# Antimicrobial Usage in Animals and Practices Associated with Antimicrobial Therapy of Bovine Mastitis in Kozhikode District, Kerala

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*Dissertation submitted in partial fulfilment of the requirements for the award of the degree of Master of Public Health*

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1999

## DECLARATION

I, hereby declare that this dissertation entitled "Antimicrobial usage in animals and practices associated with antimicrobial therapy of bovine mastitis in Kozhikode District, Kerala" is a bonafide record of research work done by me during the MPH programme and is being submitted in partial fulfillment of the requirement for Master of public health degree programme at Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology. The dissertation has not previously formed the basis for the award to me of any Degree, Diploma, Associateship, Fellowship or other similar title of any other University or Society.

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## CERTIFICATE

Certified that this dissertation entitled "Antimicrobial usage in animals and practices associated with antimicrobial therapy of bovine mastitis in Kozhikode District, Kerala" is a record of research work done independently by Dr. C. Ibraheem Kutty under our guidance and supervision and is being submitted to Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology for the award of Master of public health degree.

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**C. Ibraheem Kutty**

# Contents

## Abstract

**Objectives** of the study were to find out the monthly supply of antimicrobials for animal use in Kozhikode district of Kerala, and to study the practices associated with treatment of bovine mastitis using antimicrobials, that are favorable for the development of microbial resistance.

**Methods** Quantity of antimicrobial supplied per month, animal population and disease details and treatment facilities within the district, were collected from secondary sources. Cross sectional survey was used to study the treatment practices of 7 each of veterinarians (Vets) and livestock inspectors (LI) practicing within the locality and for care seeking practices of dairy farmers, whose cows had mastitis during the preceding one year. A random sample of 80 farmers from the milk societies in 3 blocks of the district was selected. Interviews were carried out using pre-structured interview guidelines during Jan -Feb., 1999 and descriptive analysis of the data was done using SPSS software to identify the practices likely to contribute antimicrobial resistance.

**Results** During the month of study, 68 Kg of antimicrobial ingredient was supplied in the district for treatment of animal diseases, bulk of which ( 90%) was through private agencies. There were 18 major firms involved in the supply and 35 % of the products supplied by these firms were antimicrobials. Mastitis in dairy cows was the major indication for antimicrobial use in animals and 9172 cases of mastitis were reported in about 40,000 dairy cows during the previous 1 year. There were 132 LI s and 92 Vets involved in the delivery of health care and antimicrobial usage in animals. LI s were lacking many of the basic information needed for rational use of antimicrobials. Vets were aware of the microbial resistance arising out of antimicrobial misuse, but they were lacking information on its long term consequences, especially to public health. Hence practices of both LI s and Vets showed deviations from the recommended practices of antimicrobial usage.

Care seeking by farmers showed inappropriate practices like delay in reporting (55 %), seeking unqualified treatment (24 %), insufficient course of injection ( 78 %), and lack of sufficient duration of milk discarding (71 %). Even though antimicrobials were used in all the mastitis cases, complete cure was obtained only in 51% cases, and the practices were favorable for microbial resistance. Lack of knowledge on the need for proper use of antimicrobials and its consequences was the major factor influencing practices. Hence there is need for educating both practitioners and farmers on rational use of antimicrobials and its consequences especially to public health. It is concluded that large quantity of antimicrobials are used for animal treatment and the practices are often inappropriate favoring development of antimicrobial resistance.

Chapter 1

# INTRODUCTION

# 1. INTRODUCTION

## 1.1. Antimicrobial resistance

Antimicrobials are extensively used in human beings, animal husbandry, and agriculture for various purposes. In many developed countries apart from being used for therapeutic purposes, a major share of antimicrobials are used for growth promotion in animals in the form of feed additives. Feed supplementation with antimicrobials in low concentrations has been attributed to be one of the major reasons for development of resistance [90]. However in developing countries like India, antimicrobials used in animals are mainly for treatment purposes and often such use is by unqualified personnel and even farmers themselves. Hence a larger proportion of antimicrobials may be used improperly in animals and can contribute to antimicrobial resistance in the community.

There are many bacterial species both pathogenic and non-pathogenic, common to man, animals and environment. The genetic factors for resistance, acquired by these organisms can be easily transmitted from one to another irrespective of the strain, species, habitat or host affected [28, 37, 90]. Thus human pathogens are prone to acquire resistance factors from resistant strains in animals, plants or the abiotic environment [45]. Hence microbial resistance poses a serious public health problem not only to a particular community or country but for the entire world as well.

Multi-drug resistant strains of microbes have been reported from many countries including India. So also, the causative link of antimicrobial resistance in human beings with prevalence of resistant strains and practices of antimicrobial usage in animals has been well evidenced in many studies in developed countries [11, 59]. Many studies are also available on the pattern of antimicrobial usage and prescription practices in human treatment, both from developed and developing countries. However there are no reports available from developing

countries regarding practices of antimicrobial usage in animals, even though such practices are likely to contribute towards antimicrobial resistance.

### 1.2. The situation in India

The animal husbandry (AH) sector in India consists mainly of 119 million cattle and 78 million buffaloes which contributes 77% of GDP from AH sector and forms 24% of total GDP from Agriculture [65]. Cattle rearing is mainly aimed at milk production and there has been a continuous effort in the past to improve the productivity of cattle through cross breeding using exotic germ plasm. Among the Indian states, Kerala has the largest proportion of exotic cross-bred cattle (67.33 %) and this was achieved through the exotic cross breeding program started in 1960s ( AH census 1996).

Incorporation of exotic germ plasm and better milk yield has resulted in a drastic decline of disease resistance, making the cows prone to many diseases. The situation is further aggravated by poor managerial standards and scarcity of resources such as land, feed ingredients and trained manpower. Frequent occurrence of infectious diseases has necessitated increased usage of antimicrobials and this is often improperly done owing to the inadequacy of sufficient qualified personnel, poor facilities, and lack of strict regulations on antimicrobial usage in the state.

Mastitis or inflammation of mammary tissue following infection with microbes, is the most frequently occurring major infectious disease in dairy cattle and is supposed to be the single disease consuming largest share of antibiotics used in animals in the state. Improper usage of antimicrobials for mastitis can have consequences for public health, by contributing to the development of antimicrobial resistance and also through antimicrobial residues in milk. Hence practices associated with treatment of mastitis in dairy cows has been selected as a case study, to highlight behavioral practices associated with usage of antimicrobials in animals, that

may contribute to the development of microbial resistance. This study intends to gather some preliminary information from a district of Kerala.

### 1.3. Research questions

The following were the research questions intended to be answered through this study.

1. What is the magnitude of antimicrobials supplied for animal usage in the district during the period of one year ?
2. What are the practices of animal health care personnel associated with the usage of antimicrobials in animals ?
3. What are the farmers' practices of antimicrobial usage in cows for mastitis ?

### 1.4. Objectives

With the above research questions in mind the following objectives were formulated for the study.

1. To study the magnitude of antimicrobial usage in animals in a district of Kerala.
2. To study the practices associated with the usage of antimicrobials for treatment of bovine mastitis.

### 1.5. Outline of dissertation

The dissertation consists of five chapters. The first chapter gives the details regarding need for the study and the objectives. The second chapter is the literature review on antimicrobial resistance, antimicrobial usage in animals and its public health implications. The review chapter is followed by the third chapter on the description of the methodology adopted followed by a limitations of the study. The results of the study, which forms the fourth chapter, subsumes sections entitled background, magnitude of antimicrobial usage and practices of health care providers and Farmers. The discussion of the results forms the fifth chapter and this includes a brief summary and conclusion.

Chapter 2

# LITERATURE REVIEW

# 2. LITERATURE REVIEW

Relevant literature on antimicrobial resistance, its mechanism and dissemination, antimicrobial usage in animals and related practices, drug residues in food products, public health significance, control measures and the Indian situation are reviewed.

## 2.1. Antimicrobial resistance

Antimicrobials include antibiotics, and other non-antibiotic compounds such as Sulphonamides and Nitrofurazones, which kill or inhibit the growth of other micro-organisms. After the invention of penicillin in 1929, a variety of antimicrobials were introduced, and are extensively used for medical and other purposes. Resistance of microbes to antimicrobials were recognized immediately after their introduction [91] and are conquering most of the antimicrobial weapons very rapidly [15]. Though genes for resistance existed naturally even before human usage, acquired resistance to antibiotics is the consequence of wide spread usage, and is the result of some genetic processes in bacteria [18, 23, 78]. Even though the resistance problem was confined to hospitals initially, resistant bacteria are now being detected in the community as causative of human and animal infections and as natural flora of body systems and abiotic environment [8, 24].

## 2.2. Antimicrobial usage and resistance

Emergence of antimicrobial resistance is attributed primarily to the excessive and often unnecessary use of these drugs in various fields [9, 26]. Over the last few years prevalence of antimicrobial resistance among natural flora and pathogenic bacteria has shown an abrupt increase both in hospital and community-acquired infections even to drugs that have worked clinically for decades [26, 44, 61]. Some concern has been placed on the liberal usage of disinfectants as a possible cause that might have contributed to the development of antimicrobial resistance in hospital settings [37].

Major genetic mechanisms behind the acquirement of bacterial resistance are mutation, selection, gene transfer and emergence of some dormant resistance mechanisms[18, 26, 44, 88]. All of these mechanisms are consequences of bacterial access to the drug, thus of its usage either irrationally or rationally [61]. Gene transfer has been recognized as the major contributor in the recent evolution of antimicrobial resistance on a global scale wherein the gene coding for resistance is exchanged on a molecular level between one bacterial cell to another [88, 90]. There are evidences for gene transfer between human, animal and plant associated bacteria [21, 28, 80], thus the antimicrobial resistance developed in one can be applicable to the other as well.

### 2.3. Antimicrobial usage in animal husbandry

Antimicrobials are mainly used in animals for treatment, prophylaxis and growth promotion [33]. Practices in animal husbandry such as feed supplementation and mass medication often lead to administration of low doses. Such practices are favorable to genetic selection for resistance in pathogenic and benign bacteria of the animals as well as the environment, thus increasing the pool of resistance genes [7, 27, 45, 55]. Relationship between usage of antimicrobials in animals and development of resistance in more and more strains of human bacteria has been established though the exact mechanisms and quantitative aspects are not clear [26, 22, 46, 88, 89].

Sensitivity tests in France has showed that animal strains from cattle and poultry were more frequently resistant to multiple antibiotics than from other sources [42]. However the magnitude and trend of resistance from animals depends on the husbandry practices prevalent in the country and mode of usage of antimicrobials in animals. A major share of antimicrobials are used for growth promotion of meat stock in developed countries [37, 89]. Such practices are less prevalent in developing countries, mainly because of less number or absence of meat stock and the predominantly traditional ways of rearing animals. Hence antimicrobials are mainly used for treatment purposes in these countries [25].

Digestive mechanism of ruminants are mainly microbial in nature facilitated by bacteria and protozoa in the fore-stomach. The fore-stomach of an average cow contains of about 100 liters of rumen liqour, which usually contains $10^8$ to $10^{10}$ bacteria and $10^6$ protozoa per milliliter [7]. So the amount of antimicrobial administered orally will be diluted to very low concentration for long periods favoring selection of microbial resistance [45]. A proportion of these microbes can come out during the rumination process and disseminate the resistance to other commensal strains. Most of the antimicrobials given as injections also diffuse into the rumen and result in sub-therapeutic concentrations[7]. Hence the chance of developing resistance is more in ruminants even if the drug is administered rationally.

### 2.4. Mastitis treatment and bacterial resistance in cows

Mastitis is the inflammation of the udder tissue impairing the secretion of milk and even with fatal outcomes, caused by microbes entering the udder. Mastitis forms the most common and major infectious disease in lactating cows in especially high yielders and the treatment includes antimicrobial therapy at the earliest with supportive measures [10]. Even after intensive preventive measures for decades, the prevalence of bovine mastitis has increased due to the emergence of antimicrobial resistant strains of bacteria and change in bacterial spectrum[3, 29, 50, 77]. Since a significant proportion of mastitis in cows is caused by Streptococci and Staphylococci, which are potentially dangerous to human beings causing most infections[18, 57, 92], mastitis in cows and the resistance development are of special public health concern.

### 2.5. Antimicrobial treatment practices

Rational use of antimicrobials is very important to maintain the effectiveness and potency of antibiotics avoiding conditions favorable to resistance development [91]. In human medicine there are many reports on rationality of prescriptions [39, 49, 63, 76] and these studies have showed that prescriptions of antimicrobials had large variations and were not always rational.

This is especially true in developing countries where owing to the lack of strict regulations a large share of antibiotics are sold over the counter and often mis-used [25, 85].

A study on treatment practices of 350 veterinarians in Sweden for bovine mastitis showed that many factors of importance for the clinical diagnosis of mastitis were not considered [20]. Basic measures like frequent emptying of the udder were recommended by only 40-50% of the veterinarians while about 60-70% of them took milk samples for bacteriological diagnosis. While 25% used a broad-spectrum antibiotic, 65-75% directed their initial therapy towards gram positive bacteria and 5% towards gram-negative bacteria. All of them preferred systemic route for administering antimicrobial for treating bovine mastitis while about 30-40% supported the systemic therapy with intra-mammary infusions.

Antimicrobial usage in low concentrations continuously for long periods is shown to be one of the major factor responsible for resistance development in human beings and animals [40, 45, 83, 88, 91]. Feeding sub-therapeutic doses of tetracycline to different animals and birds has been shown to cause more resistance development in bacterial flora than with therapeutic levels of the same drug [12, 14, 36, 28]. However therapeutic doses of antibiotics can also lead to resistance development especially when the administration is through oral route or the course of administration is inadequate[83, 91].

### 2.6. Antimicrobial residues and withholding period

Administration of antimicrobials to animals results in excretion of intact residues or metabolites in the products for human consumption for considerably long duration and is of public health concern. There are marked differences between the various antibiotic products, different routes and forms of administrations as regards residual persistence [4, 52]. The mean elimination periods for polypeptide antibiotic residues in cows milk lasted between three and six milking for injected preparations and between four and six milking for intra-mammary ones. While for aminoglycoside antibiotics, the mean elimination periods ranged between 4 and 13

milking after intra-mammary administration[47, 48]. The withdrawal times required for each drug has to be determined accordingly.

A 1973 survey in Pretoria showed that some of the pasteurized milk samples marketed contained more than 1.0 IU penicillin/ml and in some of the herds this figure exceeded 5.0 IU penicillin/ml [2]. A similar study in Poland also showed that 13.1 to 22.4% of raw milk, 10.5 to 19.5% of milk for consumption and 12.9 to 18.2% of powdered milk were contaminated with antibiotic residues [70]. Dudrikov´a et al [19] found that treatment of clinical mastitis in cows with Oxytetracycline resulted residues in milk for as long as two days after treatments at a concentration of 0.03 mg/kg. However they could not detect residues in milk of any animal from the 4th day of the cessation of therapy [19].

Detectable concentration of antibiotic residues have been reported in milk and meat even after observing recommended withholding period [60, 72]. Hence screening of milk samples for antimicrobial residues will be very important even if the farm practices are found to be optimum. In developed countries milk is strictly screened for antimicrobial residues and the milk containing residues is eliminated from the supply. For example, in England and Wales, there are reports to indicate that an average of 695 samples per month discarded due to higher levels of antimicrobial residues than prescribed levels in 1984-85 period [6]. Such guidelines are seldom followed in developing countries and here often the farm practices are also poor.

### 2.7. Farm practices and antimicrobial residues

Residues in milk have been attributed to defective practices of dairy farmers such as poor records of treatment, failure to observe recommended withdrawal time, prolonged period for drug clearance, treated animal identification problems, products not used according to label directions, lack of advice on withdrawal period, and so on [34, 74]. Improvement in management practices and adherence to manufacturer's recommendations were found to have a beneficial effect in decreasing the antibiotic residue in milk [32, 56].

Farmers awareness of use of antimicrobials and withdrawal duration and better relationships with veterinarians can be useful in preventing residue in milk [43, 74]. Milk received by dairy cooperative societies in Kenya was reported to be free from antibiotic residues and this was attributed to a high level of awareness among farmers on withdrawal time require-ments and its importance [58]. Several effective and useful on-farm residue screening tests are available and these are reported to be very effective strategy to reduce the risk of residue occurrence especially if the farmers were able to interpret the results of these tests [34, 43, 53].

### 2.8. Consequences of antimicrobial residues

Antimicrobial residues in milk besides interfering the manufacturing of dairy products, cause hypersensitivity or resistance to drug therapy in humans, and contribute to microbial resistance[13, 17, 34]. The chances of development of hypersensitivity reactions with residue are low. However they can sensitize individuals leading to hypersensitivity reaction on subsequent therapeutic administration. Even though the chance for sensitization is also very rare, antimicrobial residues in animal products as well as the excretion and secretion can form a strong selective force for microbial resistance [14].

Selection for resistant strains among natural flora of organisms is reported following exposure to antimicrobials [78, 86]. After administration to animals, antimicrobials and their metabolites can enter the soil or environment through manure and other routes, which could affect microorganisms and disturb ecological cycles [38, 45]. O'Brien et al found that effects of cooking and cold storage on the biological activity of the antimicrobial residues to be highly varied from nil to very minimal[54]. Any way antimicrobial residues in any products are undesirable and there are legal regulations such as withholding periods for each product to prevent detectable concentrations of residues after antimicrobial therapy [33].

## 2.9. Public health significance

The microbial resistance arising out of antimicrobial use in animals creates a major public health problem since it can increase the risk of antimicrobial resistance in human beings, mainly through the selection of resistant plasmids in animals [22, 45, 90]. In the US antimicrobial resistant strains of Salmonella, Campylobacter, Enterococcus and E. coli which have consequences for human health were shown to be transmitted from animals to human beings [37]. Similarly uncontrolled use of fluoroquinolones in animals and poultry is attributed to the explosive advent of resistant compylobacter and the link between usage in animals and development of resistance in human beings is well established [45, 59].

Development of antimicrobial resistance can also occur from the wide spread usage of compounds related to antimicrobials as well [37, 38]. Vancomyin resistance in Europe has been traced back to the sub-therapeutic usage of avoparcin ( a glycopeptide antimicrobial with structure closely related to Vancomycin ) in animals as a growth promoter. While in US, since avoparcin was not approved for use as a growth promoter, Vancomycin resistance was minimal [1].

Infections with antibiotic-resistant organisms clearly have an economic impact, although the extent remains uncertain [78]. Since antimicrobials are societal drugs, therapeutic and prophylactic use in any one individual is associated with the emergence of resistance in the entire community[46]. Studies in US have shown that infection with resistant organisms can increase the health expenditure to the extent of two folds or more due to the necessity and cost of replacement medicines[37]. There is an increasing demand for more new antimicrobials, fueled by the emergence of resistance to older ones. However the progress in the area of new antimicrobial development of is slow and the situation is exacerbated with more and more strains of bacteria acquiring resistance[66].

Though many new substances have been synthesized in recent years, to counter the development of resistance to older antibiotics, or to achieve pharmacokinetic ameliorations, resistance of clinical relevance has also been observed with these new antibiotics [89]. To illustrate, the effect of all third generation cephalosporins are affected by the overproduction of extended spectrum neutralizing factors produced against earlier ones, thus drastically reducing their effectiveness [16].

## 2.10. Control measures

Various proposals have been put forward to control the public health risk of antimicrobial resistance and to safeguard the efficacy of antibiotic therapy both in animals and human beings [22, 84]. The best approach will be to reduce the usage in all fields, and for this education of both professionals and public is the key component for action along with restricting the availability of valuable drugs through regulations [25, 82]. However in developing countries the use of antimicrobials for treating people and animals is not regulated [25]. The need for multifaceted studies to evaluate the impact of resistance globally, to identify the responsible factors and to fight against this problem have been stressed in various reports [1, 8, 9, 41, 75].

In some European countries, there is a ban on the use of antibiotics as growth promoters in animal feed. Nutritional use of antimicrobials has been regulated in UK by a council directive since 1987, which has also suggested an investigation into the potential of antimicrobial usage to increase the rate of drug resistance [27]. The Mastricht treaty has offered provisions to regulate the use of antimicrobials in animals in the whole of Europe. The use of antibacterials for growth-promotion was prohibited in Sweden in 1986 and antibacterial drugs became available only by veterinary prescription there after. This regulation has reduced considerably the total amount of antibacterials used annually and the level of antibacterial use has stabilized at a level of about 35 per cent lower than that before the ban [5].

To prevent the occurrence of antimicrobial residues in food products, quality management of dairy animals is essential along with other aspects. Concern regarding antimicrobial residue has prompted the dairy industry to develop various programs to support rational usage of antimicrobials in dairy farms [2, 73, 74]. In the US, drug residue concerns have resulted in the development of a Hazard Analysis Critical Control Point (HACCP) procedure as an effective approach for Milk and Dairy Beef Quality Assurance through residue avoidance[74]. Similarly the sensitivity levels of residue detection tests used by the Milk Marketing Board of England and Wales have been increased to minimize drug residues[6]. Such regulations are yet to be introduced in developing countries.

### 2.11. The Indian scenario

Antimicrobial resistance is a major problem in the country since most of the organisms are rapidly acquiring resistance, making them insensitive to available drugs. The development of resistance has lead to projection of drastic increases in the cost of treatment and increase in the death rates due to infectious causes in the future [25]. Multi drug resistant bacterial strains, especially Salmonella sp. have been reported from many states including Kerala [62, 67, 68, 69, 79, 81]. Most of these reports have indicated a rapidly increasing minimum inhibitory concentration for all the antimicrobials over the years [31, 68].

There are hardly any studies available from India on the magnitude of antimicrobial usage in animals, extend of resistance contributed from animals and the relationship between microbial resistance in animals and its development in human beings. Unlike developed countries, antimicrobials are not known to be used as feed additives, since there are no significant volumes of beef stock and modernization of production is lagging far behind. The very objective of cattle production in India is milk production followed by draught power and house hold production of 1-3 animals is the widely adopted strategy [64, 65]. Incidence of animal

diseases has considerably increased during the past especially after the introduction of cross breeding for better milk production [35, 71].

Poor economic status of farmers and inadequate facilities make rational treatment of animal diseases difficult and very costly. Lack of knowledge, weak regulations and free availability of medicines promote unqualified treatment and defective practices which cause resource wastage, high cost, repeated infections, loss of productivity and even incurable and fatal results. Improper usage of antimicrobial usage can have various public health consequences, due to microbial resistance and residue contamination. Vijayasree et al (1996) have reported Tetracycline residues far exceeding the permissible levels in the milk marketed in Kerala [87]. This is an indicator of the ongoing inappropriate practices among dairy animals and is possibly due to the lack of knowledge regarding its consequences.

However there is dearth of studies on magnitude of antimicrobial usage in animals, farmers' practices related to antimicrobial therapy, awareness levels of practitioners which are of relevance to antimicrobial resistance development. Hence this study is intended to gather some basic information on these lines based on secondary data analysis and community based investigation.

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Chapter 3

# METHODOLOGY

# 3. METHODOLOGY

This chapter gives the details regarding study design, descriptions of the study location, methods of data collection and analysis. It also includes a brief section on limitations of the study.

## 3.1. Study design

The information needed to draw valid conclusions for the study involved:

1. secondary data analysis to get background information on quantity and details of antimicrobial supplied, animal population details, occurrence of animal diseases and animal health care facilities and personnel available within the district;
2. primary data collection for practices related to antimicrobial usage in cows:-
   - qualitative information on antimicrobial usage practices of animal health care personnel such as Livestock Inspectors[1] (LI s) and Veterinarians (Vets), and
   - quantitative data collection as a cross sectional survey for care seeking practices of farmers whose cows had mastitis during the preceding 1 year.

## 3.2. Study location

Kozhikode district of Kerala was selected as the study location for convenience and prior personal experience in the district. The district has an area of 2344 sq. kms. along the coast of the Arabian sea and has common borders with Malappuram, Wayanad and Kannur districts on the three sides. The district has a human population of 2.6 million as per 1991 census with a population density of 11092 per sq. kms. and a total livestock population of 375731 of which 257964 are cattle (AH census.1996). Kozhikode is a historic city being the capital of Zamorin Kingdom and a major business center in South Asia. Presently Kozhikode

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[1] Para-veterinary staff intended to provide preventive vaccinations and first aid to animals, but have been known to treat animals .

forms head quarters of the Malabar (northern) region and is the second largest city in Kerala state.

There is a well functioning animal husbandry department network with at least one veterinary institution in every panchayath, and the main focus of the department is on increasing milk production through cross-breeding and providing health care. Cross breeding program in the state for increasing milk production was started in 1960s mainly in southern districts and was subsequently extended to Malabar districts. Hence the proportion of exotic cross-bred cattle in the district is about 50% which is higher than the average for Malabar districts, while it is lower than in southern districts of Kerala. Intensive efforts through various programs are going on, aimed at increasing the proportion of cross-bred cattle in Malabar districts and milk production.

Kozhikode district has a computerized data base giving the details of animal breeding activities and diseases treated at each of the veterinary institutions updated to one month prior to data collection. Moreover the Government's central veterinary store and main private veterinary medical distributor for Malabar districts is within Kozhikode city. This was expected to facilitate data collection on animal diseases treated and quantity of different medicines supplied for animal use within the district. Kozhikode also forms the head quarters of Malabar regional co-operative milk producers union and has a better network of co-operative milk societies for milk marketing. Better access to dairy farmers through above networks was also considered a favorable factor for selecting Kozhikode district for the study.

### 3.3. Data collection

Data was collected by the investigator personally during a period of 7 weeks from January to February 1999. Secondary data was collected for the entire district, while primary data collection was limited to 3 blocks of the district due to constraints of time and resources.

### 3.3.1. Secondary data

Nature of secondary data and sources are shown in the table 3.1.below. Quantity of antimicrobials supplied in the district was arrived in terms of pure antimicrobial ingredient present in different types of antimicrobial preparations supplied through public and private sources. Percentage composition of antimicrobial in each of the products and volume or quantity was used to compute the actual antimicrobial ingredient distributed. Among the animal disease details available for the entire district, month wise occurrence of total animal diseases and mastitis cases reported for the last 1 year was collected.

**Table 3.1.** Nature of secondary data required and sources of information

| Data required | Source |
|---|---|
| Quantity of Antimicrobials supplied in the district | From drug distributors and Regional Veterinary store at Kozhikode |
| Animal population details | Livestock Census report, 1996 |
| Animal disease details | AHD - NIC data base for Kozhikode district |
| Animal health care institutions | AHD - NIC data base for Kozhikode district |
| Animal health care personnel | AHD - NIC data base for Kozhikode district |

### 3.3.2. Primary data

Qualitative information on treatment practices of animal health care personnel was collected by interviewing seven each of Livestock Inspectors and Vets practicing in the vicinity of farmers selected. Data was collected using in depth interviews and discussions regarding antimicrobial usage practices based on semi-structured guidelines for the willing personnel among those working in the same locality.

Information on knowledge and practices of 80 dairy farmers, whose animals were treated for mastitis during the preceding one year was recorded based on a pre-structured

interview guideline[2]. Information was collected from owners having few cows (not more than 5) and owners of large cattle farms (more than 5) were excluded, since major deviations were expected in their practices.

### 3.3.3. Selection of Informants

In order to study farmers' practices, regarding antimicrobial usage, informants were selected through 15 milk societies of MILMA (Malabar regional cooperative milk producers union). Kozhikode district has a total of 114 milk societies under MILMA and some traditional societies. Of this 65 (57 %) societies are located within Kozhikode taluk and were selected for the study to ensure better access to farmers. Among the 4 blocks of Kozhikode Taluk, Chelannur and Kunnamangalam blocks were selected as they had high mastitis incidence reported during September-1998 and these blocks mainly cover rural areas, while Kozhikode block was selected as it include the urban and semi-urban areas for comparison purposes.

**Table3.2.** Details of milk societies selected for accessing farmers.

| Blocks | No of Societies | Societies selected | Farmers interviewed |
|---|---|---|---|
| Kozhikode | 7 | 3 | 18 |
| Chelannur | 16 | 7 | 36 |
| Kunnamangalam | 11 | 5 | 26 |
| Total | 34 | 15 | 80 |

Information regarding the proportion of milk societies and farmers selected from each of the blocks is shown in the table 3.2. Sampling of milk societies under the blocks were done randomly and informants were selected from those farmers supplying milk to these societies. From each society 5-6 informants each were selected randomly and were interviewed for the

[2] Mastitis being a very serious condition in cows, it was believed that farmers will remember the details of the disease occurred and treatments given during the past one year.

care seeking practices and milk utilization details during the very recent occurrence of mastitis in their cows.

Data collection was done using the following instruments

- Pre-structured in-depth interview using detailed interview guidelines for the farmers.
- Discussion cum in depth interview with semi-structured guideline for the practitioners.

### 3.4. Data Analysis

Data from the farmers' interviews were properly coded using convenient codes and entered into the computer by the investigator himself and the analysis was carried out using SPSS PC+ software. Information collected from the in-depth interview cum discussion with practitioners were also coded and the analysis was done manually because the small numbers involved. All other information obtained from secondary sources were manually tabulated. The main focus of analysis was descriptive, to identify the practices of practitioners and farmers related to antimicrobial usage in animals that are favorable for the development of microbial resistance and to identify the determinants of these practices.

### 3.5. Limitations of the study

- Primary data collection was limited to 3 blocks of a district and 80 farmers
- Interview involved a recall of practices during the previous 1 year
- Discrepancy in the study location between primary and secondary data
- Farmers practices were assessed based on interview and not by observation
- Drug supply data through private agencies were available only for 1 month
- Quantity of antimicrobial used for mastitis in cattle alone could not be obtained
- Proportion of mastitis and/or infectious diseases alone could not be obtained.
- No direct link with antimicrobial resistance was expected to be established

* * * * *

Chapter 4

# RESULTS

# 4. RESULTS

## 4.1. Background information

### 4.1.1. Animal population

Animal population of Kozhikode district consists of 69 % cattle and 30 % goats. Details of the animal population of the district as well as the state are given in appendix 1.1. While 8 % of total cattle in the state was in Kozhikode district, proportion of total animals in the district was 7% of the state total. The sub-divisions of cattle population in the district are given in table 4.1.

**Table 4.1.** Details of cattle population in Kozhikode district during 1996

| Categories | Population | | | | |
|---|---|---|---|---|---|
| | 1987 | % | 1996 | % | % increment |
| Total cattle | 262497 | 100 | 257964 | 100 | -2 |
| Cross breds | 75905 | 29 | 125590 | 49 | 65 |
| Indigenous | 186592 | 71 | 132374 | 51 | -29 |
| Cross-bred males | 9883 | 4 | 12841 | 5 | 30 |
| Cross-bred females | 66022 | 25 | 112749 | 44 | 71 |
| Total cows in milk | 74091 | 28 | 75752 | 29 | 2 |
| Cross-bred females in milk | 24739 | 9 | 39637 | 15 | 60 |

Source: A.H Census report 1996

Proportion of cross bred cattle though has increased only by 20 % over the 10 years period, proportion of cross-bred females has shown an increment of 71% over the same period. Among the 257964 cattle, 75752 were lactating cows and roughly 70% of them are high yielding cross-breds, they form the susceptible population for mastitis occurrence.

### 4.1.2. Institutions for animal healthcare

Treatment facilities for animals mainly included the veterinary institutions under the Animal husbandry department, hence they form the major channel of distributing

antimicro-bials for animal usage, along with private medical shops. The animal health care institutions of AH Dept. include veterinary centers and sub-centers of AH department. These are distributed almost uniformly in Kozhikode corporation, 2 municipalities and 76 Panchayaths, with at least one institution in every Panchayath. The details of animal health care institutions in the district (excluding administrative offices) are given in appendix 1.2.

Qualified veterinarians are supposed to work in all the 4 categories of veterinary institutions. However due to the scarcity of qualified Vets, most of the veterinary posts in dispensaries were vacant till the recent past and were managed by the subordinate staff, mainly LI s. During the month of study there were about 20 dispensaries with vacancy of Veterinary post in the district, wherein the treatments are provided by livestock inspectors. In addition there were 75 sub centers handled solely by LI s where some treatment was provided.

#### 4.1.3. Animal health care practitioners

Number of Vets and LI s working in Kozhikode district as on December 1998 are given in appendix 1.3. There were 101 qualified Vets in the district, of which only 75 were working in clinical posts. Every veterinary institution had one LI each along with other supporting staff. Besides, this livestock inspectors were working in the 75 sub-centers also. Altogether there were 144 livestock inspectors as against the total of 101 Vets present in the district including those retired from service.

### 4.2. Informant description

#### 4.2.1. Livestock Inspectors

Livestock inspectors are para-veterinary staff in the animal health care field in Kerala and their expected duties are to assist Vets in clinical, and administrative affairs and provide basic animal health care services at sub-centers. Minimum required qualification is

matriculation and are given 11 months training after recruitment. Training covers basic aspects of livestock management, first aid, preventive vaccinations, artificial insemination, and dispensing medicines under the direction of a veterinarian. Promotion posts in AH department are the positions of Assistant field officer (AFO) and field officer (FO). Duties of AFO s are similar to that of the LI s while FO s have only administrative duties.

Of the 7 L.I. s interviewed from the three blocks, 5 of them had more than 10 years of service and average service duration was 21.1 years(3-34 years). Five of them were working at sub-centers, and the other 2 were in hospitals under a veterinarian. Information regarding the background of these L.I. s are shown below

| | |
|---|---|
| Basic qualification | |
| SSLC | 4 |
| Pre-degree | 3 |
| Special training attended | 5 |
| Service in the present post | 1-6 years(Av. 2.6) |
| Current designation | |
| Livestock Inspector | 2 |
| Assistant field officer | 3 |
| Asst. field officer(retd.) | 1 |
| Field Officer | 1 |

Sources of acquiring knowledge for treating diseases were mentioned as Livestock Inspector training by all of them. However some of them mentioned reading books (3) and discussion with colleagues (1) as additional sources of information.

### 4.2.2. Veterinarians

Out of the 7 Vets interviewed from those practicing within the 3 blocks of the study, 2 of them had the experience of 25 and 28 years respectively (senior veterinary surgeons) and rest of them were veterinary surgeons with 2-10 years service. Two of them

were post graduates in clinical disciplines and 4 of them had received some form of special training in clinical aspects.

### 4.2.3. Farmers description

Out of the 80 farmers interviewed, 60 belonged to rural areas and 20 were from urban localities, also 45 were males and 35 females. Religion wise, 9 were Muslims and 71 were Hindus of which one informant belonged to Scheduled caste. Informant characteristics are summarized in table 4.2. below.

**Table 4.2.** Informant characteristics (figures in percentages)

| | | | |
|---|---|---|---|
| Location | | Rural<br>75 | Urban<br>25 |
| Sex | | Males<br>56 | Females<br>44 |
| Religion | | Hindu<br>89 | Muslim<br>11 |
| Caste | | SC<br>1 | General<br>99 |
| Education | Nil<br>10 | Primary<br>46 | Higher<br>44 |
| House | Pucca<br>30 | Semi-pucca<br>65 | Kacha<br>5 |
| Water source | Well<br>84 | Pipeline<br>10 | Stream<br>6 |
| Primary occupation | Cattle rearing<br>59 | Coolie<br>17 | Others<br>24 |

The mean age of informants was 49.2 ± 12.2 years and they had on an average of 20.89± 14.1 years of experience in dairying. Educational level varied widely with 33.8 % having high school education and 10% had college education. Out of the 27 informants having high school education or more, 19 were females. Of the total, 42 (53 %) had undergone some sort of training on cattle rearing and among them 19 were males and 23 females. This training was given by Milma through co- operative milk societies.

For 59 % of the informants, cattle rearing was the sole occupation and 83 % of farmers had either 1 or 2 cows and were cross-breds in 98 % cases. Except for 2

farmers who employed servants, owners themselves were looking after the cows and the primary caretaker was female in 51 % of cases. Other information related to animal rearing are given in table 4.3.

**Table 4.3.** Details of animals reared by the informants (figures in percentages)

| Criteria | Category 1 | % | Category 2 | % | Category 3 | % |
|---|---|---|---|---|---|---|
| Pr. occupation | Cattle rearing | 59 | Coolie | 17 | Others | 24 |
| Income | Rs 1000 or less | 30 | 1001-2000 | 45 | Above 2000 | 25 |
| Cow purchase | Loan | 17 | Ready cash | 54 | Born | 29 |
| Cow shed roof | Thatch | 64 | Tile or sheet | 35 | Concrete | 1 |
| Cow shed floor | Wooden | 33 | Stone | 16 | Concrete | 51 |

# Note: Rows will add to 100 per cent.

## 4.3. Magnitude of antimicrobial usage

### 4.3.1. Antimicrobial supply

The most commonly used antimicrobials in animal husbandry were antibiotics such as Tetracycline, Aminoglycosides, Penicillins and Cephalosporins, and non-antibiotic antimicrobials like Sulphonamides and Nitrofurazones. The quantity of different antimicrobials supplied over a month through government department and private veterinary drug distributor in Kozhikode district are presented in the table 4.4. below.

Government sector contributed only 10 % of the supply and 90 % was from the private source. Cross validation of the proportion was done by asking opinion of 10 veterinarians practicing in Kozhikode district regarding the sources of antimicrobial preparations they use and the proportion of government supply according to them was only 2-10 % (Av. 4.6%). Largest quantity supplied was Sulphonamide -Trimethoprim combination (44.76 Kg) followed by Fluoroquinolones (10.5 Kg). None of the preparations supplied were intended for feed supplementation as a growth promoter.

**Table 4.4.** Antimicrobials commonly used in animal husbandry sector in Kozhikode district and quantity consumed per month

| S.No | Antimicrobial | Antimicrobial supply in grams | | |
|---|---|---|---|---|
| | | Govt. source | Private source | Total |
| 1 | Tetracycline | 636 | 4308 | 4944 |
| 2 | Gentamycin | 172 | 652 | 823 |
| 3 | Streptomycin | 87 | 136 | 222 |
| 4 | Penicillins | 711 | 2982 | 3694 |
| 5 | Cephalosporines | 7 | 172 | 179 |
| 6 | Fluoroquinolones | 1100 | 9404 | 10504 |
| 7 | Neomycin | 88 | 15 | 103 |
| 8 | Sulpha +TMP | 1104 | 43659 | 44763 |
| 9 | Nitrofurazones | 2860 | 150 | 3010 |
| | Total | 6765 | 61477 | 68242 |

**Source:** Distribution records of veterinary store and private drug distributor

Common forms of antimicrobial preparations supplied are given in appendix 1.4. Except Neomycin and Nitrofurazone all antimicrobials were available as injections and other forms included oral, intra-mammary and local use preparations.

### 4.3.2. Firms involved

Antimicrobial supply for animals involved many firms, most of which were the same supplying human medicines, with a separate veterinary division. Details of the important firms involved in the supply are given in the table 4.5. Sixteen firms without antimicrobial products were supplying animal health products such as anthelminthics, non antimicrobial feed supplements and vaccines. Five of this firms were purely herbal based while others were general in nature. These 16 firms contributed only 193 (31 %) products commonly used in animals while the rest of 442 products were supplied by 18 firms of which 123 products were antimicrobials. List of important firms supplying antimicrobials for veterinary use and proportion of products are shown in appendix 1.5.

**Table 4.5.** Details of firms involved in the supply of veterinary drugs in Kozhikode district

| Sl . No | Details | Figure |
|---|---|---|
| 1 | Total Number of firms involved in the supply | 34 |
| 2 | Total number of products available | 635 |
| 3 | Total number of antimicrobial products | 123 |
| 4 | Proportion of antimicrobial products to total products | 19 % |
| 5 | Number of firms supplying antimicrobial products | 18 |
| 6 | Antimicrobials in the total products of those 18 firms | 35 % |

**Source**: Drug distribution records

### 4.3.3. Indications for antimicrobial use

**Table 4.6.** Occurrence of animal diseases and Mastitis in Kozhikode district during 1998

| (1) Months | (2) Total diseases (incl. poultry) | (3) Animal diseases (Excl. poultry) | (4) Mastitis cases | (5) Proportion of mastitis cases (4/3) |
|---|---|---|---|---|
| January | 33674 | 36202 | 797 | 2.2 |
| February | 33145 | 31137 | 651 | 2.1 |
| March | 30770 | 28959 | 629 | 2.2 |
| April | 29918 | 28502 | 562 | 2.0 |
| May | 28028 | 26335 | 736 | 2.8 |
| June | 26893 | 25642 | 843 | 3.3 |
| July | 33817 | 32424 | 914 | 2.8 |
| August | 36432 | 34992 | 823 | 2.4 |
| September | 34693 | 32766 | 850 | 2.6 |
| October | 36131 | 34023 | 917 | 2.7 |
| November | 32653 | 30681 | 717 | 2.3 |
| December | 32851 | 30983 | 733 | 2.4 |
| Total | 389005 | 372642 | 9172 | 2.5 |

**Source**: NIC - A.H. Department disease surveillance

Month wise details of total diseases treated at veterinary institutions in Kozhikode district, total diseases in animals (excluding poultry) and reported cases of mastitis are shown in table 4.6. Out of the total 3,89,005 cases treated at veterinary institutions in the district during 1998, 96 % was in animals and the rest in poultry. Mastitis was the most

important infectious disease in animals and there were 9172 cases of mastitis during the year. Mastitis cases reported showed significant variation between months ($p<0.05$) with the highest occurrence in July and October. However the proportion of mastitis cases to total animal diseases was highest during June and lowest in April.

### 4.4. Livestock inspectors' practices

#### 4.4.1. Antimicrobial usage

None of the LI s had received any special training on mastitis treatment or antimicrobial usage. However all of them were using antimicrobials. All of them had the same opinion that mastitis was the major indication for antimicrobial usage in animals. Other indications mentioned were uterine infection(2), fever(2), respiratory infections(1) and diarrhea (1). All of them knew that the major cause for mastitis in cows was microbial infection and the treatment mentioned was antimicrobials. Mastitis diagnosis was done based on symptoms (7), milk examination(4) and the history narrated by the owner (2).

Regarding the knowledge of common antimicrobial drugs used, all of them could distinguish Penicillin, Tetracycline and Gentamycin as antimicrobials, while most of them could not distinguish other common antimicrobials in use. Some of them also mentioned few commonly used non-antimicrobial drugs as antimicrobials. Regarding the mode of action of antimicrobials, only 5 of them knew that it is by destroying microbes. The details of their responses have been summarized in appendix 1.6. Gentamycin was mentioned as the first choice of antimicrobial for mastitis treatment by 6 persons and subsequent preferences were Tetracycline and then Penicillin for most of them. Opinion regarding antimicrobial treatments and usual practices are also summarized in the table 4.7.

**Table 4.7.** Opinion of livestock inspectors regarding practices of antimicrobial therapy

| Criteria | Ideal response | Response given | Person responded |
|---|---|---|---|
| Ideal duration to be given | 4 -5 days | 5 days | 5 ( n=7 ) |
| Usually given duration | | 3 days | 6 |
| Ideal frequency | 8-12 hrs | 12 hrs or less | 5 |
| Usually given at | | 24 hrs | 7 |
| Common route | Injection | Injection | 7 |

Regarding the calculation of dose, though six of them mentioned the necessity for assessing body weight, almost similar dose was used for all the animals. One of them mentioned that the use of a high dose was warranted in more severe cases and low dose in less severe cases. Preferred route of antimicrobial injection was intramuscular for 5 of them while three mentioned intravenous as the preferred route. Majority of them (4) were not aware of what happen to the injected drug in the body.

### 4.4.2. Knowledge regarding consequences of antimicrobial therapy

**Table 4.8.** Knowledge of livestock inspectors on consequences of antimicrobial therapy

| Criteria | Response 1 | Person responded (n=7) | Response 2 | Person responded (n=7) |
|---|---|---|---|---|
| Very high dose | Harmful | 6 | Harmless | 1 |
| Very low dose | Harmful | 2 | No effect | 5 |
| Short course | Harmful | 5 | No effect | 2 |
| Long course | Harmful | 5 | No effect | 1 |
| Drug combinations | Harmful | 3 | More effective | 3 |

Consequences of therapy as mentioned by the LI s are summarized in Table 4.8. Practices such as very high dose, short course and prolonged course was mentioned harmful by 5 each, but sub-dose usage was not recognized harmful by 5 of them.

Excretion of the injected drug in urine was mentioned by 5 of them while excretion in dung and milk was mentioned by 4 and 3 persons respectively and 2 of them were not at all aware of drug excretion and its channels. Duration of drug residue excretion was reported as few hours by 2, few days by 4 and few weeks by 1 out of the 7 persons interviewed. Three of them had conceived the idea that residue excretion through any route occurs only for some antimicrobials and for some routes of administration alone.

Consumption of milk with antimicrobial residue was mentioned as harmful by most of them (5) as it causes drug resistance(1) and allergy(1) in human beings, while 2 found it harmless. The means suggested to prevent residue consumption was discarding of milk during the injection days by 4 of them and two suggested boiling as a safety measure. Five of them did not know the consequences of antimicrobial residue on natural flora of microbes, while one person each mentioned destruction of flora and development of drug resistance.

**Table 4.9.** Possible precautionary measures and advises to clients suggested by livestock inspectors to maintain the potency of antimicrobials

| Precautionary measure | No of persons responded (n=7) |
|---|---|
| Rational usage | 4 |
| Use when properly indicated | 2 |
| Discarding products with residues | 3 |
| Completion of course of therapy | 2 |
| More stress on disease prevention | 1 |

All the livestock inspectors were aware that the potency of antimicrobials have decreased over the years and 6 of them agreed that there had been a change in preference of antimicrobial over the last few years. The reason attributed to this change was resistance development (3) out of extensive usage (2). They were also asked for the

possible precau-tionary measures and advises to clients so as to maintain the potency of antimicrobials and the responses are summarized in table 4.9.

Nevertheless, decreasing effectiveness of antimicrobials were not considered very serious by most (6) of the livestock inspectors. Three of them had not even imagined a situation wherein all the antimicrobials become ineffective due to the microbial resistance while another 3 were of the opinion that newer antimicrobials or other types of drugs will be invented even if the older ones becomes ineffective in total.

### 4.5. Veterinarians' attitudes and practices

(Investigator was a Veterinarian, hence, there can happen some professional bias involved).

#### 4.5.1. Mastitis treatment

Average number of mastitis cases treated by them during the previous month was 10.1 and approximate figure for the last one year was 61.4. Six of them mentioned variation in the incidence of mastitis between months of a calendar year and by seasons. Among those who mentioned seasonal variation, 3 said rainy season and 1 person each mentioned summer and post monsoon respectively as being the season of highest mastitis incidence in cows. Major cause for mastitis was microbial infections according to all of them, and non-infectious etiology was attributed in 5-10% of cases. Means of diagnosing mastitis reported is given in appendix 1.7. Culturing of the milk samples for rational treatment was done in very few cases ( 2 of the vets reported culturing in 1 and 2 % cases respectively) and was attributed to the lack of facilities available and urgency of treatment. Major remedy for mastitis was antimicrobial treatment by all of them and the other medicines mentioned were steroids (3) and antiseptics (1).

### 4.5.2. Practices of antimicrobial usage

Regarding the major indication for antimicrobial usage in animals, mastitis was the first one reported by all. Other common conditions mentioned were lower respiratory tract infection (4), uterine infection (3) and surgical conditions (2). Common antimicrobials in use for mastitis as reported is given in table 4.10.

**Table 4.10.** Common antimicrobials preferred by veterinarians for mastitis therapy

| Antimicrobial | No of responses | Preference | | |
|---|---|---|---|---|
| | | First | Second | Third |
| Gentamycin | 6 | 4 | 1 | 1 |
| Tetracycline | 4 | 1 | 1 | 2 |
| Strepto-penicillin | 3 | 1 | 2 | |
| Fluoroquinolones | 2 | | 2 | |
| Sulphonamides | 1 | 1 | | |
| Penicillin | 1 | | | 1 |
| Cephalosporine | 1 | | 1 | |

# Three veterinarians did not mention their third choice.

Gentamycin was the most preferred one, even though it was costlier and known to have a short duration of action, for its high effectiveness and low adverse effects than others. Regarding the administration of these medicines, all of them agreed that injections were the most effective route and the routes usually preferred were intramuscular and intravenous respectively for 3 each, while 1 veterinarian preferred the oral route.

Details of the administration of antimicrobials are summarized in the table 4.11. Minimum days for antimicrobial therapy was mentioned as 3-5 days by all of them depending upon the type of disease, while 4 of them also mentioned the maximum duration that can be given as 7 days, while it was 5 days for 2 and one had the opinion of variability with the disease.

**Table 4.11.** Opinions of Vets regarding administration of antimicrobials for mastitis

| Medicine | Averages of responses mentioned for | | | |
|---|---|---|---|---|
| | Usual duration | Ideal duration | Usual frequency | Ideal frequency |
| Gentamycin | 3 days | 5 days | 24 hours | 12 hours |
| Tetracycline | 3 | 5 | 24 | 24 |
| Strepto-penicillin | 3 | 5 | 24 | 18 |
| Fluoroquinolones | 4 | 5 | 24 | 18 |
| Sulphonamides | 5 | 5 | 24 | 12 |
| Penicillin | 4 | 5 | 24 | 12 |
| Cephalosporine | 5 | 5 | 24 | 12 |

### 4.5.3. Knowledge regarding consequences of antimicrobial therapy

Knowledge regarding the major consequences of deviating from the ideal practices of antimicrobial therapy mentioned is summarized in the table 4.12. All of them were aware of the kinetics of antimicrobials in the body and the expulsion of residues in excretions and secretions.

**Table 4.12.** Knowledge of Vets regarding consequences of differentials with respect to dosages associated with antimicrobial therapy

| Criteria | Response 1 | Person | Response 2 | Person | Response 3 | Person |
|---|---|---|---|---|---|---|
| Large dose | Harmful | 3 | Harmless | 1 | Beneficial | 3 |
| Small dose | Harmful | 2 | Harmless | 1 | Less/ no effect | 4 |
| Short course | Harmful | 4 | Harmless | 1 | No effect | 2 |
| Long course | Harmful | 3 | Beneficial | 2 | Less/ no effect | 2 |
| Combination | Harmful | 1 | More effect | 5 | Variable | 1 |

Milk and urine were mentioned as the excretion routes by all, while dung and other routes were mentioned at least by 3 each. Duration of drug residue excretion reported varied from few hours to few days and 6 of them mentioned variation in the

duration of excretion with type of antimicrobial. Five of them also said that duration of excretion is different for different routes of administration. Similarly only 5 of them were aware that residue of all antimicrobials are excreted in milk, while 2 disagreed with this.

Residue in milk was harmful to public health according to all of them and the consequences mentioned were drug resistance(6), sensitization (2) and flora destruction. All of the vets mentioned discarding of milk until drug withdrawal and the period mentioned was 3-7 days(Av. 3.85 ). Effect of drug residue on natural flora of microbes reported was destruction (5), resistance (1) and no effect(1).

**4.5.4. Knowledge on antimicrobial resistance**

Regarding the mechanism of drug resistance development, mutation(4) and gene transfer(1) was mentioned by 4 people, while the other 3 had no knowledge of this. Major reasons for resistance development mentioned were low dose treatments (4), while 3 mentioned both high and low doses. Similarly 3 of them mentioned short course therapy and 2 persons each had the opinion of long course or irregular course as major reasons for resistance. One person had a generalized view that all sorts of administrations equally contribute to resistance development.

Three people were unaware of the transfer of resistance factors between microbial strains, while the rest knew the possibility of antimicrobial resistance transfer between environmental strains to human strains(4), between human and animal strains(3) as well as between genera of microbes (3). Five of them reported a decrease in the potency of antimicrobials over the years, and attributed this to resistance development, while other 2 did not believe that there had been any change in the potency. Six of the vets mentioned a change in preference of antimicrobials over the last few years and the main reason for this change was attributed to resistance(5) and/or availability of better options(2).

All the Vets preferred broad spectrum antimicrobials usually to avoid the difficulty of differential diagnosis and/or the delay for culturing and sensitivity testing. Strepto-penicillin was the most preferred antimicrobial for mastitis treatment few years back and the Vets mentioned that currently it was effective only in 5- 40% (Av 21.67) cases. An average of 23.57 % (5 to 50 %) of mastitis cases were reported to have required a change of the antimicrobial selected first hand. Five of the 7 also reported a decrease in the effectiveness of same antimicrobial in the same animal for a second time treatment, while 2 of them mentioned no change.

### 4.5.5. Opinion regarding consequences of Drug Resistance

The veterinarians felt that the development of drug resistance can result incurable diseases (3), flare up of infections (2), reemergence of diseases and high cost of treatment (1 each). Four of them reported that microbial resistance is irreversible once acquired, while 1 believed that it could be reversed and 2 could not comment. Two of them could not visualize a situation wherein resistance occurs against all antimicrobials while others did not rule out such a possibility.

The modalities of tackling these developments mentioned were developing newer antimicrobials (4) or very high dose therapies (1). Five of the vets believed that there was a scope for developing newer antimicrobials while two of them did not believe that this was possible. Chances of developing resistance to newer antimicrobials was less according to most Vets (5) while two of them also agreed that there is chance for transfer of resistance from older antimicrobials to newer ones easily.

### 4.5.6. Veterinarians view on public health significance of drug resistance

All the vets had realized that antimicrobial resistance is an emerging public health problem and 5 of them knew that resistance in animals and human beings are inter related.

Five of the vets agreed that animal husbandry sector contributed to the resistance in human beings, the reasons for this being attributed to indiscriminate usage (4), improper usage (3) and lack of withdrawal period observation (3) and so on. Accordingly various precautionary measures were suggested and this includes administration of adequate dosages and completion of course (5) discriminate and qualified treatments (3), and withdrawal period observation (3).

Even though proper usage was reported as a precautionary measure to prevent antimicrobial resistance development, in most of the cases there were deviations from the correct dosage, adequate frequency and proper course of treatment, and the reasons attributed are given in table 4.13.

**Table 4.13.** Reasons attributed by the veterinarians for deviation from the ideal practices of using antimicrobials

| Reason | Number of responses (n=7) |
|---|---|
| Access difficulties | 6 |
| High cost of drugs | 4 |
| Lack of proper awareness | 3 |
| Practical difficulties | 2 |
| Lack of immediate consequences | 2 |

Opinion regarding the issues on which farmers required education to minimize the harmful consequences of antimicrobial usage were asked about and the responses mentioned were; observation of withdrawal period for products(5), completion of course of treatment (2), hygienic practices(1) and avoidance of self medication with antimicrobials (1). However, contrary to these opinions farmers were seldom advised regarding these precautions and the reasons for the same have been cited in the table 4.14.

**Table 4.14.** Reasons mentioned by veterinarians for not giving the proper advises to farmers regarding the precautions to be observed

| Reason | Number of responses |
|---|---|
| Farmers will not obey | 5 |
| Economic loss to farmers | 4 |
| Not taken very serious | 4 |
| Lack of proper awareness to people | 3 |
| Double burden to farmer | 2 |

From the above findings it is clear that even though all the vets are well aware of the development of antimicrobial resistance, its causes and contributory factors, their treatment practices indicate deviations from their knowledge and this may be attributable to lack of proper knowledge regarding, its long term consequences, seriousness of the issue and real public health significance.

### 4.6. Farmers' practices

#### 4.6.1. Care seeking for mastitis

Among the 80 cows which had mastitis during the preceding one year, 82.5% had only one incidence and 70 % of these incidences were in the ongoing lactation period. The condition occurred within 6 months of lactation in majority of the cases (94 %) and 61 % were at the beginning of lactation (within 3 months). In 73 % of cases only one quarter of the udder was involved, while either 2 or all the four quarters were affected in 23 and 5 % respectively. Details regarding treatment of mastitis are given in table 4.15.

Out of the 80 cows affected, 68 were presented to the practitioner for treatment, while for the rest, the owner had just represented the case for getting treatment. In 64% of the cases milk was tested at the hospital, while except in 1 case culturing of milk sample and drug sensitivity testing was not carried out in any of the cases.

**Table 4.15.** Details of care seeking by the farmers for mastitis in their cows

| Criteria | Group 1 | % | Group 2 | % | Group 3 | % |
|---|---|---|---|---|---|---|
| Treatment started | First day | 45 | Second day | 38.8 | Beyond 2nd day | 16.2 |
| Institution treated | Dispensary | 70 | Sub-center | 8.8 | House | 21.2 |
| Conveyance | Walk | 30.4 | Cycle | 5.1 | Bus | 64.5 |
| Personnel treated | Doctor | 76.3 | L. Inspector | 22.5 | Self treated | 1.3 |
| Preference for | Easy access | 82.3 | Availability | 8.9 | Others | 8.8 |
| Cow treated at | Home | 72.5 | Institution | 11.3 | Not presented | 16.2 |

# Rows will add to 100

### 4.6.2. Practices related to antimicrobial usage

The major remedy for mastitis was antimicrobials and the preparations commonly used were in the form of injection, udder infusion and boluses. From the descriptions about the medicines and details of administration, it was clear that antimicrobials were used in all the cases for treatment. Type of medicine used are summarized in table 4.16 and the details regarding administration such as duration of therapy, average frequency and number of antimicrobial preparation administered are shown in table 4.17. The volume of the injection as assessed from the size of vial reported was 10 ml in 34 (55.7 %) cases, and among this 34, in 27 (79.4 %) cases the medicine was powdery - to be reconstituted with water at the time of injection.

Change of antimicrobial was required in 13 (16.3 %) of the 80 cases and the change was made from fourth day in majority of the cases (Av 3.85 days±1.57). The nature of change was from one medicine to another in 92 % cases while just a shift in the form of the same drug for a different route of administration in rest of the cases.

Personnel treating was also changed in 10 (13 % )of the cases of which, 6 were cases treated by livestock inspectors and rest by Vets. The change occurred mainly from 4th day and the main reason attributed was failure to effect a cure. Medicine was left out only in 3 (4 %) cases and in these 3 cases they were medicines for external applications.

**Table 4.16.** Type of medicine used for treatment of mastitis in cows

| Type of medicine | Cases given | Percentage |
|---|---|---|
| Injections | 63 | 78.8 |
| Bolus | 40 | 50 |
| Drenches | 23 | 28.8 |
| External | 42 | 52.5 |
| Udder infusions | 35 | 43.8 |
| Non-medical | 32 | 40 |

**Table 4.17.** Details of administration of antimicrobials for mastitis

| Details of medicines | Administration | Cases given | Percentage |
|---|---|---|---|
| Injection | One type only | 60 | 95.2 |
| | 3 days or less | 49 | 77.8 |
| | Once per day | 47 | 95.5 |
| Bolus | Single | 17 | 42.5 |
| | Once per day | 3 | 8.1 |
| Infusions | One only | 34 | 97.1 |
| | Once per day | 26 | 74.3 |

Number of days of treatment advised was 3.9±2.49 days on an average for all the cases including all sorts of treatments and there were only 6 (7.5 %) cases wherein the treatment was discontinued before completion of the advised duration. The major reason for this discontinuation was cure in 4 cases while lack of hope for cure in rest of the 2 cases. Among the cow owners, those who mentioned that they had the ability to give injections and udder infusions to their cows were 14 % and 38 % of the total

respectively. Even though 22.5 % of farmers had the knowledge to indulge in self treatment for mastitis using either antimicrobial infusions (15%), injections (3.8 %) or external medications (5 %), only one(1.25 %) did so.

**4.6.3. Treatment effectiveness**

Result of treatment was complete cure of the condition with regaining of secreting function of udder only in 51% of cases, while partial cure with loss of secreting function of affected portion of the udder in 31 % of cases. In 18 % of cases, the result was complete failure of treatment which lead to either death of the cow and/ or complete loss of secreting function of mammary glands. Result of cure was found to be influenced by several factors. Distance to near by veterinary institution, time taken to start treatment and cure rate in urban and rural areas are compared in table 4.18.

**Table 4.18.** Urban rural differences in distance to near by veterinary institution, time taken to start treatment and cure rate.

| Distance to near by institution | Rural % | Urban % | Day of starting treatment. | Rural % | Urban % | Result of treatment | Rural % | Urba n % |
|---|---|---|---|---|---|---|---|---|
| 1-3 KMs | 57 | 70 | First day | 42 | 55 | Total cure | 58 | 30 |
| 4-5 KMs | 33 | 20 | Second day | 42 | 30 | Partial cure | 30 | 35 |
| 6 or more | 10 | 10 | 3rd or more | 16 | 15 | Failed | 12 | 35 |

In the cows treated 75 % are still reared by the owner irrespective of cure effected while 17 (21 %) cows were sold after the treatment and 3 (4 %) died after or during the treatment period. Among the 17 animals sold, 2 are still reared by the new owner, 8 were slaughtered and the whereabouts of 7 are not known. All the animals slaughtered were well beyond the drug withdrawal time, either within the same month (2), beyond 10 days or a month afterwards (6), which is beyond the recommended withdrawal period.

Infected quarters of the udder were milked during the days of disease in 69 (86 %) cows, of which, in 37, milking started from first day, while it was started on the 2nd day in 24 and afterwards in rest of the cows. The collected milk was very less in quantity and color and consistency were abnormal in most of the cases and hence not consumed in any of the cases. In 9 cases it was fed to calf either after milking or simply allowing to suckle without milking, and in the rest of the cases the milk was disposed off. Complete cure of the affected quarters was obtained only in 41 (51 %) cases while failed in the rest. Normal milk was obtained from these quarters within 3 days in 35 % of cases, while beyond 3 days in the rest. Average time taken for cure was 3.41± 2.14 days from commencement of treatment and the average number of days from which consumption of milk was resumed was 4.85±3.64 days.

### 4.6.4. Milk utilization during mastitis treatment

Unaffected quarters were milked in all except 4 cows during the days of disease. Milking was started from first day in 70 animals and subsequent days in the remaining 6 cows. Though the quantity was reduced, color and consistency was normal in most of the animals (68) and was used for consumption in 63 animals. Consumption started from first day itself in 51 % animals, and the average day of beginning consumption was 2.65±3.94 days. Details of milk consumption and sale from affected and unaffected quarters are given in table 4.19.

Non-consumed milk from unaffected quarters were either fed to calf (70 %) or disposed off (30 % cases). Disposal of the milk was done either by burying or pouring far away from the premises by 42 (55 %) farmers and milked out in the cow shed itself by rest of the 34 (45 %) cases irrespective of the affected/unaffected quarters. Of the 80 farmers, 41 were of the opinion that open ground discarding of the milk from

mastitis cow is harmful, while 10 of them said that it was harmless and 29 had no idea. Among the 41 who said that it was harmful, 38 people and 4 among the 29 with no idea, disposed milk either by burying or pouring off .

**Table 4.19.** Percentage of farmers by the timing of milking resumption and sale of milk from affected and unaffected quarters

| Day of starting | From affected quarter (n=41) | | From unaffected Quarter (n=63) | |
|---|---|---|---|---|
| | consumed | sold | consumed | sold |
| 1 -3 days | 48.7 | 51.2 | 73 | 66.7 |
| 4-7 days | 41.5 | 39 | 19 | 25 |
| Beyond 7 days | 9.8 | 9.8 | 8 | 8.3 |
| Average days | 4.85±3.64 | 4.8±3.67 | 2.65 ± 394 | 3.12±3.95 |

Discarding of milk during the treatment period and drug withdrawal duration was reported to have been advised only to 6 (7.5 %) of farmers and all of these had been treated by veterinarians. The average withdrawal duration advised in these 6 cases was 4.67±1.51 days while the average duration of antimicrobial treatment varied from 2-5 days with the average of 3.2 days. Days of discarding milk by the farmers from both affected and unaffected quarters are given in the table 4.20.

Out of the 63 cases in which injection was given, milk was consumed in 48 cases and for these cases alone, the ideal milk withdrawal period required, based on the number of days of injection and the days observed are compared in table 4.21. In 71 % of these cases the duration of milk discarding was less than the required withdrawal period. Even though the period observed was sufficient in 29 % of the cases, that is attributable to lack of milk secretion or emotional reasons. Even if comparisons with duration of antimicrobial treatments in any form are made, in 57 (71 %) cases discarding period observed was insufficient to complete the drug withdrawal and

residue occurrence in milk. Out of those 57 farmers, 54 were of the opinion that they would have observed discarding period if the health care practitioner advised them to follow them.

**Table 4.20.** Distribution of farmers based on the number of days of discarding milk from mastitis cows receiving antimicrobial treatments

| Days | Number of farmers | Percentage (n=80) |
|---|---|---|
| 0 days | 33 | 42 |
| 1-3 days | 13 | 17 |
| 4-7 days | 11 | 14 |
| 7-10 days | 6 | 8 |
| 11 and above | 15 | 19 |

**Table 4.21.** Ideal milk discarding period required based on the number of days of antimicrobial injection given compared with days actually discarded

| Milk withdrawal period | Duration of injection given (in days) | | | |
|---|---|---|---|---|
| | 1 day | 2 days | 3 days | 4 or more |
| Ideal period needed up to | 4$^{th}$ day | 5$^{th}$ day | 6$^{th}$ day | Above 7 |
| Cases observed less than ideal | 7 | 13 | 11 | 3 |
| Cases observed ideal days or more | 3 | 4 | 4 | 3 |
| Total cases | 10 | 17 | 15 | 6 |

The number of days from the last day of antimicrobial given to the onset of consumption or sale of milk is shown in table 4.22. The averages were1.85±3.74 and 2.26±5.10 days respectively. The difference between these two periods were mainly due to the decrease in the milk production so that milk was not sufficient for sale after household consumption. There was no distinction between children and adults in the consumption of milk during treatment and post treatment periods. Sale of the milk was to milk societies in most of the cases (58) while it was sold to near by hotels in 3 cases and to neighbors in 4 cases.

**Table 4.22.** Onset of milk consumption/sale from the last day of antimicrobial administration in cows treated for mastitis

| Days | Onset of milk consumption from | | Onset of Milk selling from | |
|---|---|---|---|---|
| | Number | Percentage(n=67) | Number | Percentage(n=65) |
| 0 days | 34 | 50.7 | 32 | 49.2 |
| 1-3 days | 24 | 35.8 | 24 | 36.9 |
| 4-7 days | 4 | 6.0 | 3 | 4.6 |
| 8 and above | 5 | 7.5 | 6 | 9.2 |

### 4.6.5. Knowledge of drug residues

Out of the 80 farmers, 41 knew that drug residue occurs in milk during treatment for mastitis and among this 41, 37.5% knew that the residue continues to occur in milk for few days after cessation of treatment. However only 25% of those 41, who knew about residues in milk mentioned that consumption of milk with drug residue was harmful to human health. Knowledge expressed by the farmers regarding drug residues in milk is summarized in appendix 1.8. All the results are discussed in detail in the following chapter below.

* * * * *

# Chapter 5

# DISCUSSION

# 5.0. DISCUSSION

## 5.1. Antimicrobial usage

Antimicrobials used in animals were same as those commonly used in human beings. Monthly supply of 68.24 Kilograms of pure antimicrobial ingredient in various preparations supplied makes a very high quantum of usage, though a comparable figure is not available for human use and/or total antimicrobial production. Since any form of use in animals irrespective of whether it is rational or irrational, can contribute to development in microbial resistance in the community [9, 22, 46, 88], it is of public health importance.

The period of study happened to be a time when total animals diseases and mastitis incidence was almost similar to the monthly average for the year (Table 4.6). ie; 30983 versus 31054 and 733 versus 764 respectively. Hence the actual quantity and proportion of supply can be more or less similar to the figures obtained. Bulk of the supply was through private sources (90 %) and government supply accounted for only 10 % of the total antimicrobial supply. As per the opinion of Vets also, government supply formed less than 5 % of the total supply for the last few years, which indicates that the proportion of private supply and total supply can be even more than what is obtained.

Sulpha + Trimethoprim combination (65 %), Fluoroquinolones (15 %) and Tetracycline (7 %) formed the major groups of antimicrobials supplied, and this concurs earlier reports [33]. This may be due to the availability of these drugs for oral administration and moreover these are used in poultry for prophylaxis of various infections [7, 33] which might have contributed to their higher quantum of usage. Thus, a major proportion of the antimicrobials supplied might have been used either orally and/or for mass medication [25, 26] and this is highly favorable for microbial resistance. Rest of the drugs are available as injections or intended for external use and are seldom used in poultry, hence the quantity supplied can be considered to have been used entirely in animals.

All the antimicrobial preparations supplied were meant for therapeutic purposes and a few for prophylaxis [33]. Even though there were preparations intended for mass treatment in poultry mixed with feed or water [25,26], there were no products available as feed additives for growth promotion in livestock or poultry. Many firms, including the veterinary divisions of major firms supplying human medicines were involved in the supply of veterinary drugs and their major focus was antimicrobials and other feed supplements since there is better turn over for these products. Out of the total products supplied by 18 major firms, 35 % were antimicrobial products which evidences the market potential of antimicrobial products for animal use and therefore its extensive usage.

Even though a small proportion of human antimicrobial products are used in animals, the magnitude is negligible because it is uneconomical for livestock and poultry use. There was no other whole sale private distributor for veterinary drugs in the district and nearby districts, other than the one from which data was collected. Hence the antimicrobial supply for animal use in the district will be more or less the same obtained in the study. During the study year, 3.89 lakh cases of diseases were treated in the veterinary institutions in the district of which a good proportion might have involved the use of antimicrobials.

Even though mastitis forms the major indication for antimicrobial usage, the proportion mastitis cases to total animal diseases was only around 2.5 % and this is due to the disparity between the susceptible population and the denominator. Animal population of Kozhikode district mainly includes 69 % and 30 % goats and the proportion of cross bred cattle and high yielding cows has increased drastically (71 %) over the last 10 years. Since mastitis is less frequent in goats, we can expect more than 95 % of the reported mastitis cases in these cows. Thus the 9172 cases of mastitis might have occurred in about 40000 lactating cross bred cows making 10 mastitis cases reported from every 44 cows

per year. All cases of mastitis including clinical and sub clinical cases require antimicrobial therapy [7, 10] thus necessitating the use of enormous quantity of antimicrobials in dairy animals.

### 5.2. Livestock Inspectors' practices

Most of the livestock inspectors had more than 10 years of service and a majority of them were working in independent stations, namely sub-centres having enough opportunity to treat animals. Even though specific details are not available, it was clear from the discussion with LI s that they did treat a range of animal diseases. Those working in hospitals under a veterinarian were also known to be treating animals in the vicinity of their residence. Even though LI s are not supposed to treat animals, that they do so is evident. The possible reasons for the same are listed below.

1) Livestock inspectors are more in number and they are often local people residing at villages for long, hence familiar, easily available and providing service at low cost to farmers. (2) Lack of sufficient qualified Vets, especially in villages and farmers preference for cheaper and easily available care. (3) Facilitating factors like independent institutions called sub-centres manned by LIs who are authorized to do first aid. (4) Poor knowledge of farmers and inability to distinguish veterinarians. (5)Availability of all medicines in the market , weak and non-implemented regulations, and poor supervision.

Even though the source of knowledge for treating animals were mentioned as basic Livestock Inspector training by all of them, this training is quite insufficient to provide a minimum baseline knowledge on diagnosing and treating animal diseases. It was obvious that all the livestock inspectors had some experience in hospitals under a veterinarians at some point of their service. Hence observations from the hospitals and information from the veterinarians might be the major source of information, supplemented by reading

books and discussions with colleagues, as mentioned by some of them, to develop their practice. So their treatments are merely empirical and may be defective.

Livestock inspectors were aware of the fact that the potency of antimicrobials had been decreasing over the years [78] and that this is due to the indiscriminate usage of these drugs [8, 22]. Yet none of them were seriously concerned about the possible long term consequences. All of them agreed on the need for controlled use of available antimicrobials, even though at least some of them were very optimistic of developing antimicrobials in the coming years, even though such a possibility is limited [37, 89].

From the available evidence it is clear that livestock inspectors were treating animals using antimicrobials even though this is not within their mandate for practice and training. Hence there were lot of defective practices, attributable for antimicrobial resistance development arising out of their lack information regarding scientific treatment of diseases, rational use of antimicrobials and the possible consequences in animals as well as human beings [1]. Even though the existing situation in animal husbandry sector is promoting their practice, there is need to regulate the usage of drugs such as antimicrobials [33], by unqualified people, as their misuse could have long term public health consequences.

### 5.3. Veterinarians' attitudes and practices

The veterinarians selected had a wide range of experiences and all of them had treated mastitis in the immediate past. Diagnosis of mastitis was usually done based on symptoms reported by the farmers and gross examination of milk and udder. Culturing of milk sample for the rational selection of antimicrobial was not done except in very few cases due to lack of facilities and the need for immediate treatment [91]. Hence broad

spectrum antimicrobials such as Gentamycin followed by Tetracycline and Strepto-penicillin were the most preferred drug for treating mastitis [7, 78].

Administration of all the antimicrobials were done only at 24 hours, even though this interval is inadequate for most of the antimicrobials to maintain sufficient therapeutic blood level[7, 91]. Veterinarians were aware of the deviation of their practices from the ideal course and frequency required [1] but had to depend on farmers bringing animals for injection along with other difficulties in animal treatment such as :

1) Contraindications of administering antimicrobials orally to ruminant species. (2) Difficulty of presenting the diseased animal for injection all the time (3) Poor knowledge of farmers leading to discontinuation of treatment when clinical cure is apparent. (4) High cost of treatment, especially in relation to the cost of the cow. (5) Poor economic background of farmers making it a double burden of treatment cost and loss of livelihood. (6) Lack of awareness of farmers regarding the consequences improper treatment.

Veterinarians had reasonable awareness regarding the pharmaco-kinetics of antimicrobials in the body and excretion of drug residue in milk. Public health hazards of drug residue in milk was known to all and they did mention of discarding of milk until drug withdrawal as the safety measure[7]. However their awareness regarding consequences of irrational treatment with antimicrobials and reasons for resistance development had major variations. While 4 persons each attributed short course and sub-dose treatments as the major reasons for microbial resistance [91], only 2 of them mentioned prolonged course also as the reason [26] for resistance selection. Likewise there were variations in the withdrawal period suggested for milk, even though the minimum days of milk discarding ( 3 days after the cessation of therapy) was quite adequate[7].

Major cause for resistance development was mentioned as mutation. However 6 of vets knew that drug residue also selects for resistant microbes [26]. Only 3 Vets were aware of the transfer of drug resistance between different strains of microbes[78] and the possibilities of resistance dissemination easily within the whole community [30]. Decline in the effectiveness and change in preference of common antimicrobials over the years was realized by all the 7 vets and was mentioned to be a consequence of wide spread usage [78] and the resultant development of microbial resistance. However 5 of them were confident of the scope for developing more and more new antimicrobials. Chances of microbial resistance against newer antimicrobials was thought to be less by 5 of them and only 2 of them were aware of the possibility of resistance transfer from older to newer antimicrobials[37, 22].

All the vets had realized antimicrobial resistance as an emerging public health problem. Most of them knew that the resistance in animals and human beings are inter related [26], hence indiscriminate usage in animals can contribute to the resistance in human beings. Precautionary measures suggested were prudent usage, proper regulation of antimicrobial usage and education of farmers and public [1, 8] regarding the consequences of antimicrobial usage.

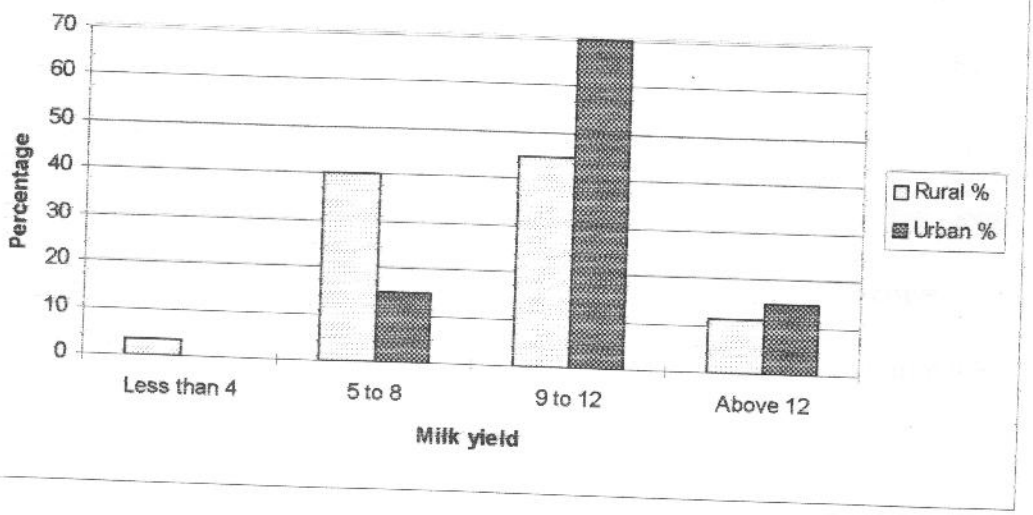
It was understood that even though Vets are well aware of the need for prudent use of antimicrobials, and consequences of microbial resistance, their practices are not well in accordance with the ideals of rational antimicrobial usage[7]. Even though this deviation was attributed entirely to the practical difficulties and special nature of animal treatment, it was obvious that besides these factors, poor knowledge regarding the dimensions and long term consequences of antimicrobial resistance in animals and the imminent public health hazard might be the major factor responsible for the defective practices of antimicrobial usage in animals not only for mastitis but other diseases as well.

## 5.4. Farmers practices related to antimicrobial usage

Farmers practices can be attributed to a major extend to the knowledge and attitude of practitioners along with various other factors. Even though 25 % of the farmers were from urban localities staying either in Kozhikode corporation area or in other towns, their care seeking practices were not very different from that of rural farmers for factors such as time lapse to treatment, person treated, and milk utilization during treatment, however the cure rate was lesser (chi-square $p<0.05$)in urban areas (table 4.18).

Only 30 % of cows from urban areas were cured totally as against 58 % in rural and the proportion of total failure was 35 % in urban areas as against only 11.7 % in rural. This happened even though the number of previous mastitis attacks in these cows and the person treated were almost similar in both the areas. More over 55% of the cows from urban areas were treated on the first day itself, while it was only 42% in for rural areas. This indicates that the effectiveness of antimicrobial treatment for mastitis is less in urban areas, and may be due to the higher prevalence of resistance organisms compared to rural areas. Overcrowding in the urban areas may be a factor contributory to this [26].

**Figure 5.1. Milk yield of cows treated in rural and urban areas**



Milk yield of the cows treated at urban and rural areas are compared in the figure 5.1. In urban areas 85 % of the cows affected with mastitis were high yielders producing more than 8 litres of milk per day while in rural areas it was only 57 %. So more high yielders can be expected in urban areas and this may also be a contributory factor to poor treatment response in urban areas.

Average age of informants was 49.2 ± 12.2 years and was found to have some influence on the day of starting treatment since all the farmers who delayed treatment beyond second day of illness were above the age of 40 yrs. Likewise maximum number of failure of treatment or partial cure was in the same age category. Educational level and training given on cattle rearing was not found to have any influence on the time lapse to treatment after the onset of symptoms and result of treatment. Likewise experience in dairying had no obvious influence on treatment practices and result of treatment.

It was found that the proportion of cases cured was significantly less (Chi-square $P< 0.05$) in case of farmers whose primary occupation is cattle rearing as compared to other categories (total cure proportion 43 % versus 64 % ). This happened even though the time of starting treatment and other practices were almost similar for these groups. However the major difference between the two groups were the milk yield of cows reared (Chi square $p<0.01$). While 77 % of the cows reared by the farmers, whose primary occupation was cattle rearing was high yielders (more than 9 litres per day) while it was only 45 % for the other occupation groups. Another factor contributed to the above result is with respect to the person who treated the cows. While 30 % of the cows belonging to those with cattle rearing primary occupation were treated by LI s , only 12 % of cows belonging to others were treated by LIs.

**Figure 5.2. Result of treatment by practitioners**


Result of treatment according to the personnel treated are shown in the figure 5.2. Out of the 18 cases treated by LI s the proportion of cows that received total cure, partial cure and failure were 28%, 33% and 39% respectively while it was 57%, 31% and 11% respectively for the 61 cases treated by Vets the variation being significant at 5% level (Yates corrected Chi-square ). A comparison of the time lapse of presenting cases, and treating personnel indicated that, a majority (56 %) of the cases were reported to the LI s on the first day itself, and 28% on the second day of noticing the illness, only 41% was reported to the veterinarian on first day, while 43% was on the second day of illness and the rest afterwards.

Even though 18 (27%) of the 66 farmers whose animals had the mastitis attack for the first time sought treatment from livestock inspectors, it is striking that none of the farmers with a previous experience in their animals went to LI s, but sought treatment by the veterinarian itself. So it may be the lack of knowledge regarding the competency of LI drives the farmers to them for treatment for the first time. Reinforcing this is the finding that none of the farmers who had higher education sought treatment from livestock inspectors.

Among the cases presented directly to the practitioner and represented by the owner, the results were better among the cases represented (chi-square $p<0.01$). Out of the 12 cases represented, 11 cases got total cure and only 1 case failed. This can be attributed to mild attacks, wrong diagnosis and early treatment in these cases. Out of the 12 represented cases, 10 were treated on the first day (7) or second day (3) of noticing symptoms.

Antimicrobials were given in all the cases of mastitis, as it is the essential line of treatment [10]. Injections were given to 63 cows, and were considered to be antimicrobials based on the descriptions of the injection, and since the most preferred route for antimicrobial therapy in ruminants is injections [7]. In 34 cases volume of injection was approximately 10 ml, and complete cure was obtained only in 38 % of these cases, which may be due to the inadequate dosage or poor effectiveness of the drug chosen. In the 17 animals which did not receive injections, antimicrobial was given orally and/locally and both are highly favorable to the development of microbial resistance[7].

Antimicrobial medication has to be given for a minimum of 3-5 days and the frequency of administration has to be adjusted to maintain therapeutic blood level for the required period[7, 91]. But in 46 % of the cases injection was given for less than 3 days, and in 16 % of the cases injection was given only once. Even though injections were given for more than 5 days only in 8% of the cases, in 81 % of the cases antimicrobial was continued either as oral bolus or as intra-mammary infusion, so the actual course of antimicrobial administration was much longer. So the course of administration was inadequate in majority of the cases favoring the development of microbial resistance[82].

In 96 % of the cases frequency of antimicrobial administration was only once per day, which is inadequate except for few drugs to maintain the adequate blood level for 24 hrs [7]. Similarly, boluses and infusions were also given once only in a large proportion of

cases which is also quite inadequate. Since sub-dose therapy and inadequate interval of administration are potential contributors for resistance development [91], the above practices are also contribute to development of antimicrobial resistance.

Even though change of antimicrobial and/or personnel was required in some cases, it occurred mostly from 4th day and the major reason was failure to effect a cure. So the drug selected first might have been used for at least 3 days before switching on to a newer one. Number of total days of treatment advised was adequate, though the course of administering antimicrobial was shorter in many cases. Even though most of the farmers were aware of the treatment for mastitis, majority of them sought treatment from practitioners only, since they were not very confident of the medicine and the chance of cure. Though self treatment was reported only in very few cases, this can be due to the lack of reporting or knowledge of the investigator's background as a veterinarian.

Result of treatment obtained was complete cure only in 51.3 % of cases which might have been influenced by various practices along with several other factors [91]. Complete failure happened in 17.5 % of cases which lead to either death of the cow and/or complete loss of secreting function of mammary glands. Among these failed cases, few cows were slaughtered, and this occurred well beyond the drug withdrawal time for meat[7], hence consumption of the meat of these animals may not produce any public health hazard.

Milk from mastitis cows were used for consumption from 4.85±3.64 days from affected quarters and on average 2.65±3.94 days from unaffected quarters of which in 51 % of animals milk from unaffected quarters were used during all the days of treatment. Insufficient duration of milk discarding followed was found to be due to the lack of awareness regarding its health consequences [82], since most of them were not given any

specific instructions by the practitioners. Out of the 57 farmers, 54 were of the opinion that they would have observed discarding period if they were advised by the practitioner.

Discarding of milk was advised to 6 farmers only and the duration advised was 4.67±1.51 days while the average duration of antimicrobial treatment was 3.2 days which is indicative of an inadequate period of discarding advised. Altogether in 71 % of cases discarding period observed was insufficient to complete the drug withdrawal and residue occurrence in milk [7]. Though the period was found to be adequate in rest of the cases, it happened due to the drying of milk secretion due to partial or complete failure of treatment and not because it was advised or followed. The number of days from the last day of antimicrobial treatment to the onset of consumption and sale was quite inadequate.

Non-consumed milk from unaffected quarters was fed to calf in 70 % cases while rest of the non-utilized milk from the unaffected or affected quarters were disposed off by pouring far away from the premises in 55 % cases or by milking out in the cow shed itself. Majority of the farmers knew that open ground discarding of the milk during treatment for mastitis is harmful either to the cow or to the human beings, not due to drug residues but due to the presence of pathogenic microbes in that milk. Regarding the knowledge expr-essed by farmers on antimicrobial residues in milk, most of them knew that during treatment period and few days after treatment also drug residues can be present in milk. However only very few of them were aware of the any health consequences for these residues while some of them believed that residue can be made harmless through boiling of milk.

Even though there are various faulty practices related to the usage of antimicrobials for animals, most of these are attributable to the lack of adequate knowledge regarding the consequences of antimicrobial usage and its long term health hazards.

## 5.5. Summary and conclusions

Large quantity of antimicrobials are used in animals mainly for treatment purposes which are commonly used in human beings. Major source of supply is private medical shops and these drugs are freely available due to weak and often poorly implemented regulations. The firms supplying veterinary drugs are mostly the same as those supplying drugs for human use, though they have a separate veterinary division. These firms are concentrating more on antimicrobials and other feed supplements for animals, considering its better turn over and increasing demand with the intensification of animal productivity. Mastitis is the major infectious disease in animals for which large quantity of antimicrobials are used. Introduction of high yielding cross-bred cattle have considerably increased the incidence of mastitis and thus antimicrobial usage.

There is a uniformly distributed and extensive network of animal health care institutions including veterinary hospitals and sub-centers. Due to the higher proportion of sub-centers and scarcity of Vets, livestock inspectors form the major group of animal health care practitioners involved in animal treatment, though not qualified to do so. Besides the lack of sufficient Vets, their practice is facilitated by the existence of independent stations, poor education of farmers, availability of medicines and poorly implemented regulations, thus creating opportunities for them. Livestock inspectors do not have the necessary training to treat manor diseases and they also do not have the knowledge nor the mandate to prescribe antimicrobials or other drugs. Vets had better knowledge regarding antimicrobials, its usage and consequences, however there were deviations from the rational practices and were attributed to the difficulties of animal treatment. However Vets were found to lack sufficient information on the long term consequences and real public health importance of antimicrobial resistance development, which might have also contributed to their defective practices.

There exist many defective practices among farmers associated with the antimicrobial treatment of mastitis in cows, which are favorable for the development of microbial resistance in animals, and can create potential public health consequences. Practices such as seeking unqualified treatments, delay in starting treatment, inadequate course and frequency of administration, and lack of discarding milk for the required period are attributable to the poor education of farmers, low income, difficulty in access, lack of awareness of the consequences and lack of strict regulations. Even though antimicrobials were used in all the cases, the overall result of treatment was poor, and can be attributed to the deviation from rational therapy contributed by defective practices of farmers, failure to select the proper antimicrobial and the difficulties of animal treatment.

Even though the practitioners had better knowledge of antimicrobial usage and its consequences, the practices adopted by the farmers were defective as mentioned earlier. This can be due to their poor education on these issues and lack of serious concern of its long term consequences, and its public health significance. The magnitude of antimicrobial resistance, relationship with its usage in animals, mechanisms of development, predisposing factors involved, mode of transfer especially the exchange between animal strains to human strains of micro organisms are unknown to most of the practitioners, and this is reflected in their attitudes, and practices and consequently the practices of farmers.

## Policy implications

Based on the findings of the study the following recommendations are made

1. Antimicrobial usage in animals has to be reduced by stress on preventive measures, and the treatments by unqualified personnel has to be controlled.
2. Rational usage of antimicrobials in animals has to be promoted by improving diagnostic and treatment facilities and enhancing scientific treatments.
3. Proper monitoring of antimicrobial resistance development in the community has to be started and necessary steps for prevention has to be taken.
4. Implementation of strict regulations to minimize drug residue in food products and proper screening for antimicrobial residue has to be introduced.
5. Education of professionals and public regarding antimicrobial usage, resistance development and its long term public health consequences.

## Areas for further research

The present study points to the need for further research on

- Total antimicrobial usage in the state and its proportionate usage in animals.
- Screening of milk marketed in the state for antimicrobial residues.
- Comparison of antimicrobial resistance patterns in human beings and animals.
- Inter linking antimicrobial usage in animals and resistance in human beings.
- Development of a suitable surveillance system for antimicrobial resistance.

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# APPENDIX

## APPENDIX - 1

**Appendix 1.1.** Livestock population of Kozhikode district and Kerala state in 1996

| Categories | Total Livestock Population | | | | District share to state total |
|---|---|---|---|---|---|
| | Kerala | % | Kozhikode | % | |
| Cattle | 3396335 | 61 | 257964 | 69 | 8 |
| Buffaloes | 165125 | 3 | 1910 | 0.5 | 1 |
| Goats | 1860501 | 33 | 113656 | 30 | 6 |
| Others | 154956 | 3 | 2201 | 0.5 | 1 |
| Total | 5576917 | 100 | 375731 | 100 | 7 |

Source: A.H Census report 1996

**Appendix 1.2.** Animal health care facilities in Kozhikode district as on December 1998

| Categories | Number | Head of office |
|---|---|---|
| District Veterinary center | 1 | District chief Veterinary officer |
| Veterinary polyclinic | 2 | Senior Veterinary surgeon |
| Veterinary Hospital | 13 | Senior Veterinary surgeon |
| Veterinary dispensary | 72 | Veterinary Surgeon |
| Sub centers | 75 | Livestock Inspector |
| Total | 163 | - |

Source: NIC - A.H. Department statistics

**Appendix 1.3.** Animal health care practitioners in Kozhikode district as on December 1998

| Category | Number |
|---|---|
| Qualified Vets in the district | 101 |
| Veterinarians treating animals | 92 |
| Senior Veterinary surgeon | 19 |
| Veterinary Surgeon | 71 |
| Para-veterinary staff in the district | 144 |
| Assistant field officer | 14 |
| Livestock inspector | 129 |
| Para-veterinary staff not treating | 12 |

Source: NIC - A.H. Department statistics

**Appendix 1.4.** Common antimicrobial preparations available for animal use

| S. No | Antimicrobial | Injections | Oral | Udder infusion | Local/ external |
|---|---|---|---|---|---|
| 1 | Tetracycline | + | + | | + |
| 2 | Gentamycin | + | | | + |
| 3 | Streptomycin | + | | + | |
| 4 | Penicillins | + | | + | |
| 5 | Cephalosporines | + | | + | |
| 6 | Fluoroquinolones | + | + | | |
| 7 | Neomycin | | | | + |
| 8 | Sulpha +TMP | + | + | + | + |
| 9 | Nitrofurazones | | + | | + |

**Source**: Drug distribution records

**Appendix 1.5.** Firms supplying antimicrobial products for animal use and the proportion of antimicrobial products supplied as a proportion of total products

| Sl. No | Firm | Total veterinary products | % of antimicrobial products |
|---|---|---|---|
| 1 | Alembic | 44 | 36 |
| 2 | Alved | 29 | 38 |
| 3 | Cadila pharma | 29 | 31 |
| 4 | Cadila health care | 27 | 22 |
| 5 | Glaxo | 47 | 9 |
| 6 | Hoechst | 34 | 15 |
| 7 | Hindustan antibiotics | 15 | 40 |
| 8 | Intas pharma | 9 | 44 |
| 9 | Merind | 22 | 41 |
| 10 | Pfizer | 27 | 48 |
| 11 | Ranbaxy | 22 | 55 |
| 12 | Sarabhai | 30 | 30 |
| 13 | TTK | 31 | 23 |
| 14 | Unichem | 12 | 25 |
| 15 | Vysali | 4 | 100 |
| 16 | Vetcare | 25 | 12 |
| 17 | Wockhardt | 35 | 23 |
| 18 | Total | 442 | 35% |

**Source**: Drug distribution records

**Appendix 1.6.** Response of livestock inspectors identifying common antimicrobials

| Drug asked for | Person mentioned as antimicrobial | Drug asked for | Person mentioned as antimicrobial |
|---|---|---|---|
| Chloramphenicol | 4 | Cephalosporine | Nil |
| Sulfonamides | 4 | Berenil | 1 |
| Kanamycin | 6 | Paracetamol | 2 |
| Streptomycin | 6 | Riboflavine | 1 |
| Erythromycin | 6 | Dexamethazone | 3 |
| Nitrofurazones | 2 | Fluoroquinolones | 1 |

**Appendix 1.7.** Means of diagnosing mastitis reported by veterinarians

| Diagnostic tool | No of responses |
|---|---|
| Symptoms | 7 |
| Milk examination | 6 |
| Owners history | 5 |
| Milk testing | 3 |
| Milk culturing | 2 |

**Appendix 1.8.** Knowledge of farmers regarding antimicrobial residues in milk

| Question asked for | Yes | No | Don't know |
|---|---|---|---|
| Whether drug residue occurs in milk during treatment ? | 51.3 | 12.5 | 36.3 |
| Whether it persist during the post treatment period also ? | 40 | 10 | 50 |
| If yes , will the residue persists for few days ? | 37.5 | 2.5 | 60 |
| Will the drug residues affects keeping quality of milk ? | 16.2 | 18.8 | 65 |
| Is consumption of milk with drug residue harmful ? | 25 | 21.3 | 53.7 |
| Whether boiling of milk inactivates drug residues ? | 27.5 | 13.8 | 58.7 |

## Appendix - 2

## Interview guideline - 1 (For farmers)

1. S.No.

Informant details.

| | | |
|---|---|---|
| 2. | Name: | Address-- |
| 3. | Place: | Rural/ urban |
| 4. | Age: | Male/Female |
| 5. | HH members (adult) males: | Females: Children: |
| 6. | Religion: | SC/ST |
| 7. | Education | Training obtained-- |
| 8. | Animals owned | Major occupation. |
| 9. | Experience in dairying (yrs) | |
| 10. | Earning members | Household Income Rs (per month) |
| 11. | Durables | Radio/T.V/ Fridge/Cycle/ Motor bike |
| 12. | Type of House | Pucca/semi-pucca/ kacha |
| 13. | House electrified | Yes/No |
| 14. | Water source | Well/ stream/ Pipeline |
| 15. | Purchase of cow | Loan / Ready cash / other ways. |
| 16. | Type of animal | Cross-bred / local/Can' say |
| 17. | Milk (peak) yield in litres | |
| 18. | Cow shed- space | One/Two/Three/more |
| 19. | Cow shed-Roof | Thatch/tiles/concrete |
| 20. | Cow-shed Floor | Wooden/Stone/concrete |
| 21. | Care taker of cow(s) | Servant / owner |
| 22. | Primary caretaker | Man / woman |

Mastitis treatment practices

| | | |
|---|---|---|
| 23. | No of attacks (During Jan -Dec, 1998) | When months back |
| 24. | Same animal | Yes/No |
| 25. | Current lactation | Yes/No |
| 26. | At what Stage of lactation | Beginning/middle/end |
| 27. | Quarters affected | Time lapse to treat(in days) |
| 28. | Institution treated | Dispensary/Sub-centre/others |
| 29. | Why there | Easy access/Familiar/better treatment/others |
| 30. | Distance to that Institution (KMs) | |
| 31. | Usual mode of conveyance | Walk/cycle/Bus/others |
| 32. | Distance to near by Vety. Hospital (KMs) | |

33. Person who treated — L.I/Doctor/Others
34. Why He/she — Familiar/ easy access/availability/better treatment
35. Case presented / represented — Milk tested / not tested
36. House call / At centre — Treatment duration(in days)
37. Milk collected for lab examination — Yes/No
38. If Yes, where was it done?
39. First Day Treatment details
40. Medicines used — Injecti/bolus/mixtur/external/udder infusion.
41. If injections, — Ampoule/Vial/Bottle
42. Consistency — Powder/ watery / oily solution
43. Colour — Colourless/yellowish/coloured bottle
44. Volume — 2 Ml/10Ml/30 Ml/50 Ml/100 Ml/500 Ml
45. Who purchased the medicines — Self / brought by the practitioner
46. Site of injection — Neck/Back/thigh/others
47. Frequency (per day) — Once/twice/thrice/More
48. How many days given — Cost of injection *( per day)*
49. 2nd day treatment variations

.....

.....

.....

50. 3rd day treatment variations

.....

.....

51. Change of injection — Yes/No — From which day
52. What change ..... ..... ..... ..... .....
53. Change of personnel — Yes/No — From which day
54. Why ..... ..... ..... ..... .....
55. Medicines left out — Yes/No — How much (*give hints )*
56. How was it disposed ..... ..... ..... ..... .....
57. Number of days of treatment advised
58. Number of days of treatment
59. If discontinued (If days treated is less than advised, Why .....
60. Are you able to give injections to cow — Yes/No
61. Can you treat mastitis yourself — Yes/No
62. If yes How ? — Left over medicines/ medicines from medical shops/ previous prescriptions/ local medicines/others

63. If based on prescription, source of it

64. Non medical treatment Yes/No

65. Details .....

.....

66. Prescription or cash receipt details.

67. Result of treatment Total cure/ partial cure/failed

68. If failed, situation of cow- Still rearing/died/Sold/Slaughtered

69. If slaughtered Which day after treatment

Utilization of milk during and post antibiotic treatment periods

70. Milking during mastitis treatment Milking done/Not done

71. Quantity of milk yielded during mastitis Reduced/stopped/No change/cannot say

72. Colour of milk yielded during mastitis Colour changed/No change/Can't say

73. Consistency of milk yielded during mastitis Abnormal consistancy/no change

74. Withdrawal period advice Yes/No Days advised

75. If followed, How many days

76. If less number of days, Why

77. If WDP advised but not followed, why?

.....

78. Milk disposal Consumed/sold/fed to calf/thrown out/others

79. Disposal by burying Yes/No

80. Do you know if open ground discarding is Harmful/harmless/ Don't know

81. Days after last injection from which milk was consumed

82. If consumed, who ? Children/Adults/All

83. Days after last injection from which milk was sold

84. If sold, to whom Society/hotels/neighbors

Knowledge on drug residue in milk

85. During mastitis treatment Present/not present/Don't know

86. Immediate post treatment period Present/Not present/ Don't know

87. Persistence Few days/ many days/ Don't know

88. Effect on human health Harmful/harmless/ Don't know

89. Effect on Keeping quality of milk Yes/No/ Don't know

90. Effect of heating on residues Inactivates fully/ partially/ not / Don't know

91. Remedial measures , if any

.....

92. Any Other information

## Appendix - 3

## Interview guidelines - 2

(For Livestock Inspectors)

Informant details

1. No — Place of working
2. Years of service — Post Sub-centre/Disp./Hosp./others
3. Service in the present post — Basic qualification
4. Special training, if any Yes/No — Details of training
5. Most common animal disease for which antibiotics are used

   (1) (2) (3)
6. Major cause for mastitis in cows — Infection/nutritional/genetic/others
7. How mastitis diagnosed — History/Symptoms/Milk exam./CMTest
8. Remedy for mastitis — Antibiotics/Antiseptics/Steroids/analgesics/others
9. How this remedy effects a cure — Destroying microbes/other ways/ Don't know
10. How many cases you treat per year
11. How many during last year (Jan - Dec., 1998)
12. How did you learn to treat mastitis .....

    ..... ..... ..... ..... .....
13. Any training on Mastitis control — Yes/No — Details of training
14. Training on antibiotic usage — Yes/No — Details of training
15. Which are the common antibiotics used in animals

    (1) Penicillin, (2) Cephalosporine, (3)Sulphonamides, (4)Streptomycin, (5) Kanamycin, (6) Erythromycin, (7) Nitrofurazones, (8) Tetracycline, (9) Pracetamol (10) Berenil, (11) Chloramphenicol, (12) Gentamycin, (13) Riboflavine, (14) Dexamethasone, (15) Fluoroquinolones. (16) Others
16. Commonly used antibiotics for mastitis, — Numbers.....
17. One mostly used now a days — Number.....
18. How many days given usually — One/Two/Three/More
19. How many days are ideal — One/Two/Three/More
20. At what interval is given — 4 hours/6 hours/12 hrs/24 hrs
21. What interval is ideal — 4 hours/6 hours/12 hrs/24 hrs
22. How the dose is arrived at — Based on weight /severity/ other ways
23. Average weight of a cross-bred cow — 150/200/250/300/350/400 kgs.
24. Weight assessing- prior to treatment — Useful/Essential/not needed/harmful
25. Is weight assessing practiced by you — Yes/No How

| | |
|---|---|
| 26. Very high dose of treatment | Harmful/harmless/ Don't know |
| 27. Very low dose of treatment | No effect/ Harmful/harmless/ Don't know |
| 28. Minimum days for antibiotic treatment-ideal | 1, 2, 3, 4, more/ Don't know |
| 29. Maximum days for antibiotic treatment- ideal | 2, 3, 4, 5, 6, 7, more/ Don't know |
| 30. Short course therapy | Beneficial/No effect/Harmful/harmless/ Don't know |
| 31. Prolonged treatment | Beneficial/No effect/Harmful/harmless/ Don't know |
| 32. Combinations of Antibiotics | More useful/less effective/harmful/ Don't know |
| 33. Most effective route | oral/local/external/injections/ Don't know |
| 34. Most common route | Oral/I.M/I.V/S.C/local |
| 35. Antibiotics in the body | Metabolised/unaffected/stored/excreted/Don't know |
| 36. If excreted, which route | Urine/dung/milk /other ways/ Don't know |
| 37. Residue in milk occurs of | All antibiotics/some/None/variable/ Don't know |
| 38. Duration of excretion from treatment | Few hours/few days/ few weeks |
| 39. Routes of excretion is more for | Oral/I.M/I.V/S.C/local/ Don't know |
| 40. Effect of antibiotic residue in milk on humans | Harmful/harmless/beneficial / Don't know |
| 41. Residue in human causes | Resistance/sensitization / drug allergy/ Don't know |
| 42. Residue prevention | Withdrawal period/boiling/not needed |
| 43. Withdrawal period required for milk | 3 days/5 days/7 days/more/ Don't know |
| 44. Effect of residue on microbes | Tolerance/destruction/no effect/ Don't know |
| 45. Potency of antibiotics over years | Increasing/decreasing/no change/ Don't know |

46. If decreasing, why

.....

47. Is there any change in preference over the last few years Yes/No

48. What precautions needed to maintain potency of antimicrobials

.....

49. What you will advice your clients

.....

50. If microbial resistance to all antibiotics occurs, what will you do ?

.....

.....

51. Any other information

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## Appendix- 4

## Interview guidelines - 3

(For Veterinarians)

Informant details S. No Place of working

Post Disp./Hosp./others Practicing/Non-practicing

Years of service Service in the present post

Special qualifications if any

Special training Yes/No Details of training

Most common animal diseases for which you use antibiotics

(1) (2) (3)

How many mastitis cases did you treat last month

Is this number similar throughout the months Yes/No

How many cases you treat per year

Is there any seasonal variation in occurrence Yes/No

Which months has larger incidence

Most common cause for mastitis in cows Infection/non infectious

What per cent is infectious

Most common means of diagnosis for you History/Symptoms/Milk exam./CMT

In how many mastitis cases culturing is done %

Major remedy for mastitis Antibiotics/Antiseptics/Steroids/analgesics/others

Most commonly used antimicrobials for mastitis

| Antimicrobial | Quantity | Days given | Ideal days | Interval | Ideal interval |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

Larger dose of treatment Beneficial/ No effect/ Harmful/harmless/don't know

Smaller dose of treatment Beneficial/ No effect/ Harmful/harmless/don't know

Minimum days for antimicrobial treatment 1, 2, 3, 4, more/don't know

Maximum days for antimicrobial treatment 2, 3, 4, 5, 6, 7, more/don't know

Shorter course therapy Beneficial/ No effect/ Harmful/harmless/don't know

Prolonged treatment Beneficial/ No effect/ Harmful/harmless/don't know

Antimicrobial combinations More effective/less effective/harmful/don't know

Most effective route oral/local/external/injections/don't know

| | |
|---|---|
| Most common route | oral/I.M/I.V/S.C/local |
| Routes of excretion for antimicrobials | Urine/dung/milk/other ways |
| Residue occurs in milk of | All antibiotics/some/None/variable/don't know |
| Duration of excretion after treatment | Few hours/few days/ few weeks/don't know |
| Duration of excretion more in | oral route/I.M/I.V/S.C/local/ All similar |
| Antibiotic residue in milk | Harmful/harmless/beneficial to human |
| Residue in human beings causes | Resistance/sensitization/drug allergy |
| How Residue can be prevented | Withdrawal period/boiling/not needed |
| Withdrawal period required for milk | 3 days/5 days/7 days/more |
| Effect of residue on microbes | Tolerance/destruction/no effect |
| Major reason for resistance | High dose/ Sub-dose/ both/ don't know |
| Mechanism of resistance | Mutation/Selection/Gene transfer/others |
| Resistance problem is more with | Short /prolonged/irregular course/all |
| Resistant animal strains -- to human | Transmissible /Not transmissible Res./Don't Know |
| environmental strain - to human | Transmissible/Not transmissible/ Don't know |
| Resistance transmissible between genera of microbes | Yes/No |
| Potency of antibiotics over years | Increasing/decreasing/no change/ Don't know |

If decreasing , why .....

..... ..... ..... ..... ..... .....

Which was the most preferred antibiotic 5 years back

Is there any change in the preference over the last five years Yes/No

If yes, why ?..... ..... ..... ..... .....

..... ..... ..... ..... .....

In what proportion streptopenicillin is effective now for mastitis

If low, why ?..... ..... ..... ..... .....

..... ..... ..... ..... .....

Most useful group of antibiotics Narrow spectrum/broad spectrum/ Don't know

Why ? ..... ..... ..... .....

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..... ..... ..... .....

How many cases requires change of antibiotic ?

Effect of same antibiotic for a second attack More/Less/No change

Why that difference, if there is ..... ..... ..... .....

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What are the consequences of microbial resistance ?..... .....

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Is the microbial resistance reversible ?, Yes/No

If yes How? ..... ..... ..... .....

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If microbial resistance occurs to all antibiotics, what will do ? ..... .....

..... ..... ..... .....

What is the scope of developing new antibiotics ? ..... ..... .....

..... ..... .....

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Chance of resistance against newer antibiotics More/less/no difference

Resistance of old antibiotics to new ones Transmissible/not transmissible/ Don't know

Is there antibiotic resistance problem in human beings Yes/No

Is there any relation between human and animal resistance Yes/No

Do you think antibiotic resistance is an emerging P.H problem Yes/No

Do you think AH sector contributes to this crisis Yes/No

If yes , which are the major reasons ..... ..... .....

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What precautions needed to minimise the problem ..... .....

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What you will advice your clients ..... ..... .....

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Any other information ..... ..... .....

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