CONTROL OR ERADICATION OF ENDEMIC DISEASES: WHAT DO WE LEARN FROM EXPERIENCE AND FROM EPIDEMIOLOGICAL AND SIMULATION STUDIES?

Christine Fourichon

ONIRIS, INRA, UMR1300 BioEpAR, Atlante La Chantre, BP40706, F-44307, Nantes, France,

The objective of this paper is to illustrate and discuss insights which can be obtained from experience and from research to support policy-making for the management of endemic diseases.

Definition of an endemic disease varies between users. It generally refers to a disease being present in a population, with no expected spontaneous extinction. The distinction with an epidemic disease is somewhat relative. Indeed, many diseases considered today as epidemic (e.g. foot-and-mouth disease, classical swine fever) are characterised by a peak frequency when the pathogen is introduced into a naïve population, followed by an endemic stage, i.e. equilibrium with a non-zero frequency if no control measure is implemented. In veterinary medicine, what is usually called endemic diseases includes the so-called production diseases or multifactorial diseases (e.g. mastitis), present in most of the herds at varying prevalence, and transmissible diseases which have been present in a population for a while and are perceived as likely to persist. In this paper, we focus on the latter.

For transmissible diseases, eradication means eliminating the pathogen from a population, generally in a defined geographical area. By contrast, control consists of maintaining the frequency and the burden of the disease at an acceptable level. The question of who defines a threshold as acceptable is then raised.

We learn from experience in different countries that it is feasible to eliminate a pathogen from a geographical area. Some recent examples in Europe are the viruses responsible for BVD (bovine viral diarrhoea) in Scandinavian countries, Aujeszky’s disease in Western Europe, IBR (infectious bovine rhinotracheitis) in France. In these examples, methods to eradicate the pathogen have relied either on sanitary measures, or on massive vaccination, or a combination of both. It is interesting to analyze why, for the same pathogens, some countries decided to “live with the disease”. It is also interesting to realize that for other pathogens, there is kind of implicit consensus that eradication is not the way to go, as e.g. for paratuberculosis.

With observational epidemiological studies, looking at the literature, we find in fact many studies identifying risk factors for occurrence of a disease (defined at large, and including presence of a pathogen), a few of them aiming at understanding risk of reoccurrence after a previous elimination of a pathogen (see for example a review of risks factors for BVD occurrence or reoccurrence in Lindberg et al., 2006). Descriptive studies can inform on the frequency of the disease after a control programme has been implemented and document the follow-up of the programme, ideally by measuring not only prevalence, but also incidence of the disease, which is a more precise indicator of effectiveness of preventing new infections. Intervention studies should allow comparing situations with and without an intervention and to assess, ex post, effectiveness of control strategies. In fact, there are very few intervention studies available for control programmes of endemic diseases, probably because they are not deemed feasible (practically and for ethical and/or political reasons), and because of their cost. Overall, available observational studies provide information useful to understand the determinants of disease occurrence, and therefore to construct control programmes aiming at controlling them, but are limited in estimating the effectiveness of control programmes. Moreover, their external validity must be thoroughly discussed before using results in a new population.

In complement to observational studies, in the last decades, epidemiological modelling and simulation studies emerged as a method to evaluate control actions for endemic diseases (see e.g. for BVD, Viet et al., 2006, Ezanno et al., 2008, Courcoul-Lochet and Ezanno, 2010). Among their
advantages, a large number of possible actions can be compared and ex ante evaluation is possible. Simulation models can be developed to account for different contexts, for example, different farming systems, high or low risk of introduction of a pathogen, high or low density of contacts between animals and herds. Uncertainty can also be accounted for and shown in the outcomes, which is of interest for a decision-maker. It is even possible to use models to characterize the required efficacy of a still theoretical control action to achieve to obtain a good effectiveness at the population level. One of the difficulties in such studies is to determine which simplifications of a real system can be done in a model to still predict the expected behaviour of the system. Then information (from observed data) is necessary to parameterize and calibrate the model. Although full model validation is generally not feasible for complex models, they can be used under well-defined assumptions to understand the determinants of persistence versus extinction of a disease in a population, and to rank control strategies according to their relative effectiveness, in a variety of contexts of interest.

Effectiveness of control actions is not sufficient an information for policy-makers to define a control strategy. Besides, socio-economic components are of importance (Saatkamp et al, 2006). One the one hand, quantification of diseases losses, on costs of the control programme and on its expected efficiency is necessary (Fourichon et al, 2005). On the other hand, even a programme theoretically efficient can fail if there is poor compliance of farmers to apply it. Then, expectations, motivations and obstacles for farmers to implement control actions should be understood (Fourichon et al, 2008). Again, modelling can be an interesting approach to link epidemiology and economics. Decisions of farmers can be simulated, and with dynamic models, it is even possible to account for risk aversion and for adaptation of farmers to a changing environment with a variable level of risk for their herd (Rat-Aspert and Fourichon, 2010).

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