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Agricultural Extension in South Asia

ANTIMICROBIAL RESISTANCE (AMR): A GLOBAL THREAT TO LIVESTOCK AND HUMAN HEALTH

There is a need to enhance understanding and awareness of AMR through effective communication, education and training. Therefore livestock extensionists should focus their efforts in this area. In this blog, Nukala Ramesh, Hema Tripathi, Rekha Yadav,and BN Tripathi discuss the issue of AMR and how it could be addressed.

CONTEXT

Use of antimicrobial drugs in animals is essential for their good health and productivity, which in turn will ensure better food security, food safety and animal welfare. In the recent past there has been growing concern about antimicrobial resistance (AMR), which threatens to reverse these benefits. Resistance, arising in one geographical location or species can easily spread to other geographical locations or spill over into other species, and thus impact both developed and developing countries. The subject of antimicrobial resistance has not received adequate focus and attention in South Asia, including India. Surprisingly, very little is known about the use of antibiotics in animal husbandry. At present AMR is a global concern and immediate attention is called for to address it. Attention has to be focused on optimum use of antimicrobials with regard to the prescribed guidelines and action plans.

INTRODUCTION

India's greatest challenge lies in providing adequate, nutritious, healthy and safe food to more than 132 crores of its human population. But this is getting to be a problem due to shrinking land, decreased labour, dwindling natural resources, climate change issues as well as the considerable migration of farming communities to urban areas. Among all these sectors, livestock sector is of utmost important as it can go a long way towards meeting this burgeoning demands. At present there is a huge gap between demand and production of milk, meat and eggs that needs to be tackled in order to meet the needs of an expanding population. In its haste to meet this need the livestock industry is using excessively high amounts of antimicrobial agents in food-producing animals to prevent diseases and achieve the fastest growth in the shortest period (Manna et al. 2006).Food animals are given small doses of antibiotics mixed with their feed to promote growth and prevent disease. This allows farmers to skimp on nutrition and hygiene, thus saving much financially in the short term but causing great harm in the long run to the human race as a whole.

What exactly is the cost to human beings? The heavy reliance on antimicrobials in animal production has resulted in bacterial resistance in humans, especially to many modern antibiotics used in the treatment of life-threatening diseases in humans. This comes about especially when antibiotic residues remain in the final food products (Bahri 2017) that human beings consume. Due to the presence of antibiotic residues in the final food products, consumers are chronically exposed to low levels of antibiotics leading to AMR, which adversely affect human, animal and plant health systems. Thus, increasing global antimicrobial resistance (AMR) compromises modern human and veterinary medicine and undermines the safety of our food and environment (FAO 2016). These antimicrobial residues also diminish the economic value of livestock products and lead to export losses for farmers with respect to international trade and consumer confidence, especially in view of global competitive markets in the post-WTO era and imposition of sanitary and phyto-sanitary (SPS) measures.

Box 1: Related terminology

An **antibiotic** is a low molecular substance produced by a microorganism that, at a low concentration, inhibits or kills other microorganisms.
An **antimicrobial** is any substance of natural, semi-synthetic or synthetic origin that kills or inhibits the growth of microorganisms but causes little or no damage to the host.
Antimicrobial resistance is the ability of microbes to grow in the presence of a chemical(drug) that would normally kill them or limit their growth. Antimicrobial resistance is thebroader term for resistance in different types of microorganisms and encompasses resistance to anti-bacterial, anti-viral, anti-parasitic and anti-fungal drugs.

The burden of antimicrobial resistance in livestock and food animals has been poorly documented in South Asian countries, including India. Apart from sporadic, small and localized studies on antimicrobial resistance, evidence at the national level is lacking. We do not have a surveillance system that accounts for use and consumption of antibiotics in the livestock sector, and there are very few regulations governing the use of antibiotics for non-therapeutic purposes in India, neither is there stringent implementation of protocols (Background paper, Inter-Ministerial Review Meeting on Antimicrobial Resistance 2016,MoH&FW).

Box 2: Reasons for using antibiotics in livestock farming

Therapeutic (or curative) use: to cure diseases, prevent death of livestock and restore their production (milk and meat);
Metaphylactic use: to control the spread of infection to healthy animals (in case 10 to 15% of the animals in a group are ill);
Prophylactic use: by administering sub-therapeutic doses of antibiotics to animals via feed or drinking water, when signs and symptoms of infection are absent but suspected, and are likely to develop into an illness in the very short term; and as
Growth Promoters to increase the growth rate and productivity of animals (Chandron and Brugere 2014).

Reasons contributing to antibiotic residues in livestock products

The major reasons for appearance of veterinary antibiotic drug residues in livestock products include: need to achieve high productivity in short duration on farm; failure to notice drug withdrawal period; extra-label (refers to the use of an approved drug in a manner that is not in accordance with the approved label directions) and indiscriminate use; and over-the-counter purchase of antibiotics by livestock owners. Low-quality medicines, wrong prescriptions, and poor infection prevention and control also encourage the development and spread of drug resistance. Lack of enforcement of restrictive legislation on the use of antimicrobials, poor government commitment to address this issue, lack of guidance on withdrawal periods, and consumer awareness about the magnitude of human health hazards associated with antimicrobial residues consumption through meat and meat products, and poor maintenance of treatment records – are also primary reasons for incidence of antimicrobial residues in meat and meat products(Muhammad et al. 1997; Kaneene and Miller 1997; CAC 2001; Prajwalet al. 2017).

Research support on use of antibiotics in field conditions

A few studies have been conducted in the field to understand the antibiotics usage pattern in different food animals. Nintey-five percent of poultry farmers from Punjab do not follow the withdrawal period of drugs after cessation of treatment mainly due to their ignorance and habitual practice over the years. Lack of awareness among poultry farmers and farm workers have been identified as one of the major reasons (Lalawnpuia 2015). The poultry farmers in Punjab use antimicrobials for disease treatment and prevention, and for growth promotion. Antimicrobials were often employed during transportation of broilers or prior to slaughter for stress tolerance (Brower et al. 2017). According to Vasant (2016),88% of farmers did not know about antibiotic use and its residue sin their animals and milk in Krishnagiri (Tamil Nadu) and Kolar (Karnataka) areas. In Telangana, 94.17% of sheep farmers were reportedly using Oxytetracycline with only self-experience. Large chunks of sheep farmers (87.50%) practice over- or under-dosing of drugs without any knowledge, and most of them treat their animals with whatever medicines available by consulting neighbours instead of using medicines prescribed by veterinarians (Ramesh 2017). Pallavi (2017) reported that in Punjab 89, 74.5 and 70 percent of small, medium, and large dairy farms, respectively, administered antibiotics on a veterinarian's prescription, while 8, 16.5 and 22 percent of farms administered antibiotics by farm workers themselves. All three types of farmers were partially aware of a withdrawal period, and dairy farmers in Punjab never discard milk of the treated animals and continue selling those to consumers.

Antibiotic residues in livestock products and effects on human health

Antibiotic residues in livestock products are a potential threat to human health. Traces of antibiotic residues in contaminated foodstuffs can produce direct toxic effects, which are dangerous for consumers. Penicillin can evoke allergic reactions and small amounts of Chloramphenicol can induce a plastic anemia in certain sensitive humans. Some the Fluoroquinolones have many adverse effects, such as carcinogenicity, mutation photosensitization and allergic reaction (Lu et al.2008). Sulfonamides can cause side effects, such as micturition and hematopoietic disorders (Fang 2007). Tetracycline can damage liver and kidneys; it also influences the growth of skeleton, and can cause other side effects (Guet al.2007). Another threat is that the sub-therapeutic doses of antibiotics in food producing animals may induce antimicrobial resistance (AMR) including transfer of R factor. The resistant bacteria from animals may be transferred directly to humans via the food chain. Further, the resistant genes may also be transferred from animal pathogens or commensals to human pathogens (Barton and Hart 2001).

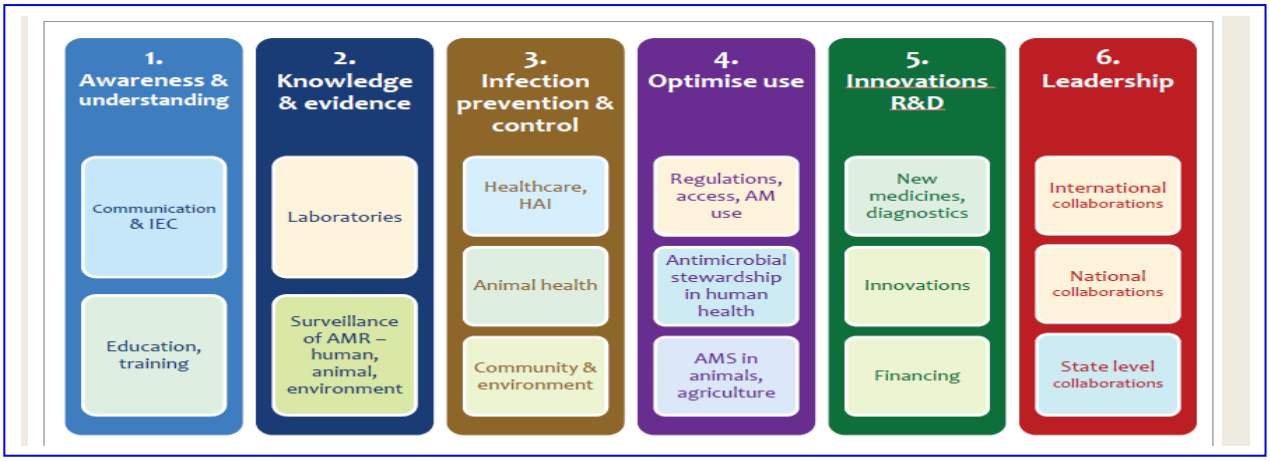
Box 3: Some important facts and the current scenario

Global consumption of antimicrobials in food animals was estimated as 131,000 tons in 2013,which would become 200,000 tons by 2030. Currently, China is one of the top five users of antibiotics in food production in the world. The projected consumption and percentage increase by 2030 would be highest in China (8200 tons, 59%), followed by the United States (9,476 tons, 22%), Brazil (6,448 tons, 41%), India (2,633 tons, 82%), and Spain (2,202 tons, 6%)(Van Boeckeet al. 2015).

Recommended inclusion levels in poultry and pig diets were 4 ppm for the narrow spectrum and 10 ppm for the broad spectrum antibiotics in the 1950s. Since then these levels have risen 10 to 20 fold (NAAS 2010).

Strategic interventions on prevention and control of antimicrobial resistance

In 2015 WHO unveiled a Global Action Plan (GAP) to combat antimicrobial resistance and implemented tripartite collaboration between FAO, OIE and WHO for this. These organizations are now sharing information and collaborating at all levels, on mechanisms to quantify the use of antibiotics in humans and animals. The strategic objectives of GAP include: improving awareness and understanding of antimicrobial resistance through effective communication, education and training; by strengthening the knowledge and evidence base through surveillance and research; by reducing the incidence of infection through effective sanitation, hygiene and infection prevention measures, optimizing the use of antimicrobial medicines in humans and animals; developing the economic case for sustainable investment that takes account of the needs of all countries; and by increased investment in new medicines, diagnostic tools, vaccines and other interventions (WHO 2015).



Using the WHO guidelines, India has also developed a roadmap for combatting AMR (in April, 2017), with six strategic priorities. The focus areas of the National Action Plan (NAP-AMR)similarly include: improving the awareness and understanding of AMR through effective communication, education and training; strengthening knowledge and evidence through surveillance; reducing the incidence of infection through effective infection prevention and control; optimizing the use of antimicrobial agents in health, animals, and food; promoting investments for AMR activities, research and innovations; and strengthening India's leadership on AMR.

Globally, many organizations such as the World Veterinary Association (WVA) and the World Organisation for Animal Health (OIE) are actively involved in combating AMR by organizing various activities. These include celebrating the 'World Veterinary Day' with the theme **Antimicrobial Resistance - from Awareness to Action** in 2017**,** to create awareness among members of the veterinary community. World Consumer Rights Day 2016 was celebrated under the theme of 'Antibiotics off the menu'. A joint collaborative meeting was held in 2016 between FAO-ICAR to tackle the AMR problem. A Red Line campaign was launched in February 2016 by the Union Ministry of Health and Family Welfare, Govt. of India, to curb irrational use of antibiotics. Recently, the Indian Society of Veterinary Pharmacology and Toxicology organized a national seminar on **Combating Antimicrobial Resistance** and the Food Safety and Standards Authority of India (FSSAI) has issued a draft on **Food Safety and Standards (Contaminants, Toxins and Residues) Amendment Regulation-2017**, to fix the tolerance limit of antibiotics and pharmacologically active substances in food stuffs of animal origin.

A meeting held to discuss methods on how to combat AMR.

Role of extension in combating AMR

In fact, the Global and National Action Plans emphasize the importance of extension services in combating AMR. The first strategic objective of these plans is to improve understanding and awareness of AMR through effective communication, education and training. Veterinary services can play a critical role in building awareness about AMR in livestock production, and encouraging the prudent use and management of antimicrobials in food producing animals. Though India does not have a separate extension system in the livestock sector the State Departments of Animal Husbandry (SDAH) have well-built networks with livestock owners up to the village level, and they can take primary responsibility to control the indiscriminate use of antibiotics at the field level.

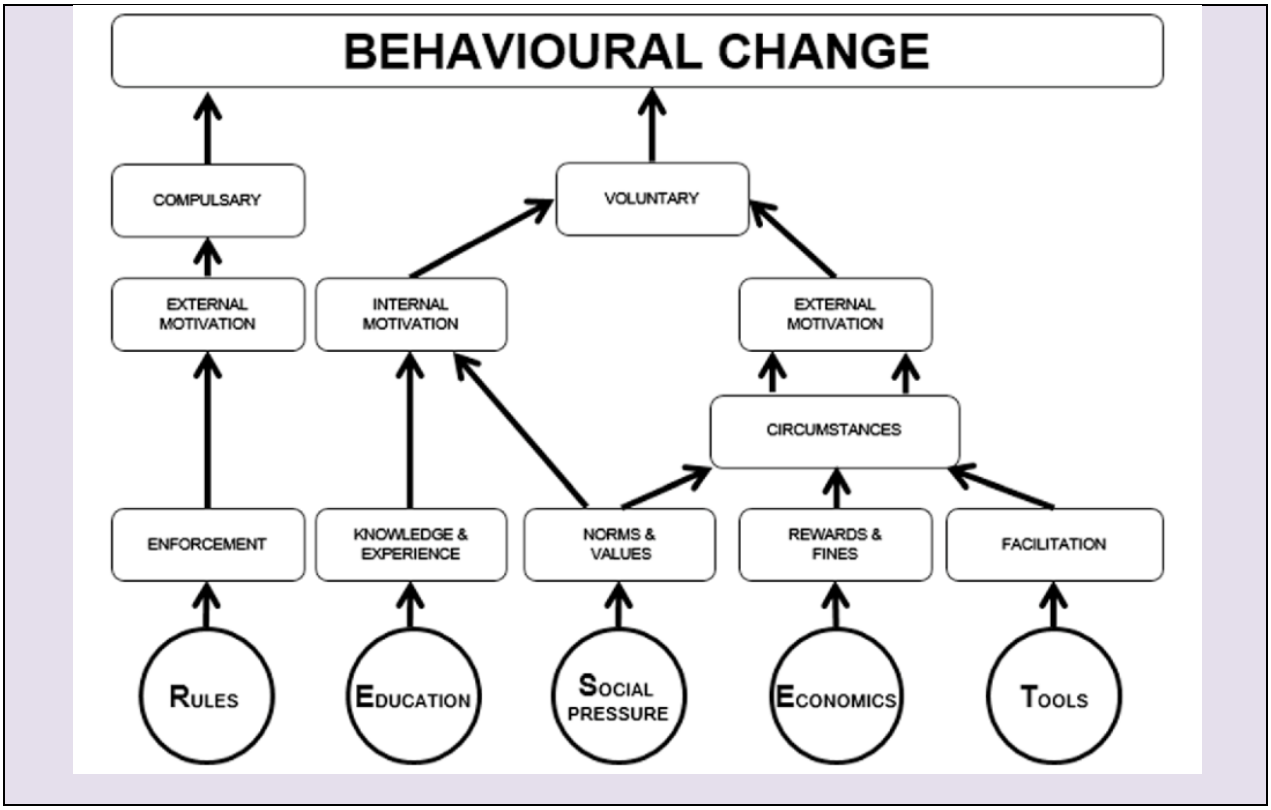
At first instance a campaign should start by creating awareness among masses, on the benefits of proper uses of antibiotics, the adverse effects of indiscriminate use on animal health, and consequences of over-the counter purchase and self-treatment of their animals with antibiotics. SDAH can prepare posters in the local language for display at milk collections points, and veterinary hospitals showing how judicious use of antibiotics and its benefits can help them and their animals. After treating the animal, SDAH personnel need to educate livestock owners on withdrawal periods and its effects. Livestock owners generally do not keep up with follow-up services after administering antibiotics; therefore veterinarians should explain the need and necessity of follow-up services. 'Antibiotics awareness week' should be conducted at the village level at least once per year so that this information gets widely disseminated among farmers. Introduction of AMR as a core component into in-service training programs of SDAH personnel will help them to update their knowledge on AMR, and on latest policies and control methods. Providing basic facilities, such as timely supply of quality medicines to treat animals in addition to diagnostic facilities will help to reduce extra label use of antibiotics. Para-vets and quacks should be adequately taught about the adverse effects of injudicious use, especially of higher generation antibiotics at the very first instance in every case, except in clinical cases. They should not be allowed to treat animals without proper prescriptions from certified veterinarians.

Veterinary universities and KVKs can establish a public communication strategy targeting the community regarding appropriate use of antimicrobials through reading materials, web-based portals and mass media. Education and training on judicious use of antibiotics given to progressive farmers and dairy cooperative members will help to reduce the severity of the problem. These programs should concentrate on reducing the dependency on antibiotics by preventing infection with maintenance of hygienic conditions and good farm management practices, using alternative herbal/homeopathic medicines and herbal feed additives in poultry production, and timely vaccination of animals. KVKs and state veterinary universities should encourage women self-help groups and other farmers who are involved in livestock-based products, to sell their products as 'antibiotic free' milk or meat to fetch higher prices as compared to the market prices. A general campaign must be initiated to create consciousness among consumers about safe food consumption, withdrawal period of drugs, as well as the ill-effects of drug residues on human health.

Box 4: Cases of extension intervention

Khatunet al.(2016) conducted a training program at two different locations (Joypurhat and Bogra districts) in Bangladesh on benefits of proper uses of drugs and additives, ways to keep hygienically operating poultry farms and poultry products, disadvantage of excessive drugs in poultry, and the eventual adverse effects of indiscriminate drug use on human health. After imparting the training program, they strengthened technical services provided to the trained farmers, monitored their performance and assessed the impact of this on selected poultry farmers in the next year. Findings revealed that 90-100% of the non-trained farmers and 8-24% of the trained farmers were involved in the indiscriminate use of drugs at respective farms. Further, it was found that 86% of the trained farmers from Joypurhat district and 56%from Bogra district were following drug withdrawal period, respectively. It shows that training and monitoring *can* play a vital role in changing the existing indiscriminate use of drugs and additives employed by farmers to increase profits.

Lam et al.(2017) used the RESET (Rules & Regulation, Education, Social Pressure, Economic Incentives and Tools) Model (adopted from Woerkumet al. 1999) to change the mindset of dairy farmers and veterinarians towards reduction of antibiotic use in dairy cattle in the Netherlands, and revealed that antibiotic use in dairy cattle decreased significantly. This was made possible by cooperation between the most important stakeholders in the dairy industry, by taking communication seriously, and by applying the RESET Mindset Model.



WAY FORWARD

- Surveillance data on antibiotic use and information management in animals should be strengthened at the field level.
- There is a need to follow proper treatment protocols in antimicrobial treatment by field veterinarians, as well as by encouraging farmers to strictly follow the withdrawal period.
- The National Action Plan on AMR barely talks about the financial loss accruing to farmers by implementing the withdrawal period. There is need for a special policy to address this issue.
- Our extension programme must focus on creating awareness among livestock owners on judicious use of antimicrobials.
- Focusing attention on the effects of AMR on human and animal health along with creating consumer consciousness are the other major concerns that need to be adequately addressed through educational programmes, by writing about it in blogs, newsletters and mass media, and through ICT tools.
- Farmers must be encouraged to follow Good Farm Management Practices to reduce the incidence of diseases through effective prevention and control mechanisms.
- The State Animal Husbandry Department must allocate adequate human resources, finance and policy guidelines for this operation.
- Controls should be put in place for the purchase of over-the-counter antibiotics by livestock owners from veterinary pharmacy shops/input dealers.
- A multi-sectorial and multi-dimensional approach is needed to address the challenge of the AMR issue. A single organization or discipline cannot solely address this global threat, it calls for the convergence of state animal husbandry departments, NGOs, animal welfare associations and veterinary universities in order to mount a fight on AMR effectively.

- There is a great need to include the topic of AMR in the veterinary curriculum so as to create more awareness among undergraduates.

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