility for continuing education in all aspects of the disease.

Research is not a luxury; it is a necessity. This should include studies of changes in the livestock industry and how these affect diseases. Any organized program must adjust to research findings and changes in livestock management and should be continually evaluated by uninvolved experts.

Statements concerning the public health aspects of brucellosis must be factual. Scare tactics must be avoided. Classification of areas, if used, should reflect disease prevalence and true program status and must not be a means of coercing compliance.

The current brucellosis program is far too rigid and inflexible. It should have true herd plans based upon local conditions with meaningful prerogatives. These should include altered test schedules, temporary retention of seropositive cattle under appropriate disease control safeguards, vaccination without penalties, etc. It is only when cattle owners are convinced that disease control is economically more beneficial than disease that any efforts are successful.

Conclusions

Brucellosis eradication is far more complex than collection of blood samples and slaughter of reactors. It depends upon a total commitment from all affected participants which does not now exist. The disease cannot be regulated away in a relationship of confrontation and antagonism between governments and cattlemen.

The psychological, logistical, and technical limitations to brucellosis eradication will prevent its success. The livestock industry will not, indeed cannot, tolerate all the necessary restrictions. Future efforts should be directed toward a multi-focal control of the disease which emphasizes prevention and is founded upon solid scientific, economic and logistic standards. The private practitioner should be an integral part of the team.

References

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