**Antibiotic use in food production; the impact on public health –
Learning lessons from Scandinavian experiences**

Hilde Kruse, DVM, PhD, Norwegian Zoonosis Centre

Antibiotic resistance represents an increasing medical problem resulting in increased morbidity, mortality, and costs to the society. Although the epidemiology of antibiotic resistance is complex, it is generally agreed upon that antibiotic resistance is a consequence of use and misuse of antibiotics for various purposes in various sectors. Controversies still exist regarding to what extent the use of antibiotics in food production impact human health. Scientific data do show, however, that such use can represent an increased public health risk and can contribute to resistance problems in human medicine. This is most obvious in regard to the zoonotic bacteria *Salmonella* spp. and *Campylobacter* spp. where human health problems have been linked to use of antibiotics in food animal production. As both resistant bacteria as well as genes mediating resistance traits can move across phylogenetic, ecological as well as geographical borders, a holistic approach encompassing both human and veterinary medicine as well as food production is needed in our endeavours to contain and prevent further spread of antibiotic resistance and to better understand the epidemiology of antibiotic resistance.

Scandinavian countries have a tradition for exerting a restrictive antibiotic policy, also in the food production sector. It is reason to believe that this explains why the resistance situation is rather favourable in an international perspective. However, there is a potential for improvement. National data show that the resistances observed is associated with antibiotic usage in the various animal species, and both resistant bacteria and resistance genes represent a reservoir for potential spread to human pathogens. Moreover, there are examples of more specific problems that can serve as learning lessons:

In Norway, the rapid growth in aquaculture in the early 1980s brought with it problems with bacterial infections resulting in a large use of antibiotics. Resistance problems soon developed. Although no human health problems so far have been associated with the antibiotic use in Norwegian aquaculture, resistance genes in fish pathogens have been shown to be similar to those found in other sectors and furthermore to be transferable to human pathogens. Thanks to the introduction of effective vaccines as well as environmental improvements, the usage of antibiotics within Norwegian aquaculture have decreased with 99% since 1987, while the production have increased manifolds.

In Norway and Denmark, the growth promoter avoparcin was used in poultry production for several years until it was banned in 1995. The ban was a result of new research showing an association between agricultural use of avoparcin and the occurrence of vancomycin resistant enterococci (VRE) in the animal food chain, including poultry producers. Recent studies show that VRE are still quite widespread in poultry production in both Denmark and Norway. In Sweden, growth promoters were banned already in 1986, and VRE are not prevalent in Swedish agriculture. No direct public health consequences have been attributed to the agricultural VRE reservoir in Denmark and Norway. However, the existence of a large reservoir of VRE and vancomycin resistance genes in the food chain is considered to represent a risk to human health, and the medical importance of the agricultural VRE reservoir may increase with increased hospital use of vancomycin. The avoparcin experience exemplifies that antibiotic use leads to resistance, that the animal and human sector is interlinked in regard to antibiotic resistance, and that resistance does not necessarily disappear when a specific antibiotic is withdrawn but rather can persist for several years without any obvious selective force.

National data show that the ban of growth promoters in Scandinavia has not resulted in increased production costs.