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Swedish dairy farmers' attitude towards the use of antibiotics

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Svenska mjölkbönders attityd till antibiotikaanvändning

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Sammanfattning

För att behandla bakterieinfektioner hos människor och djur behövs antibiotika men en överanvändning och oförsiktig användning kan leda till utveckling av antibiotikaresistens vilket gör att alternativen för behandling blir färre. Syftet med studien var att undersöka svenska mjölkbönders attityder till antibiotikaanvändning med grund i antagandet att en positiv attityd till antibiotika även påverkar viljan att använda antibiotika som kan leda till överanvändning. Studiens hypotes var att ekologiska mjölkbönder har en mer restriktiv attityd än konventionella bönder. Resultatet visar att det endast var statistisk signifikant skillnad ($P<0.05$) för några av de påståenden och bakgrundsfakta som bönderna fick svara på. Dessa var om de hade eftergymnasial utbildning, har en besättningsveterinär, vänta med att kontakta veterinären 1-2 dagar när en kalv visar symptom på diarré där ekologiska mjölkbönder hade och gjorde det i större utsträckning än konventionella mjölkbönder. Det var också en signifikant skillnad om bönderna utfodrar kalvar med mjölk från kor under behandling vilket fler konventionella än ekologiska bönder gjorde, dock med en kommentar att endast tjukalvar utfodrades den mjölken. Vidare höll fler ekologiska än konventionella bönder med om påståendet att utfärda böter och vara tvungen att ha en plan för att minska antibiotikaanvändningen på den egna gården var en bra idé. De konventionella bönderna instämde mer i att reducering av antibiotika på den egna gården spelar mindre roll om inte andra bönder gör likadant medan ekologiska bönder höll med mer om att antibiotikaanvändningen i svenskt lantbruk innebär låg risk för utvecklingen av antibiotikaresistens än konventionella bönder. Slutsatsen av studien är att det inte är någon större skillnad på attityden till antibiotikaanvändning, kunskap kring antibiotika och användingen hos svenska ekologiska och konventionella mjölkbönder.

Abstract

Antibiotics are necessary to treat bacterial infections for both humans and animals but an overuse and not enough prudent use can drive a development of antimicrobial resistance (AMR) leaving both populations with no available treatment. The aim of this study was to investigate Swedish dairy farmers' attitude towards the use of antibiotics, because a positive attitude to antibiotic use may also increase the use of antibiotics and possibly lead to more use than necessary. The hypothesis was that organic dairy farmers have a more restricted attitude towards antibiotics than conventional dairy farmers. The result showed statistical differences ($P<0.05$) where organic farmers to a larger extent had post secondary-school education, has a herd veterinarian and waited 1-2 days before contacting the veterinarian if the calf show signs of diarrhea. Significantly more conventional farmers fed calves with milk from cows under treatment with antibiotics, but with a comment that only bull calves were fed that milk. Also, organic farmers agreed more to the statement that getting a penalty if the level of antibiotic use rises above a predetermined level and having a plan to reduce the antibiotic use is a good idea. Conventional farmers agreed more that reduction of antibiotics in their herd serves no purpose while other dairy farmers not reduces their use and to the statement that they do not see why the number of treatments on their farm needs to be reduced. Organic farmers believed the level of antibiotic use in Sweden is not a threat to human health, but conventional farmer agreed more with the statement that Swedish usage of antibiotics give a low risk of development of AMR. The conclusion of this study is that it is no major difference between Swedish organic and conventional dairy farmers regarding the attitude towards the use of and the knowledge about antibiotics.

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Introduction

Every year approximately 11 million people die from a bacterial infectious disease, which worldwide is the second most common cause of death (WHO, 2003). The human population is ageing with more needs for medical care and because of urbanization and globalization the transmission of infectious diseases speeds up, which is a threat for the population. Antibiotics are life saving for both humans and animals because of their ability to treat bacterial infections (Greko, 2014) and therefore it is an indispensable drug in all disciplines of medicine (Wegener, 2003).

A large amount of antibiotics are used for the veterinary medicine and in livestock production (SVARM, 2013). Development of new antibiotics is hampered by the fact that medical companies are reluctant to develop new drugs with the purpose to be used as little as possible (Schwarz *et al*., 2001; EMA, 2014). The fact that antimicrobial resistance (AMR) usually develops two years after a new antimicrobial substance is on the market also decreases the drug companies' interest to develop new antibiotics (Sköld, 2006). Antibiotics are not on the list of top 20 most sold drugs in Sweden, which in turn also lower the interest of developing a new one in the sales point of view. In human population antibiotics are prescribed for several different symptoms and not only bacterial infections, which in some cases only have the effect that the patient in fact is getting a prescription (Schwarz *et al.*, 2001). An unnecessary prescription of antibiotics will have the effect of exposing bacteria for small amount of antibiotics, which in turn have an impact on the development of AMR (Radyowijati & Haak, 2002). The use of antibiotics is not only related to benefits; it comes with a dilemma concerning human health and food safety (WHO, 2003; Oliver *et al*., 2011). Using antibiotics with broad spectrum and therapeutic use will increase the risk for AMR, which increases the risk for not be able to treat bacterial infectious diseases (WHO, 2003). The advantages of antibiotics, however, outweigh the disadvantages, which is the reason for the continued use (Oliver *et al*., 2011).

In livestock production antibiotics have been used not only for treating bacterial infections but also as a growth promoter (Perreten, 2003). In Sweden it is, however, not allowed to treat animals preventive with antibiotics since 1986 and in EU since 2006 (Sköld, 2006; SJV, 2014a). In Sweden only the veterinarian can treat cattle with antibiotics and only in exceptional cases the animal keeper is delegated to treat the sick animalwith antibiotics. .

In both humans and animals an irresponsible prescription pattern, overuse of antibiotics and using antibiotic on healthy animals increases the risk of development of AMR (Schwarz *et al*., 2001; SJV, 2014a). Using and overusing antibiotics promotes survival mechanisms in bacteria for different environments where one can be the presence of antibiotics (Englund & Greko, 2007). The evolution of the bacteria can cause resistant bacteria to survive in a larger extent and therefore resistant bacteria has the possibility to multiply almost freely even with the presence of antibiotics. A correct determined diagnosis, a responsible use of antibiotics and more consistent use of narrow spectrum antibiotics could reduce the use of antibiotics and prevent development of AMR (Schwarz *et al*., 2001; SWEDRES-SVARM, 2013; Pascale Palhares *et al*., 2014). A frequent use of antibiotics has resulted in the presence of resistant *Staphylococcus aureus*, which is worrying because of the threat to human health (De Buyser *et al*., 2001). In order to keep the effectiveness of antimicrobial agents the use of it has to be prudent (De Buyser *et al*., 2001) since the use of antimicrobials in dairy cows does have an impact on the transmission of AMR (Oliver *et al*., 2011).

The most effective strategy to reduce AMR is to use antibiotics responsibly, complete the full treatment and identify the bacteria to choose the proper antibiotic. The mankind have known about the development of AMR for over 40 years, which have engaged medical experts and politicians ever since (zur Wiesch *et al*., 2011), but the great response from the public to prevent the spreading of AMR is still absent (Nordberg *et al*., 2004). The population needs to increase the awareness of the consequences with overuse of antibiotics (Dinleyici *et al*., 2013). Implementing guidelines with scientific basis for prescribing antibiotics for physicians will decrease the total amount of prescription, reduce AMR and reduce the medical costs.

With an increased AMR countries cooperate in order to diminish it and create policies for restrictive use of antibiotics (WHO, 2001). The policies have to be translated into actions that are concrete to be able to get an international effect to reduce the development of AMR. The issue with antibiotic overuse should be attended with the same respect as the climate change (EMA, 2014). The resistance against antibiotics is a worldwide problem with impact on both animals and humans wellbeing (Smith *et al*., 2015).

In the US preventive antibiotics fed to calves are stated to be the most important factor to keep calves healthy (Berge *et al*., 2005). According to Berge *et al*. (2005) an upbringing of calves in the US without antibiotics is problematic because of stress from surroundings, exposure to different pathogens and non-feeding with colostrum. However, Visschers *et al*. (2014) found that under Swiss conditions introducing appropriate routines and changing daily management antibiotic use can be reduced without affecting animal performance.

Farmers in Austria stated that professional journals, the Internet and continuing educational days were of importance for being updated with the latest research on animal health (Pothmann *et al*., 2014). This shows that information and advice regarding animal health and preventive management is a central instrument maintaining animal health and performance (Balabanova *et al*., 2004) and may thus also be used to influence the use of antibiotics.

To predict a person's behaviour the attitude has to be known (Garforth *et al*., 2004). The attitude is a combination of norms and motivations to the particular behaviour (Fishbein & Ajzen, 2005). For farmers, economical costs and the reduction of them can be a motivator to perform certain behaviour (van der Borne *et al*., 2014). Fulfillments at work can be another motivator when making a decision (Bergevoet *et al*., 2004; Valeeva *et al*., 2007). How convinced the farmer is that the behaviour has a positive outcome plays a major role in the decision-making progress (Alarcon *et al*., 2013). This means that the more aware a farmer is of the outcome of the behaviour and decision made, the more motivated the farmer is to do the behaviour (Visschers *et al*, 2014). If a farmer has a positive attitude towards the use of antibiotics it is more likely the farmer uses more antibiotics than a farmer with a restricted attitude towards antibiotics.

In order to establish a strategy to reduce the use of antibiotics there must be attitudinal change (Pascale Palhares *et al*., 2014). The difference in withdrawal period between organic and conventional farmers may be one factor that influences the farmer's attitude towards the usage of antibiotics, partly because of economic factors (KRAV, 2015; Alarcon *et al*., 2013; Bruijnis *et al*., 2013). In order to reduce the use of antibiotics on ranches with livestock calf production the management must change (Berge *et al*., 2005). The knowledge about the farmers' attitude is of great importance to advisors and other professionals to be able to give good and useful advice to the farmer about his production (Bergevoet *et al*., 2004). Accurate advice will help the farmer to reach his goal with the livestock production without

jeopardizing animal health and performance (Bergevoet *et al.*, 2004). For a farmer to implement a strategy given from an advisor it is better if the strategy involves the farmer's concrete goals. By knowing the farmer's goals and attitude towards it, it is more likely for the farmer to achieve his objective. A farmer's perception of antibiotics and preventive actions play an important role in the need of antibiotics (Visschers *et al*, 2014).

A study was recently performed to investigate the attitude of Swedish pig farmers' towards the use of antibiotics but no study has been made on dairy farmers' attitude (Visschers *et al*., 2014). To reduce the use of antibiotics and AMR in dairy farming in Sweden, the attitude of dairy farmers' has to be explored. Knowing their attitude will help veterinarians and advisors to provide useful information, tips and management advice in order to keep dairy cows healthy with even less use of antibiotics than today. Because regulations for the use of antibiotics differ between organic and conventional dairy farms, potential differences between the farm types would also be needed to explore.

Aim and hypothesis

The aim of this study was to investigate Swedish dairy farmers' knowledge and attitudes towards the use of antibiotics in their herds. A hypothesis of this study was that organic dairy farmers have a more restricted attitude to the use of antibiotics than conventional farmers.

Literature review

Antimicrobials

Antibiotics are a collective name for medical products used to treat bacterial infections (Smith *et al*., 2015). It is both a naturally occurring and synthetic agent and the first discovered antibiotics was Penicillin which was discovered in the 1930s by chance extracted from fungus in a bacterial culture (Smith *et al*., 2015) and is the most common used antibiotic for several bacterial infections (Dinleyici *et al*., 2013). Penicillin is a narrow spectrum antibiotic and have lower effect on the development of AMR than a broad-spectrum antibiotic (SWEDRES-SVARM, 2013). Each category of antibiotic is a finite resource possibly available for a limited period of time ahead (Englund & Greko, 2007). Antibiotics are the drug most used on food-producing animals and are used to treat bacterial infectious diseases for instance in the udder, uterus, kidneys, the respiratory tract, eyes and in intestines (SJV, 2014a).

Worldwide use and prescription for humans and animals

Approximately 50% of the used antibiotics in Europe are used in veterinary medicine, which corresponds to over 55 million tons of antibiotics in 2012 (EMA, 2014). Today the use of antibiotics shows a negative trend in dairy farms in Europe where the Netherlands had the largest reduction of sales of antibiotics for livestock during 2010 to 2012 with a 49% reduction (EMA, 2014). The reduction in the Netherlands is due to political goals set by the government in a three-step process (Bruschke, 2014; MEA, 2014). If the prescribed amount of antibiotics is too high the veterinarians in the Netherlands gets a red card (MEA, 2014). The average reduction of sold antibiotics in the EU is 14.9% based on tons presented in the unit mg/PCU (population correction unit). That corresponds to a reduction of 15.4% based on 1,000 tons antibiotics sold over two years (EMA, 2014). Norway put up a goal in 1995 to reduce the use of antibiotics with 25% over a period of five years, which succeeded and an additional 15% reduction was achieved making Norway having the lowest amount of sold antibiotics in Europe, 3.8mg/PCU. Iceland had after Norway the lowest amount of sold antibiotics, 5.9mg/PCU, in Europe for animals.

According to a US study by Berge *et al*. (2005) calves reared at ranches in the US were regularly given antibiotics in their feed to be able to resist the high pathogen pressure. The study also found that to stop feeding the drugs to calves that are used to be fed antibiotics or medicated through milk might be dangerous. Berge *et al*. (2005) drew the conclusion that because of the consistent feeding with antibiotics calves have an un-developed immune system for a longer period of time compared to calves not fed with it. Because of this calves are put at risk by eliminating antibiotics from their feed ration from one day to another. This must be done step-by-step for not jeopardizing the health of ranch-reared calves in the US.

The prescription pattern for antimicrobial agents is similar in all European countries but there is still some prescription based on incorrect diagnoses or by tradition for certain diseases. The majority of the 26 countries observed in Europe in 2012 require a prescription from a veterinarian before treating animals with antibiotics. Cyprus, Italy and Hungary were the three European countries with most sales and prescribed antibiotics in 2012. In Cyprus 396.5 mg/PCU antibiotics was sold for use on livestock animals per year, in Italy the number was 341.0 mg/PCU and in Hungary 245.5 mg/PCU.

Antimicrobials are provided by wholesalers, pharmacies or veterinary clinics and in Italy veterinarian and farmers can keep a smaller amount of antibiotics in their possession if they are authorized and have a prescription from a veterinarian (EMA, 2014). The Ministry of Health in Hungary promoted to not use antibiotics in preventive matter by having a course online in surveillance and veterinary medicine. Information brochures were handed out in 2011 about farm management and how to handle medicine on farm in order to reduce the incidence of sickness and use of antibiotics (EMA, 2014).

Prescription pattern in Russia in human care were investigated in 2004 where medical journals, advice from colleagues, professional meetings and especially chemical companies were the main sources of facts for physicians for prescribing antibiotics (Balabanova *et al.*, 2004). Russian physicians also followed certain guidelines when prescribing antibiotics for tonsillitis, which are outdated and unconsciously boosting overprescribing of antibiotics. There is in fact an overuse of antibiotics internationally because of old and out of date information and guidelines regarding the usage (Wise, *et al*., 1998). One of the main diseases in humans for prescribing antibiotics for is acute otitis media, which is done by tradition and lack guidelines with scientific basis (Dinleyici *et al*., 2013). From 2010 prescription statistics on antimicrobials are noted in the EU in order to follow the development of AMR with the intention to put in actions against the development of AMR (EMA, 2014). About 80-90% of the antibiotic use in developed countries is outside of the hospital and the majority of the use are inappropriate because the patient in fact has a viral infection (Wise, *et al*., 1998).

The length of an antibiotic treatment and the dosage differs between all European countries, which have an impact on the development of AMR (EMA, 2014). Improved diagnoses is a significant step towards a reduction in the over-use of antibiotics and reduce the usage of antibiotics (Carbon *et al*., 2008). An adequate use of antibiotics is desirable, which by World Health Organization, WHO, is defined as "*the cost-effective use of antibiotics, which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antibiotic resistance*".

Use in Sweden and prescription for humans and animals

In 1986 antibiotics were prohibited to be used in animals as a preventive treatment promoting growth or to use without prescription from a veterinarian in Sweden (Sköld, 2005). The

banning of the general antibiotic use was a result from farmers' own initiative in order to keep the consumers trust for their products. The markets' requirements and proactive farmers made this to create an added value of Swedish animal products (Ståhle, 2014). In 2012 approximately 65 tons antibiotics were prescribed to human care in Sweden in comparison to 12 tons for veterinary medicine and 11 tons in 2013 (SWEDRES-SVARM, 2013). The use of antibiotics has been reduced with 60% in Swedish veterinary medicine since 1986 due to the prohibition. In Sweden 13.5 mg/PCU were sold in 2012 for usage on livestock animals, which corresponds to 40 times lower than in Cyprus and makes Sweden's antibiotic use to top three of lowest amount in Europe (EMA, 2014).

In Sweden every pharmacy need to keep statistics on the daily sales and report it to the government-owned Apotekens Service AB's database (EMA, 2014). A prescription is required in order to buy antibiotics and it can only be purchased from a pharmacy. If needed the Swedish Board of Agriculture can authorize a farmer to mix feed and antibiotics or authorize a feed mill to create a feed after a certain recipe including antibiotics. The Swedish Board of Agriculture requires an annual report of sales and purchases from farmers and mills authorized to mix feed and medicine.

Approximately 10% of the antibiotics sold for veterinary use in Sweden are used for treatment through water and feed and 90% are used for individual treatments with injections, peroral form or local treatments (SWEDRES-SVARM, 2013). Dairy cows occasionally get sick which sometime requires treatment with antibiotics. Milk from cows during antimicrobial treatment is likely to contain residuals of antibiotics as well as milk during the withdrawal period (Duse *et al*., 2013; Smith *et al*., 2015). In Sweden both organic and conventional dairy farmers feed calves with waste milk but organic farmer in a smaller extent (Duse *et al*., 2013). But in general farmers chose to feed with withdrawal waste milk more often than to feed with treatment waste milk. Dairy companies cannot process milk containing residuals of antibiotics due to the destruction of the natural flora in the milk and to feed calves with waste milk is an alternative instead of discharge it (Smith *et al*., 2015).

Antimicrobial resistance

Today there is no option to exclude antibiotics as a treatment (Wegener, 2003). In parts of the world where a lot of antibiotics are used the AMR is also more prevalent due to the antimicrobial exposure for the bacteria (Kollef *et al*., 1999). Bacteria have a great ability to adapt to its environment and by evolution and selection pressure only the bacteria best suited for the environment survives and replicates (Englund & Greko, 2007). During antibiotic treatment the whole flora of bacteria are exposed to a selection pressure and only bacteria able to mutate or absorb resistant genes survives the treatment. There is an embedded mechanism in bacteria, which includes sharing the DNA with other bacteria, transfer it or copying it, which in turn creates an effective way to transmit resistant genes. That is a part of the mechanism regarding AMR; bacteria with genes resistant to antibiotics survive the antimicrobial treatment. Three common bacteria, that also are zoonotic, that develop AMR are *Campylobacter jejuni*, *Escherichia coli* and *Staphylococcus aureus* and they may cause severe infections (ECDC *et al*., 2009). Methicillin-resistant *Staphylococcus aureus* (MRSA) is the most studied resistant bacteria all over the world.

In human population the culture of travelling, migration and urbanization promotes the transmission of AMR bacteria and transmission over country borders (Wegener, 2003; van

der Bij *et al*., 2012; EMA, 2014). Trading of animals and animal products also has an impact on the spreading of AMR as well as the amount of antibiotics used, stocking rate and hygiene in the stables (Wegener, 2003). The spreading also occurs through manure from other animals, manure in the environment or via direct contact (Englund & Greko, 2007). If several animals are treated at the same time as for example in feed or water the transmission of AMR speeds up (Wegener, 2003).

Antimicrobial resistant genes are identical in humans and animals, which indicates a possible transfer (van den Bogaard & Stobberingh, 2000). A zoonotic transmission of AMR takes act through direct contact between animals and humans or by the food chain (SWEDRES-SVARM, 2013; Skočková *et al*., 2015). The use of antibiotics within veterinary medicine adds to the resistant bacteria transmitted between animals and humans (Bywater, 2004). Resistant genes can also be spread between animals and humans by non-harmful bacteria and not only by pathogens, which can be regarded as a "silent transmission" (Wegener, 2003). The risk of transmission of resistant genes through food decreases when it is cooked properly (Oliver & Murinda, 2012) but there is still a risk if the hygiene is poor because of bacterial transfer from uncleaned tools (Wielinga *et al*., 2014).

Worldwide AMR status in animals and humans

At the same time as there is a negative trend in development of new antibiotics; there is a positive trend in development of AMR (Schwarz *et al*., 2001). There has been a 20% increased notification rate of AMR-bacteria in humans the recent years. In Sweden, the first case of MRSA in animals was detected in 2006 in a dog and since then more than 60 cases have been reported (SWEDRES-SVARM, 2013). During 2012-2013 MRSA have been detected in tested milk seven times and in one of the cases the manager was the carrier of MRSA. In 2013 there were over 30 outbreaks of MRSA with up to 13 cases per outbreak (SWEDRES-SVARM, 2013). Eight cases were detected in animals where six were in companion animals, one horse and one dairy cow. There are large differences in the prevalence of resistant bacteria between countries but globally the occurrence is low in Sweden even though during recent years a resistance against Penicillin has increased (EMA, 2014).

In Sweden the following infections with antimicrobial resistant bacteria are notifiable; methicillin resistant *Staphylococcus aureus*, MRSA, methicillin resistant *Staphylococcus pseudintermedius*, MRSP, extended spectrum beta-lactamases, $ESBL_{CARBA}$, and other methicillin resistant coagulase positive Staphylococci (SJVSFS, 2013:23). If the infection is a MRSA-infection the risk is of a lethal infection is doubled in comparison with an infection with a non-resistant bacteria (WHO, 2003). Elderly people and children are most exposed for infections because of low or not fully developed immune system (Cosgrove *et al*., 2003). What starts as a small bacterial infection can have a lethal outcome due to unsuccessful treatments. According to Cosgrove *et al*. (2003) the number of successful treatments of infectious diseases decreases in the same rate as resistant bacteria multiply.

In the US approximately 55% of the human patients at the intensive care units carries MRSA bacteria (NNIS *et al*., 2003). The MRSA prevalence in the Vietnamese population is about 70% followed by Hong Kong Special Administrative Region, which has a 45% prevalence of MRSA in their population (Song *et al.*, 2004).

Economic aspects

When infections become resistant to first-line treatments, more expensive therapies must be used. The longer duration of illness and treatment, often in hospitals, increases health-care costs and the financial burden to families and societies (WHO, 2011). Antimicrobial resistance is connected to large economical costs, due to, for instance a prolonged stay at the hospital and reduced efficiency of the antibiotics (White, 2011). When human health care receive a risk group person it requires additional costs due to extra personnel, equipment and quarantine (Neidell *et al*., 2012) There are also extra costs when importing animals because of quarantine legislations and testing of the imported animals and also costs because of destruction of animals positive on MRSA-testing (Wallgren *et al*., 2012). Some costs can be avoided if preventive actions are made such as MRSA-testing, correct treatments and also tracing and mapping path of transmission. Berge *et al*. (2005) claims in a study made in US that it is of economic importance that healthy growing animals are given antibiotics because of an otherwise economical loss because of sick animals, high mortality and low weight gain if no antibiotics were given. In EU it is forbidden to feed animals antibiotics in a preventive matter except coccidiostats or histomonostat to poultry and is therefore not an option in livestock production (EG, 2003).

Antimicrobial resistance surveillance

In 2000 the Swedish Veterinary Antimicrobial Resistance Monitoring Program (SVARM) started and it is responsible for surveying antimicrobial resistance in animals in Sweden (SWEDRES, SVARM, 2013). When resistant bacteria are found SVARM gives advice on how to handle it and how to treat it. The program covers three levels of surveillance; indicator bacteria, bacteria causing zoonosis and clinical isolates from several animals. The report from SVARM is together with SWEDRES program data from the human medicine distributed from the Public Health Agency of Sweden (FoHM) and gathered in the report SWEDRES-SVARM-report.

There is an ongoing AMR surveillance worldwide (SVARM, 2013). In Europe five of the organizations handling the surveillance of AMR are the Community Network for Epidemiological Surveillance and Control of Communicable Diseases and European Antimicrobial Resistance Surveillance (EARSS), Enter-net, EuroTB and Hospitals in Europe Link for Infection Control through Surveillance (HELICS). EARSS started in 1999 and survey AMR on national bases in 28 countries in Europe and all work that is done is mostly made in laboratories. Health authorities in Sweden have mandate from the government to survey the development of AMR, update a joint plan of action and add a plan of communication out to the society (SVA, 2014).

Factors affecting the use of antimicrobials in livestock production

Regulations

Conventional dairy farmers

Milk produced in the EU is only allowed to be delivered to the dairy company from cows in good health with no visual signs of disease and no wounds at the udder affecting the quality of the milk (EG, 2004). Milk from a dairy cow with mastitis is only allowed to be used for human consumption after agreement with the veterinarian. During a treatment and before the end of the withdrawal period milk from a cow cannot be used for human consumption.

Farmers are required to make sure that unpasteurized milk or milk containing levels of antibiotic residuals over the limit for different antibiotics or the totally allowed level is not delivered from the farm (SJV, 2014a). In the EU, farmers are not allowed to give antibiotics for a preventive purpose. Animals are only allowed to get treatments if it is necessary because the animal is sick and only as prescribed by a veterinarian. There is withdrawal period for milk for human consumption when using medical treatments, which is determined by the authorities (SLV, 2012). Withdrawal periods have been set to avoid the risk of medicine residuals in foodstuff (SJV, 2014a). In Sweden three authorities are responsible for veterinary drugs, and these are the National Food Administration, the Food and Drug Administration and the Swedish Board of Agriculture. The Food and Drug Administration provide the approval of drugs for animals. The Swedish Board of agriculture is responsible for the use and the National Food Administration is responsible for food safety.

EU-organic farmers

The definition of organic production is according to the EUs' council the use of methods for production, which agrees with the regulation determined in this constitution in all stages of production, preparation and distribution (EGR, 2008). In agriculture, the goal for organic production is to implement a sustainable management, protecting the nature's eco system and at the same time maintaining animal health, quality of the water and soil and soundness in plants. Organic production should also contribute to a large biodiversity and use nature resources in a respectful way. When it comes to animal welfare organic production fulfills strict requirements and specific need for each species. Organic products should keep a high quality meeting the consumers demand.

Organic production cannot involve gene-modified (GMO) products and only naturally derived substances are allowed in organic production but veterinary medical remedies are an exception (EGR, 2008). Animals in organic production should be held on suitable size in stable and with a suitable stocking rate. To prevent animals from suffering, and protect human health, sick animals should be treated immediately, and antibiotics and other veterinary medical treatments are allowed. There are, however, limitations regarding treatments and period of withdrawal. The EU only sets the minimum limit, but individual members are allowed to implement stricter regulations for organic production.

Preventive medical treatments are forbidden in EU, including antibiotics (EG, 2008). It is forbidden to use hormones and other substances to control reproduction. Animals or animal products are not allowed to be marketed as organic if the animals have been treated with antibiotics or synthetically produced veterinary medical treatments more than three times or, if the animals' life-span is shorter than 12 months; have been treated more than once. There must be an available register of the treatments for control bodies and the treated animals should be marked clearly. Withdrawal period for veterinary medical treatments for organic livestock is twice the determined withdrawal period in EG2001:82 for animal production and if there is no set period it is always 48 hours.

KRAV, the Swedish organic certification association

The organic regulations in Sweden is set by KRAV, the Swedish organic certification association (KRAV, 2015). Farmer has to follow rules and regulations set up by KRAV to be a certified KRAV-producer and to label his products with the label KRAV. The withdrawal period for treated KRAV-certified livestock is twice the time for treated conventionally livestock. If the withdrawal period is zero days for a certain medicine for a treated

conventionally produced animal, the withdrawal period for a KRAV-certified animal is automatically two days (KRAV, 2015). If the animal has been treated three times or more during a year it gets a withdrawal period for 12 months before milk from that particular cow can be seen as KRAV-certified again (SJV, 2014b).

Swedish organic farmers can only feed milk from the treated cow to its' own calf during the withdrawal period (KRAV, 2015). After the withdrawal period, milk from the treated cow can be fed also to other calves. This also includes milk from a cow treated several times needing an additional period of withdrawal. Organic farmers are not allowed to treat animals on a regular basis as preventive actions, although analgestic and anesthesia are allowed in organic livestock production.

Veterinarian work

Swedish veterinarians have a policy for the use of antibiotics in livestock production compiled by the Swedish Veterinary Association (SVS, 2013). The policy is to only treat noted bacterial infections, strive to use narrow spectrum antibiotics, make an etiological diagnose and testing for resistance before treatment, and if a group treatment is necessary an etiological diagnose is required and if the veterinarian notice a high or deviant use of antibiotics on herd level an investigation about the cause of it is needed. The goal is to practice a low usage of antibiotics and also controlled within livestock production in order to reduce the development of AMR.

The Swedish Board of Agriculture has regulations regarding a hygiene plan, which were implemented in 2014 in Sweden. The hygiene plan (SJVFS 2013:14, K112) promotes a responsible hygiene strategy in livestock production included in all veterinary work. The hygiene plan exists to reduce the paths of transmission of AMR, improve the work-environment for the staff and to improve the quality of the animal welfare. The hygiene plan encourages having a manager at the farm responsible for the hygiene work. One in the staff should be responsible for the hygiene plan is being followed and that the plan is formed after the current status at the dairy farm, to have set daily routines and to continue the work of improvement. (SVA, 2014).

Biosecurity and preventive actions

Instead of treating animals with antibiotics a good hygiene, avoiding modes of transmission and having a good livestock husbandry, is a better way to keep animals healthy (Wegener, 2003). Several strategies were set up to reduce the use of antibiotics in a Danish study (Bennedsgaards *et al*., 2010), which included adapted ventilation and possibility for the animals to breath fresh air, high hygiene in the stables and especially high quality and easily cleaned stable floors. Mastitis is a large issue in dairy herds, which requires antibiotics but which can be reduced by 40% by a strict and judgmental evaluation of the actual effect of the treatment whether or not it is necessary (Aarestrup *et al*., 2004). To prevent mastitis and to keep the level of used antibiotics low there has to be good hygiene at milking stations and in the stable (Bennedsgaards *et al*., 2010).

Having cows with blind quarters were earlier associated with poor management for udder health in dairy herds (Bennedsgaards *et al*., 2010; Vaarst *et al*., 2002; Vaarst *et al*., 2006;). Now a change in farmers' attitude has made blind quarters to a strategy for reducing treatments with antibiotics and possibly reducing AMR. Farmers know a lot about preventive

strategies in order to avoid antibiotic treatments for udder infections for specific animals (Vaarst, *et al.,* 2002). According to Vaarst *et al*. (2002) if there are a lot of udder infections the farmer wants the antibiotic treatment mainly to decreases the somatic cell counts (SCC) rather than treating an animal in pain. Making farmers aware of the antibiotic treatments in their herd and introducing preventive routines in the daily management it can reduce the use of antibiotics by 50% in one year (Bennedsgaards *et al*., 2010).

Economic aspect

Dairy cows are sensitive for infections before and after calving and the most common bacterial infections are mastitis or Phlegmona interdigitalis, which requires antibiotic treatment. For calves diarrhea and infections in the respiratory tract are the most common bacterial infections requiring treatment with antibiotics. For the farmers it is both direct treatment and veterinarian costs but also in-direct and long-term costs in terms of reduced milk production and reduced growth. The total cost for the cases of illness is in long term higher than the direct costs because of extra work due to preventive actions, the risk of transmission to other animals, other diseases, mortality and reduced reproduction. (Wallgren *et al.,* 2012).

Labor costs are a great and important factor for the dairy farm, which is why it is important with effective daily routines to minimize additional costs for time-consuming labor. When rebuilding in an existing stable, the construction plan is limited compared to a new built stable, which makes it important to build or rebuild properly from the beginning to avoid routine problems, time consuming activities and poor work environment for both the staff and the animals. Animals may be injured or more easily caught a bacterial infection if the interior design is poor or not adapted for the animals' natural behavior and needs, which in turn requires treatment with antibiotics. A cheap building solution can in a long-term perspective be expensive due to extra work or animals more frequently getting sick or injured. All farms are unique and one preventive solution may not be the solution for another dairy farmer. Management decision has an important role to reduce the risk of diseases and in turn reduce the use of antibiotics. The cost for treating animals can be avoided and will give the positive effect of reducing the use of antibiotics and reduce the transmission of AMR. (Wallgren *et al*., 2012).

Attitude

Psychology behind attitudes

Attitude has been shown to be the most essential in predicting actions from a person (Garforth *et al*., 2004). Attitudes influences a persons perspective of the world and everything around her, all her thoughts and what she does. To predict a certain behaviour the persons attitude has to be investigated. An attitude can be explained by an evaluative judgment whether or not the person dislike or like the, for example, object or person. An attitude varies in direction and strength, which means the attitude can be positive, negative or neutral and very positive or only slighty positive for example. The theory of planned behaviour (TPB) presented the concept perceived behavioural control (PBC), which means the persons conviction in performing the behaviour (Ajzen, 1991). The PBC have an impact on both the intention and the particular behaviour and together with TPB also a strong prediction level of explaining and foreseeing certain behaviors (Armitage & Connor, 2001). Several traits of a persons personality were identified for playing a major role for explaining and predicting the

behaviour (Willock *et al*., 1999). Not only the personality but also other personal factors, current life situation and traditions creates a persons behaviour (Fishbein & Ajzen, 2005). An attitude is shaped after that several convictions are established regarding control of intentions and normative thinking (Ajzen, 1991).

From attitude to action

A person's behaviour to actually do something can be predicted by a combination of the person's norms and the motivation to the behavior (Fishbein & Ajzen, 2005). The intention is the first step to perform a behavior, where the intention is predicted from the person's own attitude to the behavior (Ajzen, 1991). The persons' intention or attitude can either be strong or weak, which influence the outcome of the behaviour (Fishbein & Ajzen, 2005). By knowing a person's attitude towards a particular behaviour a prediction can be made if the person performing the behaviour or not. A positive attitude for the activity is often correlated with a high motivation and it is highly believable the person performs the behaviour. The persons' attitude originates from its believing in norms, believing in the behavior and possibility to control the behavior (Ajzen, 1991). People's norm also play a major role in behaviour; if a person has the perception that people around her wants her to behave or act in a certain way she will most likely do so (Fishbein & Ajzen, 2005). A persons' background factors such as individual – personality, mood, emotion, intelligence, values, stereotypes, general attitudes and experience, social – education, age, gender, income, religion, race, ethnicity and culture and information sources – knowledge, media and intervention plays an important role in that persons' behavior (Ajzen, 1991). If a person is interested in the specific topic or activity it is more likely to take action according to the attitude. Attitude can also be a low valued motivator for single behaviors. A negative attitude can be created if the predicted benefits are much less than the predicted disadvantages for a certain action. A behavior cannot on the other hand show a persons' attitude (Fishbein & Ajzen, 2005).

Farmers' attitude and management

Socio-psychological factors have a greater impact on the management style than the actual management itself (van der Borne *et al.*, 2014). For example awareness of costs for clinical mastitis and what preventive actions that can be made increase the motivation for farmers more to work for a better udder health in the herd. Fulfillments at work is an important factor in the decision making progress (Bergevoet *et al.*, 2004; Valeeva *et al*., 2007). But economic factors were the most important consideration when making a decision on the farm and the second most important was animal welfare while the farmers' image and sense of proud were not that important (Alarcon *et al*., 2013; Bruijnis *et al.*, 2013). The efficiency of the control measures, the risk of disease, former experience, reliable advices and sources of information and the companies features were the most important factors behind the farmers' decision-making (Garforth *et al.*, 2013). A Dutch study from 2013 showed that accomplishment of improving herd health were one of the important motivators for taking action, simultaneously with reduced costs for treating animals (Bruijnis *et al.*, 2013). The issue of the actual efficiency of the labor was one thing preventing farmers from taking action. Farmers thought they had adequate knowledge for improving herd health as well as economic resources. Other motivation factors were sick animals, reduced animal performance and mortality levels (pigs) (Alarcon *et al*., 2013). These factors were also connected to an economical factor for disease control because healthy animals give more profit. Farmers' attitude and management is important when observing farm performance and in order to give advice in increasing farm performance the farmers' perception should first be analyzed (Bigras-Poulin *et al*., 1985).

Three factors regarding attitude are the own conviction, uncertainty and principles (Alarcon *et al*., 2013). The first is how convinced the farmer is that the behaviour and management works and how effective it is. This in turn could be influenced by another farmers' sharing of a positive similar experience, explanation from the veterinarian, common sense in animal husbandry or control strategies based on good husbandry. Former own experience also influence the attitude and the trust in the veterinarian. Farmers' uncertainties also have an impact on the behaviour; if there is lack of knowledge in the area or no proof of that the management is working it can have different outcomes. Farmers often have strong principles, which are followed in decision-making. Weather the farmers have control or not have an impact – there is an outcome evaluation. Not sharing information and experiences with other farmers were seen as a problem because farmers believe and trust each other's experience a lot.

To find reasons to explain farmers' behaviour their risk management strategies were investigated (Valeeva *et al*., 2011). The strongest reason to predict the behaviour were that farmers had own former positive experience from certain management. A dairy farmer's behavior can be explained by his perception, ambition and intentions, which also reflects the farmers' entrepreneurial characteristics (Bergevoet *et al.,* 2004).

Factors influencing the attitude of farmers towards pain and treatment of cattle are preventive trimming of claws that were connected to the farmers' ability to estimate the cows' pain (Becker *et al*., 2014). Visualizing the cow in pain during the decision-making influenced the decision to treat the animal or not. And the longer the farmer had worked with dairy cows the more negligent towards using local anesthesia when an animal might be in pain the farmer was. Some farmers estimated a maximum level of cost for treating the cows' sole ulcer and chose to not give local anesthesia more often than other farmers. Farmers who examined the cows claws by themselves estimated the pain level lower than farmers using a claw trimmer more frequently. Farmers' characteristics have an impact on the decision-making regarding culling criteria (Beadueau *et al*., 1996). The style of management and the farmers' social status regarding number of relationships with external advisors and people in that profession played a major role when deciding to cull or not.

A change in the farmers' knowledge and perception can change their actual behavior (van der Borne *et al.,* 2014). This influences the farmers' management style and is of the same importance as if and how the action is actually performed. Farmers from the Netherlands participated in a study with a program controlling cases of clinical mastitis in the herd. Farmers answered questionnaires about their own attitude and knowledge about mastitis in the beginning of the study and in the end of the study five years later where a change in their attitude could be seen. Making farmers more aware of things and management in stables that matters to the udder health also changed their attitude and indirect their behavior (van der Borne *et al.,* 2014).

The farms' reputation of other farmers was very important since selling healthy animals to other producers is needed (Alarcon *et al*., 2013). Selling a sick animal gives a bad reputation, fewer animals sold and less profit. The fear of an infectious disease spreading from an infected farm makes other farmers to work more preventive. The veterinarian also influence the farmers to improve disease control when putting numbers on it, for instance when it is more cost effective to vaccinate or not. The farmers trusted their veterinarian and the advice they were given (Visschers, *et al.*, 2014). When it came to improving foot health claw trimmers and advisors were higher trusted than veterinarians for advice (Bruijnis *et al.*, 2013).

A reduction of treatment by a veterinarian in dairy herds was dependent on the attitude of the farmer in a Norwegian study (Valle *et al*., 2007). A low number of treatments for metritis was linked to personnel only working at farm and nowhere else, a good economic sense, the number of personnel were average and motivation to risk the value in farm (Bigras-Poulin *et al*., 1985). It is important to take into account the farmer's attitude when the performance on farm is explained. The farmers' awareness of what risk comes with use and especially overuse of antibiotics can affect the actual use (Visschers *et al*., 2014). Pressure from the slaughterhouse and contractors is also a motivator (Alarcon *et al*., 2013). Some pressure from the government also had an impact when it came to food borne diseases.

Pig farmers' attitude towards antibiotic use were investigated in 2014 and when asked how much antibiotics were used at their farm their perception was that it was lower then the national average which also was the case when checking the actual usage level (Visschers, *et al.*, 2014). It was shown that the use of antibiotics decreased when farmer first consulted a veterinarian before treating a sick or suspicious sick animal. The pig farmers were also aware of the risks with antibiotics and thought it was not necessary to use as much as they did in their production. The more aware of the risk with antibiotics the farmer were the higher were also the farmers' perception of the impact of antibiotics. If the farmers' own perception of the usage of antibiotics were higher than the national average they got less affected from economical measures. By regularly recording the drug use, farmers had an even higher perception of the impact from antibiotics. Recording of drug use at farm tended to increase the use of antibiotics at the same time as farmers- and farm characteristics and attitudes towards antibiotics showed no relation to use of antibiotics (Visschers, *et al.*, 2014).

Material and methods

Interviews and questionnaire

A draft of a survey with questions regarding the use of antibiotics, antimicrobial resistance, animal welfare and management was made in Netigate and discussed with the supervisors, veterinarians and professors from the Swedish University of Agricultural Sciences, SLU, National Veterinary Institute, NVI, Växa Sverige and personnel at Kvalitetssystem Sigill AB before tested on three animal science students at SLU. Changes were made before the survey was tested on ten dairy farmers by personal interviews and by emailing. After modifications the survey (Appendix 1) was finished. A total of 800 dairy farmers; 300 organic farmers and 500 conventional farmers, got a postal survey with 200 questions regarding the use of antibiotics, antimicrobial resistance, animal welfare and management. The goal was to get 200 responses from the survey, which corresponds to approximately 4.5% of the total number of Swedish dairy farmers in 2014 (LRF Mjölk, 2016a). According to statistics every third farmer in Sweden was above 65 years old in 2013 and the age range between 45-55 and 55-65 years old was the most common among farmers (SCB, 2013).

Recording of data

The survey was posted in the beginning of June 2014 by Växa Sverige, which is the largest national livestock association in Sweden providing service and advice to dairy and cattle farmers, and their register of addresses to dairy farmers in order to keep the survey responses anonymous. Together with the survey a letter (Appendix 2) about the study inviting the farmers to voluntarily participate, a letter (Appendix 3) from Växa Sverige regarding their involvement providing the farmers' addresses to the study and a business reply mail was sent.

In September 2014 a postcard (Appendix 4) was sent to all the 800 dairy farmers thanking them for participating in the survey and also reminding those who had not yet responded to fill in the survey and that it was possible to do so online. A note about the survey was also put out in the Swedish agricultural magazine Land Lantbruk in order to get more responses.

Data handling and statistical analysis

In October 2014, after last answering date, all data from respondents were entered manually in Netigate. Ten surveys were randomly chosen after the manual data entering for an extra control of the recorded data, but no errors were found. Cross tabulations were made in Netigate with organic farmers' answers and conventional farmers' answers in order to get an overview of the answers. The data from Netigate were then transferred to Minitab16 for statistical analyzes. As far as possible all statistics were cross-tabulated between organic farmers and conventional farmers' answers. A parametrical Kruskal-Wallis was used for determination of the statistical significant differences on the questions where farmers had to give an answer in ratings between 1 and 6. For questions with Yes and No answers and True or False answers a Fishers' exact or Chi-2 test was made for the statistical analysis, where the answer alternative "Do not know" was excluded from the calculations. Questions where only percentage and arithmetic means were of interest calculation of descriptive statistics were made.

Results

Of the 800 farmers 198 farmers responded on the survey, but seven had to be excluded from the study due to not responding if they were an organic or conventional farmer, which was essential for this study. That left 191 surveys to analyze corresponding to a response rate of 23.9%. Of the respondents 47% were organic farmers and 53 % were conventional farmers.

Descriptive statistics

The age of the respondents had a range of 49 years for organic farmers with a lower median than for conventional farmers as presented in table 1. The age range for conventional farmers was 47 years and approximately 75% of all the respondent was older than 44 years old. From statistics by SJV in 2014 approximately 67% of the farmers in 2013 were between 45-64 years old and were 34% of the men were between 55-64 years old and 36% of the women were between 45-55 years old. The range for years in profession was larger for conventional farmers than for organic farmers and the median for number of cows was higher for organic farmers. The range for the herd size was larger for organic farmers than for conventional farmers compared to the national average which was 78 cows in 2014 (SJV, 2016) and 80.5 for the herds that are members of the Milk recording (Växa Sverige, 2015).

Table 1. Descriptive statistics of basic fact for organic and conventional farmers

Variables	Organic (N = 84-90)[a] Median (min-max)	Conventional (N = 90-101)[a] Median (min-max)
Age, years	50 (20 - 69)	53 (23 - 70)
Years in profession	25 (4 - 45)	30 (1.5 - 77)
Herd size	80 (40 - 460)	75 (25 - 400)

[a]Number of observations vary between questions

In table 2 descriptive statistics over basic facts for the respondents are presented. The majority of the respondents were males and according to statistics 93% of the Swedish farmers in 2013 were men (SJV, 2015). Most of the respondents were living in the middle, east or west province of Sweden. In 2014 approximately 30% of Swedish dairy farmers lived in the east province, 23% in the west and 17% in the middle province (LRF Mjölk, 2016b). The owner of the farms was the majority of the respondents for both categories. In relationship to the statistics for the agricultural holding the majority of the people working at farms are employed and approximately 28% are the owners of the farm and also working on it (SJV, 2015). In the study the majority of the respondents for both organic and conventional farmers were working full-time at the dairy farm. In statistics from 2013 approximately 95% were working full time at dairy farms (SJV, 2015).

There was a difference in what milking system the farmer had where organic farmers had more AMS and conventional farmers had more tie-stalls. There was also a statistically significant difference between post-secondary school educations where organic farmers had the education in a larger extent than conventional farmers. Respondents from nine of Sweden's 19 dairy companies participated in the survey where almost two thirds had Arla and the second-most respondents had Skånemejerier as their dairy. The national distribution of respondents geographically is that the major part of farmers lives in the west, south and eastern part of Sweden (SJV, 2016). The major part of the respondents was the farmer working full-time at the farm and the national statistics shows that the major part of the farmers in Sweden work part-time (SJV 2014c; SJV 2014d).

Table 2. Descriptive statistics for organic and conventional farmers' background facts

Variables	Category	Organic (N=80-90) [b] %	Conventional (N=93-101) [b] %	*P*-value[a]
Gender	Female	44.4	42.6	0.884
	Male	55.6	57.4	
Geographical distribution	North province	4.4	9.0	0.102
	Middle province	31.2	18.0	
	Stockholm-Gotland province	3.3	5.0	
	East province	27.8	27.0	
	West province	27.8	26.0	
	South province	5.5	15.0	
Role at dairy farm	Owner	82.2	88.1	0.551
	Employed foreman	7.8	4.0	
	Employed stockman	7.8	5.0	
	Other	2.2	3.0	
Working time	Full-time	73.3	82.2	0.163
	Part-time	26.7	17.8	
Milking system	Parlour	36.2	27.9	0.246
	AMS	47.9	28.9	
	Rotary	2.1	1.9	
	Tie-stall	13.8	41.4	
IP Sigill Mjölk Certifiering	Yes	32.5	30.1	0.745
	No	67.5	69.9	
Turnover from dairy farming	<50%	2.2	5.9	0.884
	51-75%	14.4	22.8	
	>75%	81.1	68.3	
	Do not know/no answer	2.2	3.0	

Elementary agricultural school education	Yes	75.0	62.4	0.085
	No	25.0	37.6	
Post-secondary school education	Yes	62.1	46.5	0.039
	No	37.9	53.3	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions

Perception of professionals

The farmers' perception of their veterinarian and livestock production advisor can be seen in table 3. There was no statistical significant difference between organic and conventional farmers' perception, but it seems as if both groups had more confidence in the advice given from the veterinarian than from the livestock production advisor.

Table 3. Respondents ratings between 1 - 6 for how much they agree with the statements regarding veterinarians and advisors, where 1 is "I do not agree at all" and 6 is "I agree completely"

Variables	Organic (N=82-90)[b]		Conventional (N=89-100)[b]		*P*-value[a]
	Median (min-max)	Mean	Median (min-max)	Mean	
The herds' main veterinarian only prescribes antibiotics after examination of the animal needing it.	6 (1 - 6)	5.4	6 (3 - 6)	5.5	0.766
The herd's veterinarian has a lot of knowledge and is interested in dairy cattle production diseases.	6 (1 - 6)	5.6	6 (3 - 6)	5.7	0.676
I have full confidence for the advice the herds' veterinarian is giving.	6 (5 - 6)	5.5	6 (5 - 6)	5.6	0.844
I have full confidence for the advice the herds' livestock production advisor is giving.	5 (1 - 6)	5.0	5 (2 - 6)	5.0	0.806

[a]Kruskal-Wallis
[b]Number of observations vary between questions

Management

Both categories of farmers thought the same regarding source of information about animal health in general and for animals in acute phase (table 4). The majority of the farmers did not have a separate pen only used for sick animals. Calves were fed with milk during withdrawal period from the majority of the farms but not from the majority during treatment of the cow. Several farmers wrote a note here saying milk during treatments was only fed to bull calves.

Table 4. Descriptive statistics for organic and conventional farmers regarding management at farm

Variables	Category	Organic (N = 90)[b] %	Conventional (N = 100-101)[b] %	*P*-value[a]
Visits from livestock production advisor	1/week	1.1	0	0.906
	1/month	33.3	38.6	
	1/2month	10.0	10.9	
	3-4/year	14.4	10.9	
	1-2/year	23.3	16.8	
	1/2year	7.8	8.9	
	Never	10.0	15.6	
Keeping own notes of treated animals	Yes	91.1	83.0	0.189
	No	8.9	16.0	
	Do not know	0.0	1.0	
Top five most used source of information for animal health in general	Veterinarian	35.1	45.6	[cd]
	Own knowledge	31.4	37.7	
	Livestock compounds	30.9	33,0	
	Other dairy farmers	25.1	26.2	
	Livestock advisor	24.6	29.3	
Top five most used source of information for animal in acute phase	Veterinarian	45.0	49.2	[cd]
	Own knowledge	37.7	44.0	
	Other dairy farmers	19.4	26.6	
	Livestock advisor	16.7	14.7	
	Coworkers at the farm	13.6	21.5	
Sick-pen used only for sick animals	Yes	38.9	34.7	0.652
	No	61.1	64.3	
	Do not know	0.0	1.0	
Milk from cow under antibiotic treatment	Disposed in manure channel	17.8	13.9	0.551[de]
	Disposed in culvert	27.8	21.8	0.401[de]
	Disposed in manure pit	30	29.7	1.000[de]
	Disposed in sewer	17.8	10.9	0.213[de]
	Fed to calves	21.1	33.7	0.074[de]
	Others	2.2	10.9	0.021[de]
Milk from cow after antibiotic treatment with withdrawal period	Disposed in manure removal system	11.1	8.9	0.636[de]
	Disposed in culvert	16.7	13.9	0.687[de]
	Disposed in manure pit	15.6	17.8	0.703[de]
	Disposed in sewer	11.1	7.9	0.469[de]
	Fed to calves	58.9	59.4	1.000[de]
	Others	10	14.9	0.384[de]

[a]Fishers'/Chi-2
[b]Number of observations vary between questions
[c]Separate ordering and no statistical comparison
[d]Multiple answers allowed
[e]Pairwise comparisons between the answers "yes" and "no" for each response to the question

In table 5 farmers' ratings for management decisions when a calf shows signs of diarrhea are presented, where number 1 means that the farmers never do and number 6 that the farmer always do. The farmers had to rate their own management. The difference was statistically significant between organic and conventional farmers' management regarding waiting and contacting the veterinarian earliest after 1-2 days where organic farmers did that in a larger extent than conventional farmers. There was no statistically significant difference for the other management alternatives between organic and conventional farmers because they had the same top five most important things to keep animals healthy

Table 5. Respondents ratings between 1 - 6 for how often they perform the statements regarding management when a calf shows sign of diarrhea, where 1 is "never" and 6 is "always"

Variables	Organic (N=85-89)[b]		Conventional (N=99)		*P*-value[a]
	Median (min-max)	Mean	Median (min-max)	Mean	
Isolate the calf	3 (1 - 6)	3.6	3 (1 - 6)	3.2	0.138
Controls the calf's body-temperature	4 (1 - 6)	4.3	4 (1 - 6)	4.2	0.739
Controls the calf's general condition	6 (2 - 6)	5.6	6 (4 - 6)	5.7	0.196
Give the calf extra heat blanket, litter/heat-lamp	4 (1 - 6)	4.0	4 (1 - 6)	4.0	0.919
Give the calf water/fluid replacement	6 (1 - 6)	5.5	6 (1 - 6)	5.5	0.983
Contact the veterinarian	2 (1 - 5)	2.3	2 (1 - 5)	2.1	0.474
Wait and contact the veterinarian earliest after 1-2 days	4 (1 - 6)	3.8	3 (1 - 6)	3.3	0.029
Contact the veterinarian only if the calf has a fever/the general condition is affected	5 (1 - 6)	4.7	5 (1 - 6)	4.6	0.694

[a]Kruskal-Wallis
[b]Number of observations vary between questions

The rating of management decisions when a cow shows signs indicating subclinical mastitis are given in table 6. There was a statistically significant difference in contacting the veterinarian where conventional farmers do it more often than organic farmers. The farm types did not differ with respect to milking the cow separately and/or last in line, which both organic and conventional farmers almost always did. Both groups of farmers always milk the inflamed quarter thoroughly when suspicious signs of subclinical mastitis, almost always control the somatic cell counts (SCC), treats the cow during the planned dry period, examines all quarters with California Mastitis Test (CMT), culls the cow if the SCC remains high after antibiotic treatment and continues to milk on three quarters if the SCC is still increased after antibiotic treatment. It was unusual to put the cow in a single pen for both organic and conventional farmers.

Table 6. Respondents ratings between 1 - 6 for how often they perform the statements regarding management when a dairy cow shows suspected signs of subclinical mastitis, where 1 is "never" and 6 is "always"

Variables	Organic (N=88-90)[b]		Conventional (N=97-100)[b]		*P*-value[a]
	Median (min-max)	Mean	Median (min-max)	Mean	
Puts the cow in a single pen	1.5 (1 - 6)	2.1	2 (1 - 6)	2.2	0.277
Contacts the veterinarian	2 (1 - 6)	2.3	2 (1 - 6)	2.8	0.039
Control the cell count of the milk	5 (1 - 6)	5.0	5 (1 - 6)	4.8	0.530
Contact the veterinarian earliest after 1-2 days	4 (1 - 6)	3.5	3 (1 - 6)	3.4	0.684
Dry up the inflamed quarter and milk the other quarters as usual	4 (1 - 6)	3.5	3 (1 - 6)	3.2	0.105
Control the herds' cell count	5 (1 - 6)	4.9	6 (1 - 6)	5.1	0.183
Chose to milk that cow separately and/or last in line	5 (1 - 6)	4.5	5 (1 - 6)	4.9	0.059
Sends the milk for bacteriological analysis	4 (1 - 6)	3.4	3 (1 - 6)	2.9	0.061
Dry off the cow earlier than planned (the whole udder) and treat the cow while on dry period	4 (1 - 6)	3.3	3 (1 - 6)	3.2	0.604
Treat the cow during the planned dry period	5 (1 - 6)	4.6	5 (1 - 6)	4.7	0.429
Examine all quarters with California Mastitis Test (CMT)	5 (1 - 6)	5.0	5 (1 - 6)	4.8	0.905
Increase cow-comfort by adding more litter/straw to the cubicles/pen/deep straw beddings	3 (1 - 6)	2.9	3 (1 - 6)	3.2	0.214
Milk the inflamed quarter properly	6 (2 - 6)	5.3	6 (1 - 6)	5.3	0.661
Do not inseminate that cow and cull it at next planned dry off period	4 (1 - 6)	3.9	4 (1 - 6)	3.9	0.705
Cull the cow immediately	2 (1 - 5)	2.1	2 (1 - 5)	2.2	0.588
Cull the cow if the antibiotic-treatment does not work	4 (1 - 6)	4.0	5 (1 - 6)	4.3	0.143
If the cell count remains increased after treatment with antibiotics; the cow is then culled	5 (1 - 6)	4.5	5 (1 - 6)	4.6	0.725
If the cell count remains increased after treatment with antibiotics; milking continues on the three healthy teats and not on the one giving high cell counts.	5 (1 - 6)	4.3	5 (1 - 6)	4.4	0.695
Continue to milk the cow and treats the animal during the planned dry off period.	4 (1 - 6)	3.8	4 (1 - 6)	4.07	0.180
Milk the cow with frequent intervals	4 (1 - 6)	4	4 (1 - 6)	4.07	0.757

[a]Kruskal-Wallis
[b]Number of observations vary between questions

Preventive actions for maintaining animal health

In table 7 the farmers' action plan for preventive actions to maintain animal health is presented. No statistically significant difference for the preventive actions could be found. Both organic and conventional farmers had the same top five most important things to keep animals healthy.

Table 7. Descriptive statistics for organic and conventional farmers preventive actions in order to keep animals healthy

Variables	Category	Organic (N=89-90) [b] %	Conventional (N=100-101) [b] %	*P*-value[a]
Check the climate in the stable	Not done	15.6	12.0	0.720
	Would like to do	18.9	22.0	
	It is done	65.6	65.0	
	Do not know	0.0	1.0	
Check interior in stable to be adapted for animal size and need	Not done	8.9	10.0	0.706
	Would like to do	10.0	13.0	
	It is done	81.1	74.0	
	Do not know	0.0	3.0	
Let visitors only use clothes and shoes belonging to the farm	Not done	3.4	8.0	0.296
	Would like to do	23.6	18.0	
	It is done	73.0	72.0	
	Do not know	0.0	2.0	
Closing farm from others than veterinarians, advisors and family members	Not done	60.0	44.6	0.113
	Would like to do	26.7	34.7	
	It is done	13.3	19.8	
	Do not know	0.0	1.0	
Regular cleaning and disinfection of stable	Not done	0.0	1.0	0.966
	Would like to do	4.4	3.0	
	It is done	95.6	94.0	
	Do not know	0.0	2.0	
Five most important things to keep animals healthy	To have alert staff	96.3	85.2	[cd]
	Set routines in the daily management	100.0	81.2	
	Preventive actions	90.1	69.3	
	Extra care and supervision of a suspected sick animal	74.1	69.3	
	Fast treatment of diseases	40.7	43.6	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions
[c]Separate ordering and no statistical comparison
[d]Multiple answers allowed

The farmers' perception about preventive management is shown in table 8 where it is a statistically significant difference that conventional farmers agree more than organic farmers to the statement regarding the necessity of reducing the antibiotic usage compared to if other farmers do not. Conventional farmers also agree a little, but significantly, more than they do not see a need to reduce the number of treatments in their herd than the organic farmers. Organic farmers agree more than conventional farmers that a penalty should be given together with demands to reduce the antimicrobial use if the usage of antibiotics in a herd is higher than a predetermined level. It is also a statistically significant difference that organic farmers agrees more with the statement that an animal owner should be responsible to form a plan together with a veterinarian on how to reduce the use of antibiotics in their herd to a certain level than conventional farmers. The opinion did not differ in if they plan to reduce the number of treatment of sick animals in their herd, although it was a borderline significant difference. The same holds for the statement that it makes no difference if a lot of antibiotics were used in their herd, as long as other Swedish producers do not reduce their use of antibiotics.

Table 8. Organic and conventional farmers' ratings between 1 - 6 for how much they agree with statements regarding preventive management and the use of antibiotics, where 1 is "I do not agree at all" and 6 is "I agree completely"

Variables	Organic (N=89-90)[b]		Conventional (N=99-100)[b]		*P*-value[a]
	Median (min-max)	Mean	Median (min-max)	Mean	
I want to prevent disease in a larger extent.	6 (1 - 6)	5.5	6 (1 - 6)	5.3	0.105
I plan to reduce the number of treatments of sick animals in the herd I work in.	5 (1- 6)	4.4	4 (1 - 6)	4.0	0.056
It is meaningless to reduce the use of antibiotics in the herd I work in as long as other dairy farmers in Sweden do not try to reduce their use of antibiotics.	1 (1 - 6)	1.6	1.5 (1 - 6)	2.0	0.022
I do not see why the number of treatments need to be reduced in the herd I work in.	1 (1 - 6)	2.2	2 (1 - 6)	2.8	0.006
The number of treatments in the herd I work in is not a problem.	4.5 (1 - 6)	4.1	5 (1 - 6)	4.1	0.968
A reduction of the use of antibiotics in the herd I work in has a low impact for the rest of the world.	4 (1 - 6)	3.3	3 (1 - 6)	3.4	0.730
I think it is important to reduce the number of treatments with antibiotics in the herd I work in.	5 (1 - 6)	4.8	5 (1 - 6)	4.8	0.740
I want a dairy cow with sub-clinical mastitis to be treated during her dry off period.	5 (1 - 6)	4.5	5 (1 - 6)	4.9	0.143
Even if a lot of antibiotics are used in the herd I work in, it makes no difference as long as other Swedish producers do not reduce their use of antibiotics.	1 (1 - 6)	1.7	1 (1 - 6)	2.1	0.051
If the use of antibiotics in a herd is higher than a predetermined level penalty and requirements of reduced usage should be required.	3 (1 - 6)	3.2	1 (1 - 6)	2.2	0.001
Animal owner should be responsible to form a plan together with a veterinarian of how to reduce the use of antibiotics in their herd to a certain level.	4 (1 - 6)	3.8	3 (1 - 6)	3.1	0.002
A dairy cow with high cell counts should be treated with antibiotics immediately.	1 (1 - 5)	1.6	1 (1 - 6)	1.8	0.996

[a]Kruskal-Wallis
[b]Number of observations vary between questions

Treatments

In table 9 results for questions regarding treatments at farm are presented. There was a statistically significant difference regarding herd veterinarian, which organic farmers had in a larger extent than conventional farmers. Only five organic farmers answered the question about homeopathy and only nine conventional farmers answered it, which makes the P-value unsecure. Both categories of farmers had the owner of the farm mostly responsible for treatments and which symptoms to treat with alternative treatments were also similar. Of the organic farmers five answered their veterinary encouraged homeopathy as a treatment to treat digital dermatitis. For the conventional farmers nine farmers were encouraged by the veterinarian to treat with homeopathy treatments and the symptoms to treat where diarrhea, teat injury, digital dermatitis, clinical mastitis and retained placenta.

Table 9. Descriptive statistics for organic and conventional farmers with respect to questions regarding treatments at farm

Variables	Category	Organic (N=88-89) [b] %	Conventional (N=98-100) [b] %	*P*-value[a]
Responsible for treatments at farm	Owner	85.4	91.0	0.222
	Employed foreman	16.9	6.0	
	Employed stockman	23.6	16.0	
	Other	1.1	2.0	
Herd veterinarian	Yes	70.11	53.5	0.024
	No	29.9	46.5	
Veterinarian encouraging treatments other than antibiotics (analgesic, anti-inflammatory agents, local anesthetics)	Yes	76.1	76.5	1.000
	No	23.9	23.5	
Symptoms treated with other than antibiotics (analgesic, anti-inflammatory agents, local anesthetics)[c]	Diarrhea	63.1	42.9	0.195
	Respiratory ill-health	16.9	17.1	
	Teat injury	40.0	42.9	
	Digital dermatitis	24.6	37.1	
	Clinical mastitis	32.3	25.7	
	Sub-clinical mastitis	44.6	37.1	
	Uterus inflammation	18.5	10.0	
	Retained placenta	49.2	28.6	
	Do not know	0.0	4.3	
Which antibiotics are mostly used at the farm	Broad spectrum	14.1	19.0	0.684
	Do not get alternative	31.8	30.5	
	Narrow spectrum	54.1	50.5	
	Do not know	5.9	6.3	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions
[c]N=65 for organic and N=70 for conventional, respondent able to give more than one answer

Farmers' former experience of antibiotics

In table 10 former experiences of treatments with antibiotics are given. Close to four out of five had not experienced an increased dosage of antibiotics after not having an effect of the treatment, and this was the same for both organic and conventional farmers. The majority of

farmers in both groups had experienced a change of antibiotics after laboratory test. More organic farmers had experienced recommendation of other treatments than antibiotics from the veterinarian to reduce resistance compared to conventional farmers, but difference was not statistically significant. The majority of the farmers had the perception that antibiotics was less or much less used at their farm compared to the national average. About 20% of the organic famers believed that the antibiotics could be reduced by at least 50% the next five years, while less than 10% of the conventional believed so. This difference was borderline significant.

Table 10. Former experience of antibiotics for organic and conventional farmers

Variables	Category	Organic (N=88-90) [b] %	Conventional (N=98-101) [b] %	*P*-value[a]
Increased dosage of antibiotics after no effect	Yes	16.7	17.8	0.848
	No	78.9	75.3	
	Do not know	4.4	6.9	
Changed antibiotics after laboratory test	Yes	86.7	85.0	0.853
	No	12.2	13.0	
	Do not know	1.1	2.0	
Veterinarian recommended other treatments than antibiotics to reduce resistance	Yes	60.0	50.0	0.118
	No	28.9	40.0	
	Do not know	11.1	10.0	
Perception of how much antibiotics are used at the farm compared to national average	Much less than	23.3	16.8	0.249
	Less than	51.1	44.6	
	Equal	18.9	28.7	
	More than	1.1	3.0	
	Do not know	5.6	7.0	
Perception of reduction of antibiotic use at the farm in the next five years	0%	21.6	30.6	0.063
	25%	58.0	60.2	
	50-100%	20.4	9.2	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions

Knowledge about antibiotics

There was no statistical significant difference in any of the True or False statements about antibiotics (table 11). In all statements except one, the majority of both organic and conventional farmers choose the same answer. In the statement about if a vaccination against viral diseases substantially reduce the number of treatments with antibiotics the answers is evenly distributed even if the majority believes it is false. The statement concerning if clean cubicles or deep straw beddings reduce the risk for mastitis were the statement where the farmers mostly agreed on.

Table 11. Organic and conventional farmers' perception regarding whether or not following statements concerning antibiotics is true or false

Variables	Category	Organic (N=89-90) [b] %	Conventional (N=89-90) [b] %	*P*-value[a]
Antibiotics work against virus	True	2.2	1.0	0.233
	False[c]	97.8	95.0	
	Do not know	0.0	4.0	
Broad-spectrum antibiotics is effective against several species of bacteria	True[c]	93.3	89.1	0.622
	False	1.1	3.0	
	Do not know	5.6	7.9	
Antibiotics prevent illness because of the increased amount of antibodies it creates, which attacks the infectious substance	True	14.6	9.9	0.502
	False[c]	73.0	70.3	
	Do not know	13.4	19.8	
To prevent antimicrobial resistance a broad spectrum antibiotics should be used for all diseases in cattle	True	4.4	4.0	1.000
	False[c]	93.3	88.1	
	Do not know	2.2	7.9	
Narrow-spectrum antibiotics are only effective on a limited number of bacteria	True[c]	90	87.1	1.000
	False	5.6	5.0	
	Do not know	4.4	7.9	
A hygiene program (for example regular cleaning and disinfection, infection control barrier) is one of the most effective alternative strategies to prevent infectious diseases	True[c]	95.5	89.1	0.119
	False	3.4	0.0	
	Do not know	1.1	10.9	
Vaccination against viral diseases can substantially reduce the number of treatments with antibiotics required in a dairy herd	True[c]	32.2	26.7	0.862
	False	43.3	40.6	
	Do not know	24.4	32.7	
Clean cubicles/pens/deep straw beddings for dairy cows reduces the risk for mastitis	True[c]	100.0	97.0	0.249
	False	0.0	0.0	
	Do not know	0.0	3.0	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions
[c]The correct answer

In most of the statements regarding treatments with antibiotics and preventive actions there were no statistical significant difference (table 12). There was a statistical significant difference between organic and conventional farmers concerning the statement if the use of antibiotics in Swedish dairy production is of no danger for human health where organic farmers agreed to the statement more. Conventional farmers agreed more that the development of AMR is low with the current level of antibiotic use in Sweden. The opinions did not differ for the statement if vaccination of dairy herds in a larger extent would increase the risk for development of AMR, but the difference was borderline significant.

Table 12. Organic and conventional farmers' ratings between 1 - 6 for how much they agree with statements regarding treatments with antibiotics and preventive actions, where 1 is "do not agree at all" and 6 is "agree completely"

Variables	Organic (N=59-90)[b]		Conventional (N=56-101)[b]		*P*-value[a]
	Median (min-max)	Mean	Median (min-max)	Mean	
Antibiotics are used for treatment for most symptoms[d]	1 (1 - 6)	1.8	1 (1 - 6)	1.0	0.236
Antibiotics are cost-effective	3 (1 - 6)	3.6	4 (1 - 6)	3	0.114
Antibiotics work against most diseases[d]	2.5 (1 - 6)	2.5	2 (1 - 6)	2.5	0.919
Antibiotics affect the cows' milk yield[d]	2 (1 - 6)	2.5	2 (1 - 6)	2	0.403
To vaccinate dairy herds in larger extent would reduce the use of antibiotics[c]	3 (1 - 6)	3.2	2 (1 - 6)	3	0.096
The use of antibiotics within Swedish dairy production is no danger for human health[c]	3 (1 - 6)	3.2	2.5 (1 - 6)	3	0.035
The problem with antimicrobial resistance is strongly exaggerated[d]	2 (1 - 6)	2.1	2 (1 - 6)	2	0.109
The consequences will be serious for humans carrying the resistant bacteria[c]	6 (1 - 6)	5.1	6 (1 - 6)	6	0.442
To regularly clean and disinfect animal stable will reduce the use of antibiotics in a herd[c]	6 (1 - 6)	5.4	6 (1 - 6)	6	0.032
The consequences will be serious for humans who are infected with the resistant bacteria[c]	6 (3 - 6)	5.8	6 (1 - 6)	6	0.562
With the current use of antibiotics within Swedish dairy production the risk of developing AMR is low[c]	4 (1 - 6)	3.9	5 (1 - 6)	4	0.025
Only antibiotics can control outbreaks from bacterial infections in cattle[d]	3 (1 - 6)	2.9	3 (1 - 6)	3	0.304
The animals recover quickly with antibiotics[d]	4 (1 - 6)	4.1	5 (1 - 6)	4	0.176
Bacterial infections in cattle can be treated without antibiotics[c]	4 (1 - 6)	4.2	4 (1 - 6)	4	0.541
If antibiotics are banned from treatment of animals in Sweden, dairy production can no longer be practiced in Sweden[d]	4 (1 - 6)	3.6	4 (1 - 6)	4	0.069
Antimicrobial resistance is reduced through regular cleaning and disinfection of animal stables[c]	6 (1 - 6)	5.0	5 (1 - 6)	6	0.130
I can think of other ways to prevent bacterial infections in animals in the herd I work in without the use of antibiotics	5 (2 - 6)	4.9	5 (1 - 6)	5	0.064
To vaccinate dairy herds in larger extent would reduce the development of antimicrobial resistance[c]	4 (1 - 6)	3.5	3 (1 - 6)	4	0.053
There is a risk antibiotics will end up in the milk in a antibiotic-treated cow[c]	6 (1 - 6)	4.9	6 (1 - 6)	6	0.536
If an antibiotics is not working as treatment for a cow in the herd I work in other antibiotics are tried	4 (1 - 6)	3.6	4 (1 - 6)	4	0.229
To give milk from a cow under treatment with antibiotics during the withdrawal period to calves does not affect the development of antimicrobial resistance[d]	2 (1.5 - 6)	2.2	2 (1 - 6)	1.5	0.319
To vaccinate dairy cows against mastitis would improve animal health[c]	4 (1 - 6)	3.9	4 (1 - 6)	4	0.736
To treat a cow during dry-up with antibiotics is more cost-effective than treat the cow immediately[c]	5 (1 - 6)	4.8	5 (1 - 6)	5	0.75
To have clean cubicles/pens/deep straw for the dairy-cows reduces the risk for mastitis[c]	6 (1 - 6)	5.8	6 (2 - 6)	6	0.849
I give milk to calves from a cow under treatment with a antibiotics during the withdrawal period because it is more cost-effective than to discard the milk	2 (1 - 6)	2.9	3 (1 - 6)	2	0.320
To have too long cubicles in comparison to the cows' size increases the risk for mastitis[c]	5 (1 - 6)	4.3	5 (1 - 6)	5	0.670
A high air humidity than recommended in the barn for the dairy-cows can reduce the frequency of treatments with antibiotics[d]	1 (1 - 6)	1.6	1 (1 - 6)	1	0.680

[a]Kruskal-Wallis
[b]Number of observations vary between questions

Knowledge about antimicrobial resistance

Organic and conventional farmers had similar perception about antimicrobial resistance and no statements had statistically significant differences (table 13). The statement about if MRSA can be transmitted from cattle to humans was the statement the farmers were most unsure of. The farmers were also not as sure as in other statements on if antimicrobial resistance cannot be transmitted from one human to another and if the use of antibiotics does not lead to AMR only incorrect use e.g. incorrect dosage and/or incorrect treatment period will do it.

Table 13. Organic and conventional dairy farmers' perception whether or not statements regarding antimicrobial resistance is true or false

Variables	Category	Organic (N=89-90) [b] %	Conventional (N=99-101) [b] %	*P*-value[a]
Antimicrobial resistance can emerge through spontaneous changes in the bacteria genes (mutations)	True[c]	73.3	77.2	0.474
	False	5.6	3.0	
	Do not know	21.1	19.8	
Antimicrobial resistance means bacteria can resist the effect of all antibiotics	True[c]	70.0	57.4	0.166
	False	20.0	27.7	
	Do not know	10.0	14.9	
Use of antibiotics does not lead to antimicrobial resistance; only incorrect use (incorrect dosage and/or incorrect treatment period) will do it	True	25.6	23.8	1.000
	False[c]	65.6	60.4	
	Do not know	8.9	15.9	
The problem with antimicrobial resistance in humans depend only on incorrect use of antibiotics for humans and not for animals	True	3.4	5.0	0.720
	False[c]	88.7	79.0	
	Do not know	7.9	16.0	
MRSA (Methicillin resistant *Staphylococcus aureus*) are resistant against several genus of antibiotics	True[c]	80.0	73.3	0.746
	False	6.7	4.0	
	Do not know	13.3	22.8	
Humans or cattle who are carriers of MRSA are always sick	True	2.2	2.0	1.000
	False[c]	82.2	76.2	
	Do not know	15.6	21.8	
MRSA can not be transmitted from cattle to humans	True	13.3	16.2	0.515
	False[c]	54.4	48.5	
	Do not know	32.2	35.3	
Infections with multi-resistant bacteria are difficult to treat since the alternative for treatments are strongly limited	True[c]	91.1	88.1	0.117
	False	3.3	0.0	
	Do not know	5.6	11.9	
Because of antimicrobial resistance (in both cattle and humans) fewer number of antibiotics can be used for effective treatments	True[c]	93.3	86.1	1.000
	False	3.4	3.0	
	Do not know	3.3	10.9	
The antimicrobial resistance can not be transmitted from one human to another	True	13.3	21.8	0.174
	False[c]	61.1	51.5	
	Do not know	25.6	26.7	

[a]Fisher's/Chi-2
[b]Number of observations vary between questions
[c]The correct answer

Discussion

The objective of this study was to investigate if there was an attitudinal difference towards the use of antibiotics between Swedish organic and conventional dairy farmers.

Descriptive statistics

The respondents were in the same age and approximately the same ratios between sexes for both organic and conventional farmers, which was rather preferable. According to the statistics the women working with agriculture were between 44-54 years old and the men between 55-65 showing that women are slightly younger than the men but still 67% of farmers were between 44-65 years old. For the respondents 75% were older than 44 years old corresponding with the majority older than 44 years old (SCB, 2014; SJV, 2015).

The distribution of employment in agriculture between sexes in Sweden was in 2013 43% females and 57% males (SCB, 2014a). It was 44% responding females and 56% responding males in the study which points at an over representing part of women of the respondents since only 7% of the farmers in 2014 were women (SJV, 2015). Could more women be responding to this study because of more interest in AMR or simply because of more time at the desk or by the computer? Also more owners answered the survey than employed staff and a reason for that is that the survey was addressed to the owner of the dairy farm. Approximately 7% of the people occupied in agriculture is an employed foreman and 28% is the owner which points at the majority of employed workers in agriculture (SJV, 2015).

The respondents geographical spreading were well represented with the majority from the east, west and the middle province which corresponds to the statistics (LRF Mjölk, 2016b) giving more accuracy to the study.

Years in profession did not differ considerably from statistics and herd size for conventional farmers was close to the national average herd size for herds members of the Milk recording (Växa Sverige, 2015). The average organic herd size was lower than average explained by several organic farmers answering the questionnaire had a smaller herd size or that fewer organic farmers are members of the Milk recording affecting the average herd size. The fact that average age was 47 and 75% of the respondents was older than 44 years old might have influenced the answers. Farmers who have worked for a longer time in dairy production might have more experience and basic knowledge about AMR than younger farmers and might be more interested and aware of AMR. A certain interest in AMR can have influenced the motivation to actually answer the questionnaire which in this case might influence the result. The majority of the respondents may have a special interest in AMR.

The number of respondents was almost equal for both farm types, which means organic farmers are a bit overrepresented compared to the actuality because there is a larger proportion of conventional farmers than organic farmers in Sweden. It was positive with the geographical spreading covering Sweden from the south to the north with the majority from the southern, eastern and western province, but to corresponds with reality a higher number of respondents from the south was needed (SJV, 2016). None of the descriptive statistics were significantly different except whether or not the respondent had post-secondary school education, where more organic farmers had post-

secondary school education than conventional farmers. This might influence the general knowledge about antibiotics, but no such statistical analysis was made.

Perception of professionals

It is positive that both the organic and conventional farmers fully trust their veterinarian about animal health, but this leaves the veterinarian with an increased responsibility to give correct and up-to-date advice about the use of antibiotics. This was also proved among pig farmers that they trusted their veterinarian and the advice they were given (Visschers *et al.,* 2014). It is very important that the veterinarian has a restricted attitude towards the antibiotic use because the farmer trusts them highly and the farmer tends to emulate the veterinarian's attitude. A responsible attitude to the usage of antibiotics from the veterinarian is optimal for the farmer to also have a responsible attitude. The fact that the veterinarian also influences the farmers transmission control when the economical aspect come to light also play a major role in the use of antibiotics (Alarcon *et al*., 2013). They trusted their livestock advisor almost as much as the veterinarian and it has been found that especially when it comes to improving foot health a claw trimmer and the advisors were higher trusted than veterinarians for advice (Bruijnis *et al.,* 2013).

Management

The fact that both organic and conventional farmers use the same top five sources of information for animal health in general and for sick animals in acute disease phase proves the lack of attitudinal differences. Swedish farmers use their veterinarian and own knowledge for animal health most often. They also use other dairy farmers' knowledge, which indicates the need for meeting and gathering dairy farmers to exchange experience. The livestock advisor is also one of the top five most important sources of information, which proves the need for knowledge of preventing management for animal performance. This puts a strong responsibility on the advice the advisor and organizations gives because about 60% of the farmers use a livestock advisor at least 3-4 times per year (table 4), which agrees with other studies (van der Borne *et al.,* 2014).

The majority of the farmers did not have pens only used for sick animals which indicate a lack of understanding how AMR develop, lack of space in the stable or that set routines are often hard to change. Healthy animals exposed to small amounts of antibiotics, which may be the case with multipurpose pens can develop AMR. It could be lack of space in the stable forcing farmers to use the same space for several purposes, but the optimal would be to only have sick animals in the pens or place where they are treated to reduce AMR.

The organic farmers tended to wait longer than conventional farmers to contact a veterinarian when a calf shows signs of diarrhea. This could be an economical issue or that organic farmers try to find other solutions and alternatives for treatments. The fact that the organic farmers also tended to wait longer before contacting a veterinarian when a cow shows signs of subclinical mastitis indicates that organic farmers might choose to treat the subclinical mastitis during the planned dry period in a larger extent than conventional farmers or because of economic consequences due to the prolonged withdrawal period in organic production. The withdrawal period is twice as long as the

conventional withdrawal period for milk. This means that milk has to be discarded for a longer period of time if the cow gets treatments at an organic farm (KRAV, 2015).

According to van der Borne *et al.* (2014) farmers with a lot of health problems in the dairy herd also possess a great knowledge about the milking process and milking machine due to a motivation to learn and seek detailed information about the issues. This means farmers with a high disease incidence also have greater knowledge about the medical conditions but says nevertheless about the correlation to the actual preventive management.

Preventive actions for maintaining animal health

The majority of the farmers had already done most of the preventive actions in the stable to maintain healthy animals, which indicates a good attitude to preventing diseases in animals. Both groups agreed on the top five most important preventive actions for animal health where an alert staff and set daily routines were the two most important things. This requires a good manager in the stable to set up good and effective routines in the stable and in-job training for the staff to know what to look for in the herd in order to detect possible injuries or diseases in advance. The fact that 95.6% of the organic farmers and 94% of the conventional farmers already regularly clean and disinfect the stable is positive. But because of the formation of the question it was difficult to distinguish if the cleaning of pens and cubicles was regularly done or if actuality was the disinfection that was regularly done.

In the statement that the farmer do not need to reduce the use of antibiotics in their herd as long as other dairy farmers do not there was a statistical significance that organic farmers did not agree with that statement in a larger extent than conventional farmers. It was also a significant difference that conventional farmer agreed in a larger extent that they did not see why the amount of antibiotics used in their herd had to be reduced. This slightly indicates that organic farmers have a more restricted attitude towards antibiotics and that it is everyone’s responsibility to reduce it whether it is a single person or a company.

Significantly more organic farmers thought fees and requirements to reduce the antibiotic use should be given to farmers using more than a predetermined level of antibiotics than conventional farmers. This might be due to the organic farmers’ attitude that it is everybody’s responsibility to reduce the antibiotic use and if this is not followed someone should pay. Because of the long withdrawal-period in organic dairy farming the antibiotic use is put out as a serious matter and should be taken seriously. It was also a statistically significant difference that organic farmers thought animal owners should form an antibiotic reduction plan together with the veterinarian for their herd.

To decrease the use of antibiotics in livestock production one way is to learn about the farmers’ knowledge and management at the farm and their attitude towards the use of antibiotics (Visschers *et al.*, 2014). Endorsing and implementing habits among farmers, which by making them a routine simultaneously lower the otherwise, required amount of antibiotics is another alternative to reduce the number of antibiotic treatments at farm.

Treatments

It was the same ratios for the answering alternatives for who at the farm is responsible for treatment and calling the veterinarian when an animal is sick between organic and conventional farmers. However, a lot more organic farmers had a herd veterinarian indicating their awareness of the importance of consistency in veterinary advice. Very few respondents had veterinarians recommending them to treat animals with homeopathy but more were recommended alternative treatments for symptoms not always requiring antibiotics. It was only five organic and nine conventional farmers answering the question about homeopathy, which makes the result very unsure. The majority of the farmers used narrow spectrum antibiotics if an alternative was given from the veterinarian, which is positive considering the development of AMR slows down when using narrow spectrum antibiotics (SWEDRES-SVARM, 2013). The attitude of the farmer play a major role to reduce the number of treatments in dairy herds (Valle *et al*., 2007).

It was a statistically significant difference that more conventional farmers did *"Other"* with milk from a cow under treatment with antibiotics than organic farmers. The majority of the ones answering *"Other"* also wrote they fed only bull calves with the milk. The reason for only feeding bull calves and not heifer calves with milk from cow during treatment might be that the bulls will not be a part of the dairy production and the farmer therefore tries to protect the heifers from possible residuals of antibiotics. However, the antibiotics and possible bacteria with AMR will still be in the environment in the stable if any category of animals is fed with milk containing residuals of antibiotics (Livermore, 2003). Bacteria exposed to small amounts of antibiotics are most likely to develop AMR, which will be the case in herds where calves, also bull calves, are fed with milk from cows during treatment. To avoid and reduce development of AMR milk from cows during treatment should not be fed to calves, but this could be an economical as well as a convenient aspect because of the milk not having to go to waste and be short of milk or have to feed powder milk instead.

It was no significant difference in feeding waste milk during withdrawal period to calves, which indicates that organic farmers are more concerned over feeding milk to calves during treatment of the cow than feeding milk after treatment of the cow during withdrawal period. If the farmer is aware of the risk with overuse with antibiotics it does affect the actual use (Visschers *et al*., 2014). Farmers are probably not fully aware of the effect of feeding calves with milk containing residuals of antibiotics. Informing farmers about this might help to slow down the development of AMR.

According to Bigras-Poulin *et al*. (1985) for the farmers to further reduce the number of treatments they need a good economic sense and a low number of personnel only working at the farm and nowhere else. This indicates the economical factor to be motivators for the farmers' attitude and management. Farmers' attitude towards pain and estimation of the cows' wellbeing plays an important role when it comes to treatment of animals, just as much as the economical point of view (Becker *et al*., 2014).

Farmers' former experience of antibiotics

The majority of farmers had experienced a change of antibiotics after a laboratory test of the bacterial infections, which proves an incorrect choice of treatment by the

veterinarian, and is a risk because an incorrect use of antibiotics might lead to the development of AMR (Schwarz *et al*., 2001; Pascale Palhares *et al*., 2014). The need for improved equipment to diagnose the cow is increasing in order to reduce the use and overuse of antibiotics (Radyowijati & Haak, 2002). To prevent the development of AMR more accurate and careful examination of bacterial agents should be determined. The fact that more organic dairy farmers had been given advice for other alternative as treatment than antibiotics might also be an indication of not contacting the veterinarian for all kinds of symptoms.

Knowledge about antibiotics

The knowledge about antibiotics did not differ and was not significantly different between organic and conventional farmers, which is positive. Swedish dairy farmers have the same basic knowledge about antibiotics. The only statement where the farmers were uncertain was the statement regarding if the number of antibiotic treatment would be reduced if vaccination against viral diseases were introduced. The answer is true but indirect because viral diseases are not treatable with antibiotic but a side effect of a viral disease could be a bacterial infection. By reducing viral diseases bacterial infections are also reduced and in turn less treatments of antibiotics are required. The farmers agreed the most on the statement that a clean cubicle or deep straw bedding reduces the risk for mastitis, which is positive and a relatively easy management thing to handle.

Knowledge about antimicrobial resistance

The fact that it does not differ that much for the perception of AMR between organic and conventional farmers is promising. A common basic knowledge within the agribusiness concerning antibiotics and AMR is a strong weapon in this worldwide fight against AMR. The numbers in the answers show that there is still a bit uncertainty in both groups of farmers regarding paths for transmission of AMR. Farmers are not as sure on transmission between humans and animals and from humans to another human as they are on other statements about AMR. This indicates a lack of knowledge about zoonosis at farmers and since farmers use veterinarians, livestock associations and livestock advisors as sources of information for animal health outside of the farm a responsibility rests with them to inform the farmers about animal and also about human health. Farmers are sure about development of AMR can come from mutations and that the meaning of AMR is that bacteria can resist the effect of antibiotics. This is good knowledge helping farmers to be more aware of their own use of antibiotics at their farms. The farmers believed that the statement that only usage of antibiotics does not lead to development of AMR but incorrect use of antibiotics does, was false, which indicates their believing in accurate use of antibiotics can reduce the spreading of AMR. It also shows that farmers believe in the power of the drug but one should only use it carefully. The majority of the farmers knew the meaning of MRSA, which is positive meaning they understand that they cannot use several of the existing antibiotics to cure an infection with MRSA. They also know that a carrier of MRSA is not always sick but can pass on MRSA to others without even knowing, which is one more reason to work with preventing animal health. A great majority knew that an infection with MRSA is difficult to treat because of few options to choose from. This question was a similar question to the statement about if MRSA are resistant against several genes of antibiotics but put in others words. This shows the meaning of how the question is told and what language is used to reach with the actual message is of importance. The

overuse of antibiotics occur in both veterinary and human care and in order to reduce the development of AMR politics must be more involved and treat AMR with the same respect as other global changes (Balabanova *et al.,* 2004).

Conclusion

The conclusion of this study is that the basic knowledge regarding antimicrobial use and development and transmission of AMR were in general good for Swedish dairy farmers. There was no statistically significant difference between Swedish organic and conventional dairy farmers' attitude towards antibiotics. The hypothesis was disproved and there was no verification that organic farmers had a more restricted attitude towards antibiotics than conventional farmers. The Swedish dairy farmers attitude and knowledge towards antibiotics does not differ regardless if it is a conventional or an organic dairy farmer.

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Appendix

Appendix 1. The survey

Enkät om mjölkbönders attityd till antibiotika

1. Frågor om din uppfattning om antibiotika och antibiotikaresistens

1. Nedan är ett antal påståenden om antibiotika och om antibiotikaresistens där du svarar efter om du tror påståendet är sant eller falskt.

Om du är osäker, markera vet ej

	sant	*falskt*	*vet ej*
a. Antibiotika fungerar mot virus.			
b. Bredspektrigt antibiotikum är effektivt mot flera bakteriearter.			
c. Antibiotika förhindrar sjukdom eftersom de ökar antalet antikroppar som attackerar infektionsämnen.			
d. För att förhindra antibiotikaresistens bör man använda bredspektrigt antibiotikum vid alla sjukdomar hos nötkreatur.			
e. Smalspektriga antibiotikum påverkar endast ett begränsat antal bakterier.			
f. Antibiotikaresistens kan uppkomma genom spontana förändringar i bakteriens gener (mutationer).			
g. Antibiotikaresistens betyder att bakterier kan motstå effekten av alla antibiotikum.			
h. Användning av antibiotika leder inte till antibiotikaresistens; endast felaktig användning (dvs felaktig dosering och/eller felaktig behandlingslängd) gör det.			
i. Antibiotikaresistensproblematiken hos människor beror endast på felaktig användning av antibiotika för människor och inte för djur.			
j. MRSA (Meticillinresistenta *Staphylococcus aureus*) är resistenta mot flera klasser av antibiotika.			
k. Människor eller nötkreatur som bär på MRSA är alltid sjuka.			
l. MRSA kan inte överföras från nötkreatur till människor.			
m. Ett hygienprogram (t.ex regelbunden rengöring och desinfektion, smittskyddsbarriär) hör till de mest effektiva alternativa strategierna för att förhindra infektionssjukdomar.			
n. Vaccinationer mot virussjukdomar kan avsevärt minska antalet antibiotikabehandlingar som behövs i en mjölkbesättning.			
o. Infektioner med multiresistenta bakterier är mycket svårbehandlade eftersom behandlingsalternativen är kraftigt begränsade.			
p. På grund av antibiotikaresistens (hos både nötkreatur och människor) kan färre antibiotikum användas för att bota sjukdomar.			
q. Antibiotikaresistens kan inte spridas via bakterier från en människa till en annan.			
r. Att ha rena liggbås/djupströbädd för mjölkkor minskar risken för mastit.			

2. Nedan är ett antal påståenden där du svarar efter hur stor grad du håller med påståendet.

Ange i vilken utsträckning du håller med om följande påståenden.

	håller inte alls med 1	2	3	4	5	*håller helt med* 6	*vet ej*
a. Antibiotika ges för att behandla de flesta symptom.							
b. Antibiotika ger valuta för pengarna.							
c. Antibiotika fungerar mot de flesta sjukdomar.							
d. Antibiotika påverkar mjölmängden hos en ko.							

	håller inte alls med				håller helt med		vet ej
	1	2	3	4	5	6	
e. Att vaccinera mjölkbesättningar i större utsträckning skulle minska antibiotikaanvändningen.							
f. Användningen av antibiotika inom svensk mjölkproduktion är en fara för människors hälsa.							
g. Problemet med antibiotikaresistens är starkt överdrivet.							
h. Konsekvenserna blir allvarliga för människor som är bärare av resistenta bakterier.							
i. Att regelbundet rengöra och desinficera djurutrymmen/djurstallar minskar antibiotikaanvändningen i en besättning.							
j. Konsekvenserna blir allvarliga för människor som får en infektion med resistenta bakterier.							
k. Med den nuvarande antibiotikaanvändningen inom svensk mjölkproduktion är risken liten för utveckling av antibiotikaresistens.							
l. Endast antibiotika kan kontrollera utbrott av bakteriellt orsakade sjukdomar hos nötkreatur.							
m. Djuren tillfrisknar snabbt av antibiotika.							
n. Bakteriellt orsakade sjukdomar hos nötkreatur kan även behandlas utan antibiotika.							
o. Om antibiotika förbjuds att användas till djur i Sverige kan man inte längre bedriva mjölkproduktion i Sverige.							
p. Att regelbundet rengöra och desinficera djurutrymmen/djurstallar minskar risken för antibiotikaresistens.							
q. Jag kan tänka mig andra sätt att förebygga bakteriellt orsakade sjukdomar hos djuren i besättningen jag arbetar i utan användning av antibiotika.							
r. Att vaccinera mjölkbesättningar i större utsträckning skulle förhindra utveckling av antibiotikaresistens.							
s. Det finns risk att antibiotika hamnar i mjölken hos en antibiotikabehandlad ko.							
t. Om ett antibiotikum inte fungerar som behandling för en ko i besättningen du arbetar i provas ett nytt antibiotikum.							
u. Att ge mjölk från en ko som är under behandling med ett karensbelagt antibiotikum till en kalv påverkar inte resistensutveckling.							
v. Att vaccinera mjökkor mot mastit skulle förbättra djurhälsan.							
w. Att sintidsbehandla en ko med antibiotika är mer kostnadseffektivt än att behandla direkt.							
x. Att ha rena liggbås/ren djupströbädd för mjölkkorna minskar risken för mastit.							
y. Att ge mjölk från en ko som är under behandling med ett karensbelagt antibiotikum gör jag för att det är mer kostnadseffektivt än att kassera mjölken.							
z. Att ha för långa liggbås i förhållande till mjölkkornas storlek ökar risken för mastit.							
å. En högre luftfuktighet än rekommenderat i stallet hos mjölkkorna kan minska frekvensen av antibiotikabehandlingar.							

2. Frågor om dina erarenheter och din uppfattning om djurhälsoarbete, antibiotika och antibiotikaanvändningen i besättningen du arbetar i

Nedan beskrivs situationer som du anger hur ofta du eller den/de som är ansvariga utför varje alternativ:

1. Hur ofta gör du nedanstående om en av kalvarna (upp till och med 6 månader) i en avdelning får diarré…	*aldrig* 1	2	3	4	5	*alltid* 6
a. Isolerar kalven						
b. Kontrollerar kalvens kroppstemperatur						
c. Kontrollerar kalvens allmäntillstånd						
d. Ger kalven extra värme - täcke, strö eller värmelampa						
e. Ger kalven vatten/vätskeersättning						
f. Kontaktar veterinär direkt						
g. Avvaktar och kontaktar veterinär tidigast efter 1-2 dagar						
h. Kontaktar veterinär endast om kalven har feber/är allmänpåverkad						
i. Annat _____						

2. Hur ofta gör du följande om en ko i en avdelning får subklinisk mastit (osynlig juverinflammation)…	*aldrig* 1	2	3	4	5	*alltid* 6
a. Ställer kon i sjukbox						
b. Kontaktar veterinär direkt						
c. Kontrollerar själv mjölkens celltal (CMT, CST, LDH)						
d. Avvaktar och kontaktar veterinär tidigast efter 1-2 dagar						
e. Sinlägger den inflammerade juverdelen och mjölkar som vanligt på de övriga juverdelarna						
f. Kontrollerar besättningens celltal						
g. Mjölkar den kon separat och/eller sist						
h. Skickar själv mjölk från den kon på bakteriologisk analys						
i. Sinlägger kon tidigare (alla fyra juverdelar) och sintidsbehandlar						
j. Sintidsbehandlar kon under den planerade sintiden						
k. Paddlar kon för CMT- analys						
l. Ökar kokomforten genom att strö mer						
m. Mjölkar ur den inflammerade juverdelen ordentligt						
n. Inseminerar inte den kon som sedan slås ut vid planerad sinläggning						
o. Slår ut kon direkt						
p. Slår ut kon om inte antibiotikabehandlingen fungerar						
q. Om celltalet förblir högt efter antibiotikabehandling slås kon ut						
r. Om celltalet förblir högt efter antibiotikabehandling görs kon trespent						
s. Fortsätter att mjölka kon och sintidsbehandlar under den planerade sintiden						
t. Mjölkar ur med täta intervaller						
u. Annat_____						

3. Hälsofrågor om besättningen du arbetar i

	ja	nej	vet ej
a. Är klövhälsa med i avelsmålet för besättningen du arbetar i?			
b. Är juverhälsa med i avelsmålet för besättningen du arbetar i?			
c. Förs det dokumentation över behandlade djur i besättningen (förutom veterinärens anteckningar)?			
d. Finns det sjukboxar som endast används till sjuka djur och ingenting annat i besättningen du arbetar i?			

4. Om veterinären ger alternativ på antibiotikum för att behandla ett sjukt djur; ett smalspektrigt och ett bredspektrigt antibiotikum; vilket används oftast i besättningen du arbetar i?

smalspektrigt *bredspektrigt* *vet ej* *får ej alternativ*

5. Vad görs med mjölk från en ko under behandling med ett karensbelagt antibiotikum?

kasseras i utgödsling *kasseras i kulvert* *kasseras i gödsel-brunn* *kasseras i avlopp* *ges till kalvar* *annat* _____

6. Vad görs med karensmjölk från en ko som har behandlats med ett karensbelagt antibiotikum?

kasseras i utgödsling *kasseras i kulvert* *kasseras i gödsel-brunn* *kasseras i avlopp* *ges till kalvar* *annat* _____

7. Har du någon gång upplevt följande i besättningen?

Om du är osäker, markera vet ej

	ja	nej	vet ej
a. Veterinären ökade antibiotikadoseringen eftersom den ursprungliga doseringen inte längre hade effekt.			
b. Antibiotikasort fick bytas eftersom laboratorieundersökning visade att den första behandlingen var felaktig.			
c. För att minska risken för antibiotikaresistens rekommenderade veterinären andra behandlingsmetoder än antibiotika.			

8. Vad är din uppfattning om hur mycket antibiotika som används i besättningen du arbetar i jämfört med genomsnittet i mjölkbesättningar i Sverige?

mycket mindre än *mindre än* *lika med* *mer än* *mycket mer än* *vet ej*

9. Med hur stor del tror du att det skulle vara möjligt att kunna minska antibiotikaanvändningen i besättningen du arbetar i de närmaste 5 åren?

0% 25% 50% 75% 100%

10. Vilken är din uppfattning om antibiotika inom mjölkproduktionen?

Ange i vilken utsträckning du håller med om följande påståenden. Endast ett kryss per fråga.	*håller inte alls med* 1	2	3	4	5	*håller helt med* 6	*vet ej*
a. Jag vill försöka förebygga sjukdom i större grad.							
b. Jag planerar att minska antalet behandlingar av sjuka djur i besättningen jag arbetar i.							

	håller inte alls med 1	2	3	4	5	*håller helt med* 6	*vet ej*
c. Det är meningslöst att minska antibiotikaanvändningen i besättningen jag arbetar i så länge som andra producenter i Sveige inte försöker minska sin antibiotikaanvändning.							
d. Jag ser inte varför antalet behandlingar skulle behöva minska i besättningen jag arbetar i.							
e. Antalet antibiotikabehandlingar i besättningen jag arbetar i är inte ett problem.							
f. En minskning av antibiotikaanvändningen i besättningen jag arbetar i har lite påverkan för omvärlden.							
g. Jag anser att det är viktigt att minska antalet antibiotikabehandlingar i besättningen jag arbetar i (många bäckar små).							
h. Jag vill att en ko med osynlig juverinflammation (subklinisk mastit) ska sintidsbehandlas.							
i. Även om det skulle användas mycket antibiotika i besättningen jag arbetar i gör det ingen skillnad så länge andra svenska producenter inte minskar sin antibiotikaanvändning.							
j. Om antibiotikaanvändningen i en besättning är högre än en förutbestämd nivå ska en avgift och krav på minskad antibiotikaanvändning krävas.							
k. Djurägare ska vara skyldiga att utforma en plan tillsammans med veterinär om hur användingen av antibiotika kan minska i besättningen till en viss nivå.							
l. En ko med höga celltal ska behandlas med antibiotika genast.							

11. I vilken utsträckning planeras det att införas eller har det redan införts följande åtgärder i förebyggande syfte i besättning du arbetar i?

	görs inte och planerar ej att göra det	*görs inte men skulle kunna göra det*	*görs inte men skulle vilja göra det*	*görs inte men planerar att göra det*	*görs/ har gjorts redan*
a. Se över stallklimatet när det gäller ventilation, luftfuktighet och lufttemperatur.					
b. Se över att inredningen är anpassad för djurens storlek och deras behov.					
c. Låta besökare till besättningen endast använda gårdsegna stövlar, kläder och rockar.					
d. Stängt gården för andra besökare än veterinär, rådgivare och familjemedlemmar till personal.					
e. Regelbunden rengöring och desinfektion av stallarna.					

12. Välj ut de fem viktigaste av nedanstående alternativ och rangordna de fem efter hur viktiga du tycker de är för att hålla djuren friska i besättningen du arbetar i:
(1 till och med 5 där 1 är viktigast)

__ Ha en produktionsrådgivare	__ Uppmärksam personal	__ Att använda antibiotikum med brett spektrum
__ Fasta rutiner i den dagliga skötseln	__ Inredning anpassad efter djurens storlek och behov	__ Extra vård och tillsyn av misstänkt sjuka djur
__ Snabb behandling av sjukdomar	__ Att veterinär kan komma snabbt till besättningen vid behov	__ Ha en besättningsveterinär
__ Att använda antibiotikum med smalt spektrum	__ Förebyggande åtgärder	__ Annat _____

3. Frågor om ViLA - Villkorad Läkemedelsanvändning (av veterinär föreskriven egen behandling av akut juverinflammation och klövspaltsinflammation samt luftvägsinfektion, navelinfektion, nekrobacillos, ledinflammation och diarré hos kalv)

	ja	nej	vet ej
1. Har du hört talas om ViLA sedan tidigare?	✎	✎	✎
2. Tycker du det är rimligt att djurägare/skötare får behandla sjuka djur under regelbunden tillsyn av veterinär?	✎	✎	✎
3. Vill du att ViLA ska införas i mjölkbesättningar?	✎	✎	✎
4. Kommer det att vara lönsamt för en besättning att ansluta sig till ViLA om det införs?	✎	✎	✎
5. Kommer besättningen du arbetat i att ansluta dig till ViLA om det införs?	✎	✎	✎
6. Genom införandet av ViLA kommer djurhälsan i mjölkbesättningar i Sverige att förbättras.	✎	✎	✎
7. Tycker du att det är rimligt att ha en djurskyddsdeklaration som krav för att ansluta en besättning till ViLA?	✎	✎	✎

8. Genom att införa ViLA tror du att…	minska	ingen skillnad	öka	vet ej
a. …antibiotikaförbrukningen i mjölkbesättningar kommer att…	✎	✎	✎	✎
b. …antibiotikaresistensen kommer att…	✎	✎	✎	✎
c. …veterinärkostnader i anslutna mjölkbesättningar kommer att…	✎	✎	✎	✎
d. …läkemedelskostnader i anslutna mjölkbesättningar kommer att…	✎	✎	✎	✎

4. Frågor om dig och mjölkbesättningen du arbetar i

1. **Födelseår** 1 9 _____
2. **Kön** ✎ *Kvinna* ✎ *Man*
3. **Vilken är din roll i besättningen?**

   ✎ *Ägare* ✎ *Anställd Förman* ✎ *Anställd djurskötare* ✎ *Annat* _____
4. **Hur stor del av arbetstiden ägnar du åt mjölkkobesättningen?** ✎ *Heltid* ✎ *Deltid*
5. **Hur länge har du varit verksam inom mjölkproduktion?** _____ *år*
6. **Hur stor del har mjölkproduktionen av den totala omsättningen i företaget där du arbetar?**

   ✎ *mindre än 25%* ✎ *25 - 50%* ✎ *51-75%* ✎ *mer än 75%* ✎ *vet ej*
7. **Vilket län tillhör din mjölkproduktion?** _____
8. **Vad är det för mjölkningssystem för besättningen?**

   ✎ *Grop* ✎ *Robot* ✎ *Robotkarusell* ✎ *Karusell* ✎ *Uppbundet*
9. **Hur många helårskor har besättningen i genomsnitt?** _____ *st*

   Antal mjölkkor inklusive sinkor.

	ja	nej	vet ej
11. Köps det in rekryteringsdjur till besättningen?	✎	✎	✎
12. Om ja på fråga 11; placeras nyinköpta rekryteringsdjur i karantän?	✎	✎	✎

13. Till vilket mejeri levereras mjölken från besättningen du arbetar i?

Arla Emåmejeriet Falköpings mejeri Gefleortens mejeri Grådö mejeri Gäsene mejeri

Hjordnära Norrmejerier Sju gårdar Skånemejerier Wapnö mejeri Östgöta mjölk Övrigt

14. Vilken typ av mjölkproduktion är mjölkbesättningen du arbetar i?

certifierad enligt KRAV *Konventionell* *Annat*_____

	ja	*nej*	*vet ej*	*helmjölk och pulver-mjölk*
15 Får kalvarna i besättningen helmjölk efter råmjölksperioden?				
16. Är din mjölkproduktion certifierad enligt IP Sigill Mjölk (Svenskt Sigill)?				
17. Har du gått på naturbruksgymnasium?				
18. Har du någon eftergymnasial utbildning?				

19. Om ja på fråga 18; vilken/vilka eftergymnasiala utbildningar har du gått?

_____

20. Vem på gården ansvarar för att ett sjukt djur blir behandlat?

Ägare *Anställd Förman* *Anställd djurskötare* *Annan*_____

21. Vilken är den vanligast utslagsorsaken för djur i besättningen du arbetar i?

_____

22. Vad är procenten för den vanligaste utslagsorsaken i besättningen du arbetar i? _____ **%**

	ja	*nej*	*vet ej*
23. Har besättningen en besättningsveterinär?			
24. Är den veterinären som oftast kontaktas för besättningen en Distriktsveterinär?			
25. Uppmuntrar veterinären för besättningen till att använda andra alternativ än antibiotika som behandling (smärtstillande, antiinflammatoriskt, lokalbehandling etc.)?			

26. Om ja på fråga 25; vid vilka skador/sjukdomar uppmuntrar veterinär till besättningen andra alternativ än antibiotika som behandling (smärtstillande, antiinflammatoriskt, lokalbehandling etc.)?

diarré *luftvägsinfektion* *spenskada* *klövspalts-inflammation* *klinisk mastit* *subklinisk mastit* *livmoder-inflammation* *kvarblivenefterbörd* *vet ej* *annat* _____

	ja	*nej*	*vet ej*
27. Uppmuntrar veterinären för besättningen till att använda alternativ behandling (homeopati) istället för antibiotika?			

28. Om ja på fråga 27; vid vilka skador/sjukdomar uppmuntrar veterinär till besättningen alternativ behandling (homeopati)?

diarré *luftvägsinfektion* *spenskada* *klövspalts-inflammation* *klinisk mastit* *subklinisk mastit* *livmoder-inflammation* *kvarblivenefterbörd* *vet ej* *annat* _____

29. Hur ofta anlitas en produktionsrådgivare för besättningen du arbetar i?

1ggr/vecka 1ggr/månad 1ggr varannan månad 3-4ggr/år 1-2ggr/år 1ggr/2år aldrig

	ja	*nej*	*vet ej*
30. Är besättningen ansluten till Salmonellaprogrammet?			

31. Nedan följer några påstående om veterinär och rådgivare till besättningen du arbetar i.

Ange i vilken utsträckning du håller med om följande påstående:	*håller inte alls med* 1	2	3	4	5	6 *håller helt med*	*vet ej*
a. Besättningens huvudsakliga veterinär förskriver endast antibiotika efter att ha undersökt djuret.	✎	✎	✎	✎	✎	✎	✎
b. Veterinären för besättningen är kunnig och intresserad av sjukdomar hos produktionsdjur inom mjölkprodution.	✎	✎	✎	✎	✎	✎	✎
c. Jag har fullt förtroende för de råd besättningens veterinär ger.	✎	✎	✎	✎	✎	✎	✎
d. Jag har fullt förtroende för de råd besättningens produktionsrådgivare ger.	✎	✎	✎	✎	✎	✎	✎

32. Hur långt bort finns närmaste veterinär som kan anlitas för arbete i mjölkkobesättning du arbetar i? _____ *km*

33. Markera de fem viktigaste källorna till information och rådgivning om *djurhälsa generellt* för besättning du arbetar i.

✎ Andra mjölkproducenter	✎ Husdjursförening	✎ LRF	✎ Produktionsrådgivare
✎ Egen kunskap	✎ Husshållningssällskap	✎ LRF Mjölk	✎ Statens Veterinärmedicinska Anstalt, SVA
✎ Erfarenhetsgrupper	✎ Internetsidor	✎ Manualer	✎ Sveriges Lantbruks-universitet, SLU
✎ Faktaböcker	✎ Sociala medier	✎ Medarbetare på gården	✎ Veterinär
✎ Forskningsrapporter	✎ Lantbrukstidningar	✎ Nyhetstidningar	✎ Annat _____

34. Markera de fem viktigaste källorna till information och rådgivning angående *behandling av ett individuellt djur i en akutfas av en sjukdom* för besättningen du arbetar i.

✎ Andra mjölkproducenter	✎ Husdjursförening	✎ LRF	✎ Produktionsrådgivare
✎ Egen kunskap	✎ Husshållningssällskap	✎ LRF Mjölk	✎ Statens Veterinärmedicinska Anstalt, SVA
✎ Erfarenhetsgrupper	✎ Internetsidor	✎ Manualer	✎ Sveriges Lantbruks-universitet, SLU
✎ Faktaböcker	✎ Sociala medier	✎ Medarbetare på gården	✎ Veterinär
✎ Forskningsrapporter	✎ Lantbrukstidningar	✎ Nyhetstidningar	✎ Annat _____

Tack för din medverkan!

Om du har några övriga kommentarer angående denna enkät kan du skriva dem nedan. Om du önskar få rapporten skickad till dig skriv då din adress här nedan.

Adress (gärna e-post) _____

8

Appendix 2. Letter sent to the farmers

Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Institutionen för Kliniska vetenskaper

2014-06-06

Vad är mjölkbönders attityd till antibiotikaanvändning?

Hej,
vi vill veta svenska mjölkbönders attityd till antibiotikaanvändning och genomför nu en enkätstudie där Er besättning har blivit slumpmässigt utvald att ingå.

Vi ber Er att fylla i den bifogade pappersenkäten och returnera den i det portofria svarskuvertet eller fylla i nätupplagan som finns på följande länk: https://www.netigate.se/a/s.aspx?s=162642X8715

Det är givetvis frivilligt att delta i studien och alla enkätsvar behandlas anonymt och inga enskilda uppgifter kommer att kunna härledas till enskild besättning när resultat redovisas.

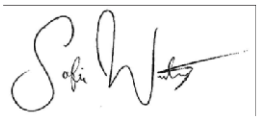
Har du frågor och/eller vill veta mer om studien kontakta:

Agronomstudent — Sofie Winding
Telefon: 070 - 397 30 25
Epost: sowi0001@stud.slu.se

Huvudhandledare SLU — Ulf Emanuelson
Telefon: 018 - 67 18 26
Epost: ulf.emanuelson@slu.se

Din medverkan är viktig och bidrar till att resultaten blir mer tillförlitliga och vi ber Dig att besvara frågorna som snart som möjlig dock senast **måndag den 1:e september 2014.**
Tack på förhand för att Ni tar Er tid att fylla i enkäten!

Med vänliga hälsningar



SLU, Box 7070, SE-750 07 Uppsala, Sweden
Org.nr 202100-2817
www.slu.se

tel: +46 (0)18-67 10 00
info@slu.se

Mer information om studien:

Studien är en del av ett examensarbete som utförs vid Institutionen för Kliniska vetenskaper vid Sveriges Lantbruksuniversitet (SLU) i Uppsala och kommer att redovisas i en rapport när alla enkätsvar är sammanställda.

Syftet med studien är att ta reda på attityden till användning av antibiotika inom mjölkproduktion för att möta den pågående diskussionen om synen på antibiotikaanvändning inom djurproduktion på ett säkert sätt. Inom grisproduktion finns det redan en liknande studie och nu utökas det med en undersökning av ytterligare ett djurslag.

Enkätstudien går igenom frågor om

- Din uppfattning om antibiotika och antibiotikaresistens
- Din erfarenhet och uppfattning om djurhälsoarbete, antibiotika och antibiotikaanvändning
- Villkorad Läkemedelsanvändning (ViLA)
- Hur besättningen du arbetar i ser ut och dess förutsättningar

Det är frivilligt att delta i studien och vi hoppas att Ni har möjlighet att bidra med Era erfarenheter.

Genom att ange er adress i slutet av enkäten (gärna e-post) blir det möjligt för oss att skicka resultatet direkt till Er när rapporten är klar. Adresserna kommer inte på något vis att kopplas ihop med enkätsvaren.

För friska kor är glada kor
Är kon glad är bonden glad

Appendix 3. Letter from Växa Sverige regarding addresses to the farmers

VÄXA SVERIGE

Eskilstuna
2014-06-09

”Vad är mjölkbönders attityd till antibiotikaanvändning?”

Ovanstående rubrik finns även på brev och enkät från SLU bifogat detta utskick. Växa Sverige har fått en förfrågan om adresser till djurägare som deltar i Kokontroll för utskick av denna enkät. Växa Sverige har dock en policy att ej lämna ut adresser från våra adressregister.

Vi anser samtidigt att det är viktigt att stödja undervisning, forskning vid SLU, och de aktiviteter som hör till detta. Därför har vi valt att göra detta utskick åt SLU, Institutionen för kliniska vetenskaper.

Vi ber Er som djurägare ta del av information kring enkäten och om Ni väljer att besvara den, bidra till kunskap om mölkproducenters attityder och åsikter i frågan.

Mer information och kontaktuppgifter finns i bifogat material.

Med vänlig hälsning

Nils-Erik Larsson
Kundservice & IT

Besöksadress:	Postadress:	Telefon:	E-post	Hemsida:	Bankgiro:
Kungsängens gård 6D Uppsala	Box 288 751 05 Uppsala	010-471 00 00	info@vxa.se	www.vxa.se	150-3846

Appendix 4. Thank you note and reminder-postcard to farmers

Hej! Tack så mycket för att Ni tagit Er tid och delta i enkätundersökningen om attityd till antibiotika i mjölkbesättningar i Sverige. Har Ni ännu inte hunnit svara på enkäten eller har den råkat komma bort? Oroa Er inte, det finns även en nätupplaga som Ni hittar på: **ww.netigate.se/a/s.aspx?s=162642X8715**

Tack så mycket för Er tid!

Med vänliga hälsningar Sofie Winding (070-3973025 sowi0001@stud.slu.se) och Ulf Emanuelson (018-671826 ulf.emanuelson@slu.se)

*Sista svarsdatum har förlängts till **15 september.***

Appendix 5. Notice in the agricultral paper Land Lantbruk

Just nu görs en examensarbete på Sveriges Lantbruksuniversitet, SLU, för att ta reda på svenska mjölkbönders attityd till antibiotikaanvändning.

Enkäten finns på: **www.netigate.se/a/s.aspx?s=162642X8715**

Frågor om enkäten kontakta Sofie Winding på **070-397 30 25** eller Ulf Emanuelson på **018-671826**.

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