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Antibiotic use by farmers to control mastitis as influenced by health advice and dairy farming systems

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ABSTRACT

Mastitis is a bacterial disease common in dairy farms. Although knowledge about mastitis and its optimal technical management and treatment is now available, some dairy farmers still use antibiotics in inappropriate ways. Antibiotic use by farmers can be influenced by personal restraints and motivations, but it can be assumed that external drivers are also influential. The main purpose of this article is thus to analyse the choices of antibiotic and alternative medicine use for mastitis treatment and investigate the possible influence of two unexplored external drivers in dairy farms: (i) the health advice offered to farmers by farm advisors and veterinarians, (ii) the dairy farming system, as defined by combining the market valuation chosen for the milk, the level of intensification, and the perceived pressure related to investments. Research was based on 51 individual semi-structured interviews with farmers and their corresponding veterinarians and farm advisors. Based on verbatim, the use of antibiotics and alternative medicine by farmers for mastitis treatment, the vet-farmers interactions, and the dairy farming systems are described. The advisory relationships between farmers and farm advisors and between farmers and veterinarians influenced the implementation of selective dry cow therapy, but had very little effect on the use of alternative medicines by farmers, who were more willing to experiment alternative medicines than their advisors. The dairy farming system had very little influence on antibiotic use: some misuse of antibiotics was found whatever the farming system. Systematic dry cow therapy was also a widespread habit in all dairy farming systems except organic. The use of alternative medicine was common in all farming systems.

1. Introduction

Mastitis is a production disease widespread in dairy farms, and its effective control is important for economic and public health reasons. Indeed, mastitis in dairy farms was deemed responsible for one third of the economic impact related to dairy health disorders in Western France (Fourichon et al., 2001). On the public health side, in 2012, each cow in the dairy sector received on average the equivalent of 1.58 antibiotic treatments for mastitis per year in France (Chevance and Moulin, 2013), amounting to 70% of all the antibiotics administered to dairy cows (Gay et al., 2012). However, the use of antibiotics increases the proportion of antibiotic-resistant bacteria and thus decreases antibiotic effectiveness for both livestock and humans (Gonggrijp et al., 2016). This is a growing concern worldwide (OECD, 2014).

Nowadays, knowledge about mastitis and its optimal technical management and treatment is available (De Vliegher et al., 2012; Sant'Anna and Paranhos da Costa, 2011). At the farm level, the prevalence of mastitis is decreased by improving preventive measures and thus the need for antibiotics. Antibiotics use is also decreased by implementing prudent antibiotic practices. Prudent practices can be defined as the decrease of antibiotic misuse and systematic treatments, and the increased use of substitution treatments, where relevant, such as alternative medicines. Nevertheless, dairy farmers are still regularly using antibiotics in an inappropriate manner (Oliveira and Ruegg, 2014).

Farmers' restraints and motivations to implement prudent antibiotic practices have thus to be explored so as to nudge them towards these more desirable practices. Some deviations from what is considered "prudent" can be explained by technical considerations: for example Lhermie et al. (2014) assume that farmers would rather implement curative than preventive measures on the grounds that they are more easily self-evaluated. In addition, the farmers' decisions to implement strategic health management decisions are undoubtedly affected by behavioural factors. Psycho-sociological factors such as farmers' motivations and representations are particularly important in the decisions-making process (Russell and Bewley, 2013). Health management

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practices on farms can be influenced by farmers' attitudes and behaviour (Valeeva et al., 2007), farmers' perception (Lam et al., 2011) as well as farmers' personal experience (Garforth, 2011) and farmers' decision-making processes (Murray-Prior, 1998) regarding their performance and their perception of risk. In a Dutch study, for example, at least thirty to fifty percent of the variation in different parameters of milk quality output (in terms of milk somatic cell counts and mastitis incidence) could be explained by farmers' perception and attitudes (Jansen et al., 2009).

Besides these internal determinants, it is assumed that antibiotic use by farmers is also influenced by external determinants, namely: (i) the recommendations provided by farm advisors and veterinarians and (ii) the dairy farming system.

First, as veterinarians are responsible for antibiotic prescription, their influence on antibiotic use is expected to be important. Other farm advisors can influence the self-selected medication habits of farmers, even if they themselves do not prescribe antibiotics. Previous research on the attitudes and perceptions of veterinarians regarding the reasons for their prescription habits demonstrated multiple conflicting interests and a widespread perception of the importance of reducing antibiotic use (Speksnijder et al., 2015a,b). However, the interplay between those restraints and motivations to reduce antibiotic prescription and farmers' habits on-farm has not been yet explored. Moreover, the interplay between farmers and veterinarians regarding antibiotic use and reduction has only been investigated from the veterinarian's point of view (Speksnijder et al., 2015b). However it is very important to include the priorities of all stakeholders to develop public health strategies and programs that will be appropriate to field constraints (Catley et al., 2012).

Second, societal pressure is encouraging the improvement of farming practices. On farms, this can lead to a change for differentiated products (organic or PDO) or to a change of practices. This could subsequently lead to a reduction in antibiotic use. Antibiotic use might be impacted by the dairy farming system in which the farmer operates. The farming system can be constrained by certifications and their consequent specifications. For example, organic certification limits the use of antibiotics (Le conseil de l'Union and Européenne, 2007). The choice of farming system can also be linked to the farmer's personal beliefs (*e.g.* attitude towards biodiversity, ecology, tradition, *etc.*) and influence antibiotic use. These certifications determine the market valuation of the milk, which in turn affects farm income. In addition, health management practices, such as prevention or the use of medication, can also be impacted by the financial resources available, depending on the cost of the different practices. Financial resources are dependent on the level of investments and on the gross margin. Veterinarians consider the availability of financial resources to be strongly related to the compliance of farmers with veterinary advice (Speksnijder et al., 2015). The level of intensification varies between farming systems (work productivity and agronomic intensification) and also impacts the organisation of labour on the farm, such as the work load (Visschers et al., 2014). The practices and habits of farmers are often limited by labour resources.

Thus health management and antibiotic usage can be influenced by health advice and the characteristics of the farming system.

Our objective in this article is to analyse the choice of use of antibiotics and alternative medicine[1] for mastitis treatment by describing the possible influence of two unexplored factors in dairy farms: (i) the health advice offered to farmers by farm advisors and veterinarians, (ii) the dairy farming system, as defined by the market valuation chosen for the milk, combined with the level of intensification and the level of investment.

[1] In this article, "alternative medicines" takes into account two major categories of products: (i) homeopathy, products where active ingredients are at an infinitesimal dose; (ii) herbal substances, at non-concentrated or concentrated doses (called aromatherapy).

2. Material and methods

2.1. Context of drug use in France and general study design

In compliance with French law, veterinarians are the sole prescribers of drugs. Farmers can buy antibiotics from two authorised parties, namely veterinarians and pharmacists, but only under a prescription. Since 2007, a decree allows farmers to buy antibiotics with a prescription but without any clinical examination of the animal or batch if the veterinarian establishes a treatment protocol at least once a year, which is specific to a given disease often encountered in the farm. This decree legalises and supervises an old French habit of self-medication by farmers. Since 2016, the use of critical antibiotics has been strongly restricted and, apart from some exceptions, these molecules can no longer be used as first-line treatment.

In this context, a survey focusing on antibiotic use in dairy farms was carried out in France in 2015. The aim was to study the trajectories of change regarding farmers' practices with respect to antibiotic use, farmers' restraints and motivations to reduce it, and their decision processes leading to the treatment of an animal with antibiotics. The interactions within the "farmer-veterinarian-farm advisor" triptych were assumed to be influential in the decision to use antibiotics. This survey was based on a qualitative approach involving 51 individual semi-structured, separately-conducted interviews with 24 farmers, 14 farm advisors from the National Milk Record group and 13 veterinarians. Farm advisors and veterinarians were contacted based on ' indications. Some veterinarians or farm advisors were involved with two different farmers in the sample. This explains why some triptychs were incomplete. In this study, we used the information collected in the survey and focused on the choices of antibiotic and alternative medicine use by farmers and the possible influence of two external factors affecting antibiotic and alternative medicine use by farmers to treat mastitis, namely the farming system and health advice.

2.2. Selection of farmers

Farmers were selected with the collaboration of French technical institutes. We aimed to include farmers who had marked a break, either in light of their choice to produce differentiated milk (organic, or PDO), or in light of their expressed intention to reduce antibiotic use.

First, we included diverse milk valuation systems in order to explore the influence of milk valuation on farmers' practices. Thus the main selection criterion was based on the commercial valuation of the milk (organic, Protected Designation of Origin (PDO) or conventional). Within these commercial groups, the selected sample was assumed to include a wide range of intensification levels. Organic and conventional farmers were mainly located in western France because this area is the most important dairy cattle region in France with 35.8% of the French production volumes (Martin-Houssart et al., 2016). PDO-labelled farmers are milk producers for "Epoisse" cheese and located in Burgundy (eastern France). The valuation of milk from PDO and organic farmers differs from that of conventional producers. Farmers are paid more for milk if they respect a set of quality requirements and specifications. In the case of "Epoisse", the use of a particular breed (Montbéliarde, Pardo, or French Simmental), and specific management practices (animal feed) are required.

Second, other criteria were then added in order to select farmers who expressed concern about antibiotic reduction or had reduced antibiotic use. Selection was based on information obtained from the farm advisors *i.e.*, (i) farmers whose cows had a good level of udder health, in order to discuss the issue of antibiotic use under correct sanitary conditions, (ii) farmers implementing or planning to implement selective dry cow therapy, or, (iii) farmers that were known to have done training in the use of antibiotics or alternative medicines.