

## Global Emergence of Anti-parasitic Drug Resistance, Associated Loss and Future Perspectives: Growing Threat to Veterinary Practices

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Parasitic diseases are one of the world's most distressing and prevalent infections, causing millions of morbidities annually. According to a survey, a veterinary practitioner, during his entire career, experienced greater number of cases of parasitic diseases in comparison to bacterial, viral or rickettsial diseases. Therefore, emergence of anti-parasitic resistance is highly devastating to our livestock industry. Anti-parasitic drug resistance is the selection of some specific heritable trait that led to genetic ability of parasites to survive treatment with the standard recommended dose of the drug. In general, an animal is treated with an anti-parasitic drug, the susceptible parasites die and the resistant parasites survive to pass on resistance genes to their offspring. Anti-parasitic resistance in gastrointestinal nematodes (*Haemonchus contortus*), protozoan parasites (such as *Trypanosoma* spp., *Theileria annulata*, *Eimeria* spp.) and arthropods (ticks, mites, mosquitoes, flies etc.) poses a significant threat to the economy of animal health industry. Unlike bacterial diseases, veterinary have to rely upon a handful of anti-parasitic drugs for their patients and therefore, development of resistance against those drugs can result into substantial production and health losses.

Earlier, in the dearth of anti-parasitic drugs, livestock owners have experienced overnight death of their entire sheep flock, cattle herd and equine herd due to haemonchosis, bovine tropical theileriosis and trypanosomosis, respectively. Unfortunately, we are heading towards the similar circumstances. Moreover, anti-parasitic drug resistance has a significant impact upon vector population. According to WHO estimates, 17% of all infectious diseases are vector-borne and drug resistance in these arthropods could invite several pandemics in the coming age. Continuous emergence of anti-parasitic resistance in livestock has been documented throughout the world, irrespective of their climatic conditions.

However, many of the parasitic diseases are preventable and some of those could be eradicated, through effective preventive measures and stringent legislations. For instances, *Trypanosoma equiperdum* and *Dracunculus medinensis* were eradicated by systemic screening and control. Babesiosis was eradicated from the United States between 1906 and 1943, by eliminating its vectors *Rhipicephalus microplus* and *R. annulatus*, leading to the annual saving of 3 billion US dollars. India bears an annual loss of US\$ 498.7 million due to tick and tick borne diseases. Total annual loss caused by surra in India was estimated to US \$ 671.1 million. In the long run, these estimated losses can be converted to saving by effective control strategies.

Constant surveillance and monitoring of anti-parasitic drug resistance using pen side test such as LAMP, spiral PCR, lateral flow assays etc. is the need of the hour. Pyrosequencing and biochemical assays could be used for mass screening of samples. Investments should be directed towards development of highly sensitive and specific monitoring tools followed by global eradication programs targeting a particular parasitic disease. For the available battery of drugs, the problem of resistance can be circumvented either by delaying its onset or use of alternate strategies in the form of integrated parasite management. Moreover, the work on repurposing of the drugs and molecular docking to identify novel drug molecules should be encouraged as a preparatory plan in global resurgence of anti-parasitic drug resistance.

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