



Anti-Parasitic Stewardship: An Update in the Indian Setting

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INTRODUCTION

Parasitic diseases are an important public health problem in India, where millions of people are infected with conditions such as malaria, soil-transmitted helminthiasis (STH), filariasis and others. Drug resistance, with incorrect use of anti-parasitic medications, provides fuel to these problems. As anti-Microbial resistance (AMR) is rising rapidly; to address this, anti-parasitic stewardship (APS) has emerged as an important strategy. This editorial provides an observation of the current status of APS in India, and emphasizes performance, challenges and directions for the future.

PRESENT SCENARIO OF PARASITIC INFECTIONS IN INDIA

India carries a heavy disease burden of parasitic infections. In 2023, India was responsible for about two million malaria cases, making it the highest contributor in the Southeast Asia region, despite the progress achieved in the fight against diseases in recent years¹. STH infect large population groups, especially in rural areas where sanitary and health facilities are limited. According to the WHO, 21% of India's population is affected by STH². India accounted for 6.19 lakh lymphedema and 1.26 lakh hydrocele cases due to filariasis by 2023, with endemic cases found in 20 states and Union Territories, excluding North-Western and selected North-Eastern states³. Visceral leishmaniasis (Kala-azar) cases in India have reduced by over 99% (from 9,241 in 2014 to just 95 by March 2025)⁴.

Approximately 1 in 1000 persons may have Neurocysticercosis (NCC) as a primary cause of epilepsy in India, as shown in various studies⁵. Toxoplasmosis seroprevalence is reported between 21% and 24.3% in various studies in India⁶. These infections result in morbidity and economic losses.

PARASITIC AMR: A CONCERN

Indiscriminate application of anti-parasitic medications has resulted in the development of resistance, making treatment regimens more complex and extending infection duration. In India, Chloroquine resistance in *Plasmodium falciparum* is around 99%, while sulfadoxine-pyrimethamine shows 42–51% resistance due to large-scale mutations; in contrast, artemisinin-based combination therapy remains highly effective⁷. Resistance to miltefosine among VL patients has also been observed in some areas of India⁸. Although Metronidazole remains effective in treating amoebiasis, there are reports of treatment failures and increased MICs, which may result in drug resistance. Similarly, resistance to nitroimidazoles in giardiasis is also being reported. Although drug resistance in other parasitic diseases has not been documented properly yet, inappropriate usage, such as self-medication and interrupted treatment courses, can enhance the development of resistance. More importantly, parasitic AMR is less prevalent compared to bacterial/fungal AMR because:

- Slower replication and smaller populations → fewer resistance mutations.

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- Rare horizontal gene transfer → limited spread of resistance traits.
- Intermittent and combination drug exposure → less selective pressure.
- Complex life cycles → reduced continuous drug pressure.
- Limited surveillance/reporting → under-detection compared to bacteria/fungi.

The veterinary and agricultural application of anti-parasitic medications is a lesser-known generator of resistance among human parasites, especially in India, where human, animal, and environmental health infrastructure are highly connected. Ivermectin and albendazole are frequently used in veterinary animals to decrease gastrointestinal parasites as well as improve productivity. By 2023, the price of India's veterinary parasitic market was around \$ 288.4 million, and by 2030, it is estimated to reach \$ 583.0 million, indicating a mixed annual growth rate of 10.6% from 2024 to 2030⁹. The use of anti-parasitic agents is also seen in agriculture to control infestations due to nematodes in plants¹⁰.

Environmental contamination provides one of the most important routes along which resistance arises. Anti-parasitic residues find their way into soil and water environments through animal dung, farm runoff, and indiscriminate disposal of drugs¹¹. These residues impose selective pressure on parasitic populations in the environment, leading to the survival of resistant genotypes. Humans can pick up these resistant strains through exposure to contaminated environments or from zoonotic transmission from animals in rural and peri-urban areas with inadequate sanitation¹².

Cross-resistance in veterinary and human anti-parasitic has been reported as well. For instance, resistance of parasites in animals to albendazole has homologues among human soil-transmitted helminths¹⁰. Abuse of ivermectin in animal husbandry is likely to affect its effect in mass drug administration campaigns against onchocerciasis and lymphatic filariasis as well¹².

ANTI-PARASITE STEWARDSHIP IN INDIA

The National Vector Borne Disease Control Programme (NVBDCP) has streamlined treatment procedures for malaria and VL and included drug resistance monitoring in national surveillance^{2,3,4}. The use of rapid diagnostic tests (RDTs) has enhanced diagnostic accuracy and minimized empirical and improper usage of anti-parasitic drugs.

Public awareness campaigns like the Red Line Campaign, which aims to promote responsible use of antibiotics, including anti-parasitic medications, to fight against AMR and follow up with prescribed treatment¹³.

APS principles [A1] have also been incorporated into medical education and continuing medical education (CME) for health professionals, with positive effects on responsible prescribing¹².

CHALLENGES IN IMPLEMENTING ANTI-PARASITE STEWARDSHIP

Despite remarkable progress in APS, many important barriers still prevent its widespread application. One of the most important boundaries is the inaccessibility of an appropriate diagnostic facility in rural and remote areas. It leads to empiric treatment and abuse of parasitic medications from time to time¹³⁻¹⁵. Another challenge is the lack of surveillance systems for tracking resistance trends; it is difficult to identify resistant patterns and adjust the treatment guidelines accordingly¹⁴.

There is a lack of trained staff - especially parasitologists and pharmacologists who have a direct impact on the quality and sustainability of parasitic treatment. Another major problem is the over-the-counter availability of anti-parasitic drugs, which leads to irrational use. Regulatory problems also represent a major obstacle, as there is readily availability of over-the-counter anti parasitic medicine leads to irrational use of parasitic drugs. To ensure robust APS activity and sustainable parasitic disease control in India, it is imperative to remove these obstacles.

STRATEGIES TO ENHANCE ANTI-PARASITE STEWARDSHIP

India needs to implement a holistic and integrated APS framework, which will be guided by evidence-based principles including appropriate diagnosis, proper drug use, and surveillance of drug resistance. While no formal Anti-Parasitic Stewardship (APS) guidelines are present several national program incorporate Stewardship guidelines like evidence-based parasitic disease treatment protocols, the WHO 'Test, Treat, Track' strategy for malaria, MDA in filariasis, and rational switching of IV to oral therapy in several malaria.

One of the priorities is to strengthen diagnostic strength by developing microscopy facilities along with efficiency, increasing the coverage of RDTs and molecular diagnosis tests for early and correct detection of parasitic infection. Concurrently, surveillance systems need to be fortified through the creation of strong regional and national databases that can track resistance patterns in diverse populations. This will aid in the development of dynamic, evidence-based policy recommendations.

Capacity development among health care providers is also a key element. Educating clinicians, pharmacists, and community health workers on the rational use of anti-parasitic drugs and the developing resistance patterns

will enhance prescribing behavior and minimize misuse. Reforms in regulations should also be made, such as enforcing prescription-only status for anti-parasitic drugs to prevent over-the-counter purchases and inappropriate self-medication. Community participation is central to stewardship.

Finally, the One Health strategy provides a comprehensive solution to combat parasitic resistance by accepting the mutual dependence of animal, human and environmental health. This encourages collaboration between doctors, veterinarians, farmers and environmental organizations to facilitate rational use of parasitic medicines in the areas. Resistance patterns in both human and animal populations should be traced by surveillance systems, and environmental pollution should be regulated through efficient waste management. Public awareness, regulatory reforms, and cross-sector cooperation are important to prevent abuse and secure drug efficiency.

CONCLUSIONS

Anti-parasitic stewardship is important for India's plan to control parasite infections and maintain the effectiveness of anti-parasitic drugs. Although much has been achieved through the national initiative, consciousness production and revised guidelines, there are challenges in diagnosis, monitoring and the health care distribution. Long-term commitment, multi-sectoral collaboration and health care improvements are required to combat this obstacle. With a strong APS structure (Box 1), India can increase the treatment effectiveness and protect the population from the new surge of parasitic diseases.

Box 1- APS structure that can be practiced in whole India

- ☐ Appropriate Diagnosis
- ☐ Evidence-Based Treatment
- ☐ Adherence to Standard Treatment protocols
- ☐ Surveillance for Drug Resistance Patterns
- ☐ Regular Training of Healthcare Workers
- ☐ Health Education at Community level
- ☐ Integrated Vector Control Programs
- ☐ Restriction of Over-the-Counter drugs
- ☐ Availability and adherence to hygiene, sanitation and safe water practices
- ☐ Pharmacovigilance for Anti-Parasitic Drugs
- ☐ One Health Approach in parasitic Control

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All authors are qualified for authorship as per ICMJE criteria. They approved the manuscript.

AI DECLARATION

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