Compilation of Articles Contributed by Experts

World Antimicrobial Awareness Week 2022

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Containing AMR in Food Systems

Intensification of food production must be sustainable

Rise in demand for meat and dairy products was reconciled through the intensification of livestock systems

By Habibar Rahman, Kennady Vijayalakshmy
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Intensification of food production is gaining prominence in a world battered by climate change and food insecurity. Intensification aims to increase output for each unit of input (labour, land, time, fertiliser, seed, feed, or money).

The need for intensification is more pressing when the supply of food needs to be augmented. For instance, in case of high population growth scenarios.

Intensification that uses resources more effectively may be more important when social or environmental problems are involved. Agricultural intensification has unquestionably been a prerequisite for human civilisation despite its complexity.

Civilisations were based on organising, gathering, concentrating, selecting and harvesting plants and animals to diversify food. The domestication of animals and farming in the setting of productive agricultural systems allowed the human population to flourish.

Sustainable intensification recognises that increased productivity requires the maintenance of other ecosystem services and increased shock resistance. Sustainable intensification in intensively farmed areas may need a drop in output to promote sustainability in the broadest sense.

One strategy to achieve the goals of food security, climate change adaptation and mitigation is to intensify agriculture. Recent proposals for sustainable intensification are based on the idea that the advantages of producing more food on new lands balance the harm caused to the environment.

However, expanding the net production area by recovering existing degraded land may contribute to greater output and increased carbon sequestration. It enhances natural capital outcomes and agricultural productivity.

The rise in demand for meat and dairy products was reconciled through the intensification of livestock systems. The growing need for animal protein has been a significant aspect of global dietary change.

Intensification in the livestock industry could increase food production for expanding populations. Still, there are moral concerns about the safety and quality of the food produced, equity and animal welfare.

In both industrialised and developing countries, intense livestock production and processing have resulted in widespread land, water and air pollution, frequently triggering diseases.

In addition, there are immediate problems such as disease transmission and general food safety. Excessive intake of animal products poses various dangers to human health.

It would be ideal for developing countries to consume more animal products to fight malnutrition. But it may not be a good idea for these countries to adopt the dietary habits of developed countries.

Grain consumption by livestock accounts for around one-third of global grain production. It puts a strain on the land and other natural resources.

These environmental and food safety risks serve as a list of potential expenses that must be compared against the advantages of intensifying livestock production. Population expansion serves as the foundation for a utilitarian case for intensification.

It is crucial to express moral justification for intensification programmes by deriving ethical obligations. Agriculture needs to be intensified further to cater to the needs of the growing population.

However, intensification runs the risk of destroying natural resources and reducing food security if it is not properly managed. Additionally, it may have significant social repercussions, particularly regarding rural livelihoods.

Policymakers must therefore identify and assess alternative solutions to achieve sustainable agricultural intensification, considering their short- and long-term impacts on all relevant socioeconomic groups. Therefore, creating such policies and the ensuing imperative for intensification has a strong ethical component.

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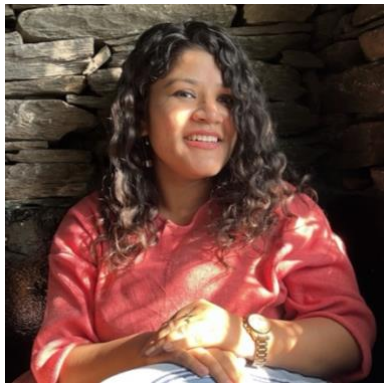
How factory farming is destroying our planet



The health and well-being of animals, people and our planet are interdependent. Poor animal health and welfare in intensive farming negatively affect food safety, our environment and climate

By Harsha Doriya
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Factory farming or intensive food-animal farming is the intense and confined farming of animals such as pigs, cows, and birds. They are industrial facilities that raise large numbers of animals, mostly indoors, in conditions intended to maximise production at a minimal cost.

The suffering of billions of animals within such intensive farms around the world is too often overlooked or seen to be separate from the big issues of our day: pandemics and the public health crisis; climate change and biodiversity loss; food insecurity and malnutrition.

In reality, intensive farming exacerbates these global problems as well as causing immense cruelty to billions of animals.

Producing more than 50 billion factory-farmed land animals each year to satisfy growing demand for cheap meat requires using breeds of genetically uniform animals squashed together, creating an ideal breeding ground for disease that can jump to humans.

When diseases jump from one species to another, they often become more infectious and cause more serious illness and death, leading to global pandemics. Bird flu and swine flu are two key examples where new strains constantly emerge from intensively farmed animals.

However, there is an addition to this list — Antimicrobial Resistance (AMR) which is overlooked among these big issues. Heavy crowding of factory animals in barren environments leads to fighting, biting, competition for feed or general stress in high density living.

Antibiotics are often used in feed or water in such situations at low levels. They alters gut bacteria and work as either growth promoters or prevent illness in a herd.

Animals are routinely given antibiotics (usually once off: Oral, feed, water) when painful procedures (mutilations) are performed in low-welfare animal farming. There is ample science showing how the overuse of antibiotics on factory farms leads to superbugs that spreads to workers, the environment and into the food chain.

India has banned the use of colistin in livestock feed after researchers showed AMR in poultry.

Global livestock production continues to increase year-on-year as the industrialised model of livestock and fish production spreads to many low-and-middle-income countries (LMICs),

especially in Asia, with poultry accounting for an increasingly large share of meat production globally.

The global livestock sector has grown to the extent that farmed poultry represents 70 per cent of all live birds, with wild birds representing only 30 per cent of the global bird population.

Meat production is 470 per cent higher in 2018 than it was 50 years ago. It has increased to more than 330 million tonnes annually from 70 million tonnes, off the back of industrialisation. Fish farming also grew rapidly during this period, with a 50-fold increase to over 100 million tonnes per year, from 2 million tonnes.

Industrial livestock systems are replacing traditional forms of livestock production in many LMICs. This has direct impacts on livelihoods: the UN estimates that livestock contributes to the livelihoods of about 1.7 billion poor people and 70 per cent of those employed in the sector are women.

Traditional and nature friendly forms of animal husbandry (eg, pastoral or agropastoral systems), give people in LMICs access to livestock-derived foods which provide an important source of nutrients, family income, transport, fuel, and fertiliser inputs (manure) for crop production on mixed farms. As a result, the sector plays a major part in reducing poverty, improving resilience as well as combating food insecurity and malnutrition.

Factory farms, characterised by substandard husbandry practices and poor animal welfare, drive the increased use of antimicrobials, and are connected to the emergence of AMR alongside a range of zoonotic pathogens.

They diminish animal health, exacerbating the human health crisis, and contributing to the ecological crisis. Zoonotic pathogens and AMR are increasing as a direct result of the growth in industrial livestock systems and pose one of the most significant threats to human health across the globe.

Starting from zoonotic diseases, habitat destruction, public health devastation, antimicrobial resistance, known as AMR to the most evident problem climate change, intensive farming is leading to destruction of the planet and its living beings in many ways.

The health and well-being of animals, people and our planet are interdependent. Poor animal health and welfare in intensive farming negatively affect food safety, our environment and climate.

We should develop sustainable food systems by increasing the demand for plant-based foods, in turn, reducing reliance on farmed animals and make higher welfare production systems — with more space, fewer antibiotics, healthier growth, and more natural environments — more feasible. We can transform our food system to be more sustainable and significantly improve the overall health of animals and humans.

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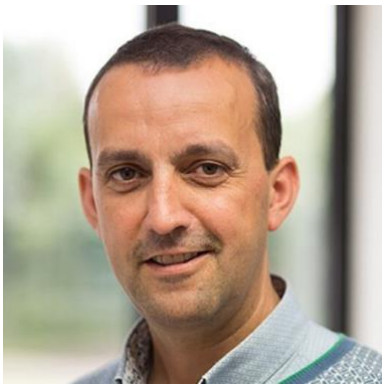
How biosecurity in livestock can be a tool to improve animal health, reduce antimicrobial use



Inability to measure biosecurity and hygiene status of a farm has been a major obstacle

By Jeroen Dewulf
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Food producing animals such as pigs, poultry and cattle are susceptible to a wide range of diseases, including zoonotic infections. These affect their health, welfare and productivity, and thereby have a major economic impact.

The implementation of biosecurity measures along the production chain presents itself as one of the major solutions to minimise the risk of introduction of these diseases into a farm, as well as their spread within the farm.

Recently, several studies have demonstrated a positive association between biosecurity and production parameters as well as between biosecurity and farm profitability. Moreover, biosecurity has been shown to have a positive impact in reducing the amount of antimicrobials used in pig and poultry production and, consequently, a reduction of the antimicrobial resistance selection pressure.

This is a promising finding considering that antimicrobial use in livestock production has been estimated to contribute over 70 per cent of the global antimicrobial consumption. Despite these documented associations and the recognised importance of biosecurity measures, there are still major shortcomings in the implementation of these measures in livestock production.

What is biosecurity?
Biosecurity consists of the combination of all measures implemented to reduce the risk of introduction and spread of disease agents. The measures to be established should not be seen as constraints but rather as part of a process aimed at improving the health of animals, people and the environment.

Biosecurity can be subdivided in two main components: External biosecurity, which is focused at keeping pathogens out of the herd, and internal biosecurity or bio-management, which is focused at preventing the spread of pathogens within the herd.

Implementing biosecurity requires the adoption of a set of attitudes and behaviors to reduce the risk in all activities involving animal production or animal care.

Infectious diseases may spread through many different transmission routes — some are airborne, some vector-borne and some may be spread through semen. Biosecurity measures generally aim at preventing these different transmission routes in an attempt to break the infection cycle.

When designing biosecurity measures, one can either approach the topic from the point of view of one specific pathogen and design measures that are specifically adapted to the epidemiology of that pathogen.

Alternatively, a biosecurity plan can be made more generic and include the majority of the transmission routes with a focus on those that are more important either because they are important in the transmission routes of many different pathogens or because they are of importance in the transmission pathways of the most prevalent or damaging diseases.

Biosecurity measures in livestock production?

Based upon the described transmission routes, biosecurity measures have been developed aiming to prevent either the introduction or spread of these pathogens in a herd.

In general terms, external biosecurity measures are mainly linked to either infrastructural aspects such as organisation of buildings on a farm, presence of entrance restriction for animals and persons (hygiene lock, quarantine pen, etc) or measures implemented upon others (entrance restrictions of visitors, hygiene of transport vehicles, safety of feed and water, vermin and bird control).

The purchasing policy also is an important component as the introduction of non-proprietary animals or genetic material such as semen might lead to the introduction of pathogens for which there is no farm immunity.

In many cases, the external biosecurity is better understood and implemented by farmers compared to the internal biosecurity. This is likely the result of the fact that external biosecurity measures have received more attention in the past as they were promoted in the control of epidemic diseases.

The internal biosecurity measures aim at preventing the spread of infection within the farm. Animals of different ages may have different levels of susceptibility to specific pathogens and therefore, it is crucial to keep different age groups separate and to work in a well-defined sequence according to well-designed working lines.

Equipment and materials such as bedding, feeders, drinking troughs, boots, spades, syringes and needles may also play an important role in the transmission of a large number of diseases.

Also, the management of diseased animals is an important component of the internal biosecurity. This includes proper diagnostics, isolation of the sick animals and disease registration as well as the improvement of the immunity status of susceptible animals, in particular through vaccination.

Correct disease management should result in a good insight into the specific health situation of the herd and in an application of the required preventive treatment to avoid disease and its subsequent losses.

In case of a slower growth rate of some animals compared to the remainder of the group, one should avoid, by any means, that the animals that lag behind are moved to a batch of younger animals.

Equally, the stocking density in the pens / stables should be respected. A high stocking density induces stress, which results in an increased susceptibility to infections and an increased excretion of germs.

Finally, good and efficient cleaning and disinfection is a crucial component of internal biosecurity. A complete cleaning and disinfection protocol consists of seven steps:

- Dry cleaning to remove all organic material
- Soaking of all surfaces preferably with detergent
- High pressure cleaning with water to remove all dirt. This step will go much easier, faster and effective if a good soaking step is performed before
- Drying of the stable to avoid dilution of the disinfectant applied in the next step
- Disinfection of the stable to achieve further reduction of the concentration of germs
- Drying of the stable to assure that animals afterwards cannot come into contact with pools of remaining disinfectant
- Testing the efficiency of the procedure through sampling of the surface

Measuring biosecurity

"You need to be able to measure, to be able to improve" is one of the most famous quotes of William Thomson (better known as Lord Kelvin), a famous British mathematician of the 19th century. This is certainly true for biosecurity and hygiene.

The inability to measure, accurately and reproducibly, the biosecurity and hygiene status of a farm has long been one of the main obstacles in the pursuit of improvement of both.

If farm managers need to be motivated to enhance the biosecurity or hygiene status of their farm, it is essential to provide them with quantitative goals and benchmarks. They can use these to position the farm with respect to its biosecurity and hygiene status, so that the required measures for improvement can be identified and subsequently their effect measured, if possible in a quantitative way.

At Ghent University, a risk-based biosecurity scoring system (Biocheck.UGent™) was developed to quantify on-farm biosecurity. The scoring system is available for pig, poultry and cattle production, including many variants depending on the production systems (indoor vs outdoor; broiler vs layer; dairy vs beef).

It does not start from a specific disease but rather approaches biosecurity in general and focuses on those aspects that are common for the transmission of many different types of infectious diseases.

The Biocheck.UGent™ system consists of a number of questions divided into several subcategories for internal and external biosecurity. Depending on the importance of a particular biosecurity measure, the score per question is multiplied by a weight factor.

Also, the subcategories have a specific weight factor equal to their relative importance for disease transmission. As such, the Biocheck.UGent™ scoring system provides a risk-based score that takes into account the relative importance of all different biosecurity measures.

The Biocheck.UGent™ scoring tool is accessible to everybody and its use is totally free of charge (www.biocheckgent.com). After filling in the questionnaire, the results allow evaluation of the strong and weak points of the biosecurity on a farm and it will give a basis for improvements.

Although most of the measures to be implemented are logical and generally easy to apply, it requires a strong discipline to adhere to the measures in the daily practices. Those who do surely will see the benefits.

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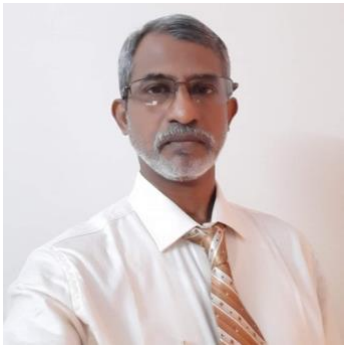
Can sustainable integrated multi-trophic aquaculture reduce AMR in aquatic systems

Developing sustainable and well-maintained integrated multi-trophic aquaculture systems could be a new hope to constrain AMR



By Avishek Bardhan, T Jawahar Abraham

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The global aquaculture industry has recently undertaken a dual approach to increase production while addressing criticisms towards the environmental impact of aquaculture production.

Integrated Multi-Trophic Aquaculture (IMTA) has been suggested as a production process that can reach this dual aim.

The IMTA aims at the integrated production of multiple aquaculture species of different trophic levels under a circular economy approach to improve efficiency, minimise energy losses, reduce waste and environmental deterioration and provide ecosystem services, such as bioremediation.

Bioremediation is a branch of biotechnology that uses living organisms, like microbes and bacteria, to remove contaminants from soil, water and other environments.

Species at the lower trophic level — usually plants or invertebrates — use waste products, such as faeces and uneaten feed from the higher trophic fish species, as nutrients.

The lower trophic species can then be harvested in addition to the fish to give the farmer more revenue, or even to be fed back to the fish.

It is suggested that IMTA systems are more efficient in mitigating diseases and preventing the spread of certain parasites.

As a result, IMTA may require lower doses of antibiotics and drugs, thereby potentially reducing the risk of antimicrobial resistance (AMR) in the direct environment of the farm.

The spread of diseases and parasites is found to be lower for IMTA systems, although it is highly dependent on species selection and environmental factors.

IMTA has been widely used to reduce aquaculture's environmental pressure and increase profits. But the effects of IMTA on host immune and metabolic responses — the dynamics of bacterial communities and antibiotic resistance genes (ARG)— are relatively understudied.

A team of researchers in Southwestern Taiwan worked on an IMTA system established for farming milkfish (Chanos chanos). In this system, fish were cultured with organic extractive shellfish and inorganic extractive seaweeds.

They isolated 31 sulfonamide-resistant bacterial species and raised concern about the cross-transfer of antibiotic resistance from one pathogen to another.

Recently, another researcher studied the IMTA mariculture (cutivation of fish or other marine life for food) systems with different combinations of the hybrid grouper — the white-leg shrimp and the algae Gracilaria bailinae.

The results showed that the algae could effectively remove inorganic nutrients accumulated in water. This, in turn, significantly enhanced non-specific immunity and glycolipid metabolism in the hybrid grouper.

Several ARGs were documented throughout the culture process. But the relative abundance of these ARGs in three of the four culture systems decreased with culture time. This was especially the case in the monoculture and the fish-algal IMTA systems, indicating that these aquaculture systems had a scavenging effect on ARGs in the environment.

Approximately 25 bacterial groups of Bacteroidetes and Proteobacteria were significantly correlated with ARGs. The study also evaluated the IMTA system's effects during the initial aquaculture stage.

Their study provided deep insights into further optimising culture methods and controlling ARGs' spread and ecological risk in IMTA systems.

Developing sustainable and well-maintained IMTA systems could be a new hope to constrain AMR as IMTA systems aim to reduce the outbreaks of pathogens.

A sequential IMTA system should show the superior ability to maintain the prevalence of AMR and the integrity of the bacterial community structure compared to the traditional farming system, representing a potentially valuable aquaculture system.

Although the IMTA system maintains the prevalence of AMR, the ARGs will typically congregate from all the different trophic levels into a singular trophic level, which might be a potential problem.

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Here are some practices that can improve milk quality, cattle health

There is a lack of knowledge and expertise regarding how to limit the use of antibiotics at the farm level without harming cattle health

By Katrien Van't Hooft
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The focus on cross-breeding and productivity in the global quest for dairy modernisation has increased milk production while also leading to high use of agrochemicals.

The use of antibiotics for common cattle diseases, such as udder infection and diarrhoea, is widespread. This contributes to the global threat of antimicrobial resistance (AMR).

An international network under Natural Livestock Farming Foundation (NLF) — a non-profit — has developed an effective methodology to support farmers in reducing their use of antibiotics and other veterinary drugs in smallholder and large-scale dairy systems.

The foundation has brought together farmers, livestock scientists and veterinarians from Ethiopia, Uganda, India and the Netherlands since 2014.

This international network on knowledge development for livestock health is re-valuing time-tested methods, such as the use of medicinal plants and strategic use of local breeds, to be applied in a modern context.

NLF combines knowledge from various backgrounds, indigenous knowledge, western veterinary science and Ayurveda.

The NLF Foundation aims at improving cattle health based on a five-layered approach comprising the following:

- Appropriate management of animals, farms and soils
- Strategic use of local breeds, strategic crossbreeding
- Ethnovet Medicine: Use of herbs and natural products
- Food quality improvement and control
- Better farm income through cost reduction and direct marketing

NLF's core activities are action research, exchange of best practices and training. The combination of bottom-up experimentation and international peer-to-peer exchange is additional to existing initiatives in AMR control.

This opens up opportunities that more conventional livestock development programs fail to unlock — providing an opportunity for increased farm income, better child nutrition, food security and an improved environment.

Some success stories

Ethnovetmedicine as part of the five-layered approach is gradually being adopted, especially within countries with smallholder dairy farmers. The main example is India. It is the largest

dairy producer in the world, based on 98 per cent zero-grazing smallholder dairy farmers with two-five cows.

Over the past decade, NLF India has trained 30,000 farmers and 2,000 veterinarians on efficiently using herbs for cattle health, also known as ethnoveterinary practices.

The National Dairy Development Board (NDDB) has adopted the method since 2017. The empirical data of more than 556,000 cases of 30 bovine diseases cured with herbal medicine were recorded through an online reporting system.

An overall average cure rate of 82 per cent was registered and an 87 per cent reduction in antibiotic use was observed within two years after the training.

NLF in Ethiopia — headed by the Ethiopian Society of Animal Production — implemented action research based on the NLF approach in two zero-grazing smallholder dairy communities.

Experts from NLF India headed a training on the use of medicinal plants — mainly kitchen herbs. The organisations collaborating with NLF Netherlands guided training on laboratory skills and calf management.

The approach has shown significant improvement in milk quality in two years — eight per cent reduction in antibiotic residue, over 50 per cent increase in milk quantity, 33 per cent increase in farm income and 60 per cent reduction in calf mortality.

The average cost of cattle health was reduced by 20 per cent. This pilot project will support the Ethiopian Ministry of Agriculture in improving milk quality and scaling up the strategy into various dairy programs.

The initial focus of NLF in Uganda — headed by the Lake Mburo Farmers Cooperative Society — was on the natural control of ticks and tick-borne diseases among smallholder-ranging cattle. A herbal formula based on local plants was developed and experimented by experts from NLF India in 2017-2018.

The society has also focused on diversifying farm activities, including value addition and local marketing of dairy products in recent years.

Some 400 farmers and 50 veterinarians have joined the activities since the initiative was launched in the Netherlands in 2015. Mastitis treatment with antibiotics was a common practice in the dairy industry.

The government has required mandatory (national) registration of antibiotic use since 2014, establishing a one-to-one link between farmers and veterinarians regarding the use of antibiotics.

As a result, the use of antibiotics in the total livestock production systems was reduced to around 70 per cent compared to 2009. The use of ready-made natural products was one of the major shifts in mastitis prevention and cure in the Dutch dairy sector.

Moreover, farmers started reintroducing herbs in cattle feed and grasslands. This exposed the lack of knowledge among farmers and veterinarians about herbal grassland management and the safety of herbal products.

NLF in the Netherlands has trained farmers and veterinarians on the safe use of herbal products and herbal grassland management since 2018. The Dutch government has invested in the spread of knowledge on natural remedies.

The main focus in dairy development has been on maximising cattle productivity and milk quantity. At this point, the crisis with AMR obliges the sector to look beyond this and focus on both milk quantity and quality.

However, there is a lack of knowledge and expertise regarding how to limit the use of antibiotics at the farm level without harming cattle health.

The strategic collaboration headed by NLF has brought about a road map for improving cattle health and milk quality.

It is time to upscale it into mainstream dairy policies, extension and education. For this, NLF is reaching out to non-profits, government, research institutes and funding agencies while organising webinars, field-level pilots and international exchanges.

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Use these ethnoveterinary medicines for Lumpy Skin Disease

Healthcare systems for livestock should be accessible, affordable and effective; ethnoveterinary medicine fulfils this criteria

By N Punniamurthy
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Lumpy Skin Disease (LSD), host-specific vector-borne viral (pox) disease of domestic cattle and Asian water buffalo, has been ravaging cattle populations throughout India after it was reported for the first time in India (Odisha) at the end of 2019.

There is no specific antibiotic chemotherapy for pox viral diseases such as LSD. Hence, indiscriminate use of higher version of antibiotics as a first line of intervention in LSD is of questionable value.

In fact, it might jeopardise and interfere with the innate immunity cascade of the individual animal in fighting the viral infection which is otherwise a self-limiting disease.

Globally, Antimicrobial Resistance (AMR) is a major threat to human / animal health. AMR undermines the safety of our food and environment.

The aim of pharmaceutics should not be a battle against microbes. Rather, an approach for peaceful co-existence of plant, animal and microbes in the environment is needed as the current data on microbiota research suggests that microbes apparently rule the world.

This is where ethnoveterinary medicine (EVM) can make a difference.

What is LSD?

The World Organization for Animal Health (OIE) categorises LSD as a notifiable disease. The disease was restricted to sub-Saharan Africa for a long time. It later invaded west Asia and Turkey. It has been in the Balkans, the Caucasus and the Russian Federation since 2015.

LSD transmission may occur through vectors (flies / mosquitoes), contact with contaminated feed or water, natural mating or artificial insemination. The LSD virus is a stable one and survives well in extremely cold and dry environments within the pH range 6.3-8.3. Infected animals shed scabs from skin lesions. Inside the scabs, the virus may remain infectious for several months.

Limiting vector breeding sites like stagnant water bodies and slurry / manure is an affordable and environmentally friendly way of reducing the number of vectors around cattle.

Bio security measures suffer as farming activities are scattered over a large area. Also, it is difficult to control the movement of animals, particularly where cattle are free-roaming or kept in open grazing.

LSD is characterised by skin nodules, fever, mastitis, swelling of peripheral lymph nodes, loss of appetite, abortion, infertility, increased nasal discharge and watery eyes. Generally, cutaneous nodules (two-five centimetres in diameter) are noticed.

Of late, lesions are not necessarily widespread and appear localised. Swelling and oedema particularly on the eyelids, head, neck, shoulder, knee, udder, genitalia and perineum appear within 48 hours of the onset of febrile reaction.

Erosions, ulcers may develop in the mouth and alimentary tract and in the trachea and lungs. Young calves suffer much if infected. Occasionally, mortality occurs due to other complications .Permanent infertility may occur among infected cows and bulls.

Enter ethnoveterinary medicine

The era of considering EVM with suspicion is long gone. The role of EVM in livestock development for the present and in the future is beyond dispute. Globally, scientists are elucidating on the effects and action mechanism of local and indigenous communities' phytomedicines.

The under mentioned EVM formulations are recommended for the management of LSD as a first line of disease management. Since 2020, lakhs of animals have been protected by using the following EVM herbal recipes without much loss of production (Ethnoveterinary formulations at www.nddb.coop):

Oral preparation I (for one dose)

Ingredients : Betel leaves-10 # + black pepper - 10 gm + salt - 10gm
Blend this to form a paste and mix with jaggery.
Dose:
Day 1 - One dose every three hours
Day 2 onwards for 2 weeks - Three doses daily

Oral preparation II (for two doses)

Ingredients: Garlic - 2 pearls + coriander seeds - 10 gm + cumin - 10 gm + dry cinnamon leaves - 10 gm + black pepper - 10 gm + betel leaves - 5 + shallots - 2 bulbs + turmeric - 10gm + chireta leaf powder - 30 gm + sweet basil 1 handful + neem leaves - 1 handful + Aegle marmalos 1 handful + Jaggery - 100 gm
Blend this to form a paste and mix with jaggery.
Dose: Day 1- One dose every three hours
Day 2 and onwards till recovery - Two doses daily

External application

Ingredients: Acalypha indica leaves - 1 handful + Garlic - 2 pearls + Neem leaves - 1 handful + Coconut or Sesame oil - 500 ml + Turmeric powder - 20 gm + Henna leaves - 1 handful + Tulsi leaves - 1 handful.

Blend all ingredients and mix with 500 ml coconut or sesame oil and boil and bring to cool. Apply gently as a fomentation on the lumps and swollen areas.

Application for wounds if any: clean the wound with a soft cloth and apply gently but do not rub.

For Maggots: Apply Anona leaf paste or camphorated coconut oil for the first day, only if maggots are present.

Until very recently, the veterinary academia ignored the significance of the traditional healing practices, which were popular till the advent of modern drugs. Now, EVM has been accepted globally as an evidence-based practice. It can also address emerging environmental and biomedical issues associated with the use and abuse of modern drug technology.

Healthcare systems for livestock should be accessible, affordable to the patient-owners and must ensure health and wellness in ailing animals.

EVM fulfils all the above criteria and ensure the last mile connectivity to farm-gate animal-health needs of the farmers. EVM is also viewed as a potential tool to promote natural-farming to produce clean milk, meat and eggs for human food basket.

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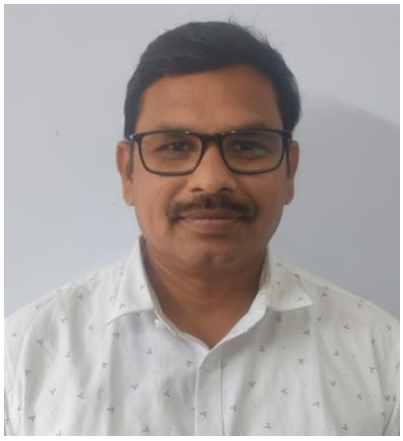
These tribal Andhra districts effectively use ethnoveterinary medicine for poultry care



The formal poultry healthcare service system in the tribal districts Alluri Seetha Ramaju and Parvathipuram Manyam is almost non-existent

By ML Sanyasi Rao
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Antibiotics are pumped into farm animals indiscriminately, leading to antimicrobial resistance (AMR) in poultry as well as humans. AMR refers to the ability of microorganisms such as bacteria, fungi, parasites and viruses to proliferate despite exposure to drugs designed to kill them or slow down their growth.

Some 4.95 million deaths were associated with, and 1.95 million deaths directly attributable to bacterial AMR across the world in 2019 according to a study in the journal, The Lancet.

In Andhra Pradesh's tribal districts Alluri Seetha Ramaju (ASR) and Parvathipuram Manyam, poultry population becomes zero in villages where Ranikhet disease strikes.

The fatalities hurt household income and it takes six months to regain the bird population.

The formal poultry healthcare service system in these areas is almost non-existent. The local communities depend on local herbal remedies for seasonal diseases.

The proportion of tribal population was 82.67 per cent and 28.14 per cent in ASR and Parvathipuram Manyam respectively, according to the 2011 Census.

Tribal communities like Kodareddy, Konda Kammara, Koya Dora, Savara, Jathapu, Bagatha, Kotiya, Manne Dora and Konda Dora and Valmiki are predominant and livestock rearing is one of their major sources of livelihood.

Culturally, all tribal communities rear some indigenous poultry. A flock of 10-20 birds is the average holding of a family.

They also use indigenous poultry as offerings to their deities for protecting their crops and livestock. They celebrate 12 tribal festivals, and in each ritual, sacrificing and consuming poultry is compulsory.

Apart from this, tribal families consume poultry meat during family gatherings, such as when children, studying or working outside in cities return home.

Tribal communities manage their birds under a free-range system: They leave their birds out in the morning and keep them in huts during the night. The birds forage in the backyard for their food. Tribal women take some care of the flock, helping with shed management and feeding millet grains and bran.

Leading by example

Watershed Support Services and Activities Network (WASSAN), a public trust, has tried to strengthen the desi (local) poultry production system through the integration of indigenous knowledge, particularly on shelter, feeding and plant-based ethnoveterinary medicines.

Ethnoveterinary medicines are used extensively and effectively for primary healthcare of poultry, with the guidance of local herbal healers for the propagation of medicinal plants and preparation of herbal medicines.

The medicinal plants were prioritised based on the local herbal practitioner's experiences. Species were also identified taxonomically and scientific evaluation was done for extensive promotion through posters and digital platforms.

WASSAN developed desi poultry-breeding farm entrepreneurs locally for supplying chicks to tribal women. Entrepreneurs manage farms in half-acre lands (generally old orchards) and develop forage areas to obtain enough feed material for birds.

In these breed farms, WASSAN promotes cultivation of medicinal plants used for treating poultry, such as Andrographis paniculata Burm.fil (Chiretta), Aloe vera (L.) Burm, Curcuma longa L. (turmeric), Acorus calamus L. (muscrat root), Ocimum sanctum L. (tulsi), Holarrhena antidysenterica L. Wall. ex A. DC. (kurchi), Cymbopogon citrarus DC. Stapf. (lemon grass), Carica papaya L.(papaya), Zingiber officinale L.var rubrum (ginger).

WASSAN also builds capacities of entrepreneurs in diagnosing diseases of birds, administration of lasota (RD F1) vaccine and preparation of herbal medicines.

In 2015, WASSAN established five desi poultry breed farms with the help of the animal husbandry department in the Seethampeta integrated tribal development agency region. By 2017, this was scaled up to 129 units.

Today, strengthening desi poultry management and indigenous knowledge systems has become a mainstream programme for the tribal welfare department.

Currently, there are about 350 desi poultry breeding farms managed by tribal women, and they serve 20,000 households of both ASR and Parvathipuram Manyam.

Tribal women make arrangements in nesting for hens to lay eggs. In the summer, they use tamarind seeds and paddy husk in winter to increase the hatchability rate.

They also perform fumigation once a month to control infestation of microorganisms. They use dry leaves of Annona squamosa L. (custard apple), Chloroxylon swietenia (Roxb.) DC (satin wood), Nicotiana tobaccum L. (tobacco), Azadirachta indica L.(neem) and Cymbopogon citratus DC. Stapf (lemon grass) for this purpose.

WASSAN has been integrating desi poultry in the community-managed natural farming villages to produce chemical-free chicken. The demand for desi poultry meat is increasing rapidly, due to consumers' awareness of the nutritional value of this meat, which is even more so, if it is produced naturally.

As per the WASSAN experiences metabolic disease conditions are more responding to ethnoveterinary medicines in desi poultry. WASSAN has been testing for eradicating intestinal worm infestation, poultry lice, watery diarrhea, white diarrohea, bronchitis as well as cuts and wounds.

Marri Jame (62) belongs to a particularly vulnerable tribal group and lives along with her husband in the Chinasangham village of Pedalochili Gram Panchayat, G Madugula mandal, ASR district.

In 2018, she established a desi poultry unit in her old orchard of 0.5 acres with 40 hens and 10 roosters. She currently has more than 200 birds on her farm and earns Rs 60,000 per year as additional income apart from sale of fruits.

She is a herbal practitioner and manages her birds through ethnoveterinary medicine sources from plants grown inside the forage area.

It is more important to promote ethnoveterinary medicine in tribal areas since local communities have abundant access to medicinal plants as well as backyards to grow frequently used herbs. Local traditional healers are available to upscale the scientifically validated herbal medicine.

About the author:
ML Sanyasi Rao is a programme manager at WASSAN

Here are some practices to ensure safe poultry

All farmers and flock handlers are trained specifically for the no antibiotics policy
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Antimicrobial resistance (AMR) is now widely acknowledged as a public health issue. AMR harms people's health and impacts economies. Rampant usage of antibiotics in humans and animals may lead to an AMR pandemic. AMR has even impacted more recent and powerful antibacterial substances like carbapenems.

Nearly 1.27 million fatalities a year have been directly linked to AMR. Meat consumption introduces antimicrobials into the food chain, impacting the environment, humans, food and animals.

The efficacy of antimicrobials is reducing due to the rise of antibiotic-resistant bacteria. It also proliferates unchecked spread of antibiotic-resistant genes in non-clinical environments.

Actions must be prioritised and coordinated across all stakeholders to address this situation. Continuous surveillance of antimicrobial resistance in bacteria that infect humans and animals is crucial for tracking changes in the antimicrobial susceptibility patterns of these organisms.

The Government of India's National / State Action Plan is comprehensive. It is aligned with World Health Organization's (WHO) Global Action Plan (GAP) for AMR. The plan addresses the five main goals outlined in the GAP and includes a new goal to enhance India's position as a global leader in AMR.

The strategy suggests using the 'One Health approach' to focus on several important AMR-related issues in human and non-human sectors (such as agriculture, fishery, animal husbandry and environment).

'One Health' is an integrated, unifying approach to balance and optimise the health of people, animals and the environment.

India is the largest importer of antibiotics in the world ($1.33 billion a year). Antimicrobial resistance is steadily increasing in India, not just through medicine but also through water, crops, cattle and other sources, according to the fifth report from the Indian Council of Medical Research.

The fast food sector continues to be one of the largest consumers of poultry. The chicken industry in India alone is expected to increase to almost 6.3 million tonnes by 2023.

Antibiotics are widely used in animals in industrial farming for enhanced growth and disease prevention (prophylactic usage).

Poultry sans AMR

Five years ago, the poultry sector was not prepared for initiatives on the AMR front. It has been challenging, but Jubilant Foodworks Ltd's (JFL) perseverance has paid off.

JFL established an ecosystem of research and development specialists, veterinarians, food technologists, suppliers and academicians to ensure the highest levels of quality and food safety/hygiene at all of our restaurants, slaughterhouses and farms.

We put our antibiotics avoidance policy into reality, emphasising the sourcing standards and farm practices.

We have successfully moved towards avoidance of the usage of antibiotics for prophylactic treatment as well as a growth promoter. We are making interventions to ensure that treated birds don't enter the supply chain.

JFL continues to lead initiatives in the following areas.

Tracing bird lifecycles: Surveillance or audits, sampling the feed and monitoring slaughterhouses are key to successful implementation of the policy.

JFL works with its business partners to ensure feed mills and converters have designated lines for "no antibiotics" usage. Antibiotics should only be used when necessary and under a veterinarian's prescription. Treated poultry is kept out of JFL's supply chain.

Usage of natural supplements: Antibiotics can be replaced with — essential oils (for better digestion), Salstop (to stop the growth of pathogenic bacteria) and liver tonics (like Hepatocare and Toxiliv B).

Structural training: All farmers and flock handlers who work with live birds are trained specifically for the "no antibiotics policy".

Oversight for disease prevention: Our team of veterinarians collaborates with suppliers to ensure that antibiotics are used sparingly and only when necessary to maintain their effectiveness.

They also prevent using those birds in the supply chain of JFL. The administration of vaccinations is done under the direction of licenced veterinarians. A licenced veterinarian develops a tight health programme. It is implemented under their direct supervision to maintain poultry birds' health and well-being.

Sustainable sourcing policies: All farms that provide chicken to JFL put good farming methods into effect. Some of the deliverables for JFL's suppliers/farms include providing constant, high-quality feed that is always accessible.

Cleaner eggs, better management of broiler farms, adequate stocking density on broiler farms and a robust bio-security policy for farms and hatcheries — contribute to ensuring animal well-being.

Enhanced audits, quality control measures: Record-keeping is essential to ensure the finest farming methods. These treatment and result records are used to assess and enhance the

animal health care programme. Veterinarians appointed by JFL periodically review these records.

Campaigns on AMR: JFL is currently updating and renewing its antibiotics/poultry policy, moving towards 100 per cent ‘no antibiotics ever’ chicken.

About the author:
Devendra Yadav is the vice president of quality, food safety and regulation at Jubilant Food Works Ltd

‘Ethnoveterinary medicine will be a game changer for dairy in India’

Down To Earth speaks to Meenesh Shah, chairman, NDDB on EVM use in the Indian dairy sector

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AMR is the resistance developed in bacteria, viruses, fungi and parasites against the antimicrobial drug such that they can no longer be inactivated or killed by the drug.
This occurs naturally over time but can be accelerated by the misuse and overuse of antimicrobials in human health, animal health and food production. The environment also plays a crucial role in spreading AMR through waste.
Animal farming systems use nearly 75 per cent of total antibiotics globally. India is the fourth largest user of antibiotics in animals. The poultry and cattle industry is the largest consumer of the same.
Ethnoveterinary medicine (EVM) involves the use of traditional / herbal preparations in treating diseases of cattle. It is becoming popular as an alternative to antibiotic use in livestock.
One of the biggest ongoing programmes on EVM in the Indian dairy sector is led by the National Dairy Development Board (NDDB). Down To Earth spoke to Meenesh Shah, chairman, NDDB on EVM use in the Indian dairy sector. Edited excerpts:

Deepak Bhati: What approach has the NDDB adopted to scale up the use of EVM in dairy farms?
Meenesh Shah: The main approach adopted to scale up EVM use was to take it to the last mile farmer with the aim of transferring knowledge.
Extension materials on EVM for various common ailments in various forms like videos, brochures, posters and apps were propagated extensively in all major vernacular languages.
Along with this, training of key veterinarians, supporting agencies in setting up EVM production plants, etc were also taken up.

DB: The MCPP programme has been running from almost a decade. Apart from improved animal health, what has been the underlying driving factor for continuing the programme for these many years?
MS: The programme has been running only since 2017 and not a decade. The negligible costs involved and the efficacy of the EVM preparations have been the overarching reasons for the programme being continued. This is also helping us build a robust database on the cure rates of various EVM preparations.
The implementing agencies are also realising that alternate approaches are the need of the hour and would help them in the process of complying with regulatory requirements.

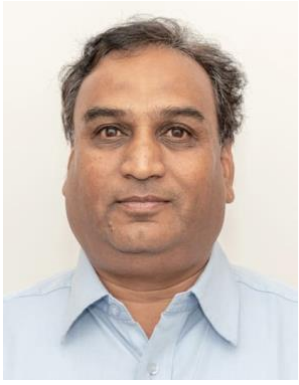
DB: What were the challenges faced during the scale up process?
MS: The main challenge was convincing veterinarians and managements of institutions in the dairy sector on the need for such an approach and aligning it with the curative approach being adopted today by most veterinarians.

DB: What is the NDDB doing to take the success of EVM forward?

MS: EVM as an alternative approach is gaining ground both among veterinarians and farmers alike. NDDB continues to propagate the EVM formulations through the various media formats mentioned above. NDDB is also facilitating training of all the stakeholders in dairying.
Publication / presentations in international forums like World Organisation for Animal Health and International Dairy Federation is also being done, showcasing EVM as an alternative approach to allopathy.

DB: Where do you see this alternative approach in the coming years?
MS: This is surely going to be a game changer that will help in significantly reducing the usage of drugs, especially antibiotics, in dairying.
Many institutions in the dairy sector have seen the immense potential and possibilities of EVM in drastically reducing their drug load and treatment costs. With time and with domestic food regulations becoming more stringent, we are sure that many other institutions would also mainstream EVM.
The realm of EVM will also widen to cover more number of ailments and NDDB is working in this direction.

‘Ethnoveterinary medicine is a simple, cost-effective, farmer-friendly tool’



Down To Earth speaks to Anil Kr Bayati, managing director of Sabar Dairy in Sabarkantha, Gujarat about the use of EVM at the dairy

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Ethnoveterinary medicine (EVM) involves the use of traditional / herbal preparations in treating diseases of cattle. It is becoming popular as an alternative to antibiotic use in livestock. Down To Earth spoke to Anil Kr Bayati, managing director of Sabar Dairy in Sabarkantha, Gujarat about the use of EVM at the dairy. Edited excerpts:

Deepak Bhati: How have you executed the use of EVM in Sabar Dairy from idea to practice?
Anil Kr Bayati: Our organisation works for the well-being of farmers; our belief is prevention is better than cure. We have implemented a mastitis control project with the technical guidelines of National Dairy Development Board (NDDB) since 2014.
This project gave us an excellent concept of EVM, with guidelines from the Trans Discipline University and NDDB. In the initial stage, we started our work with mastitis and were convinced of the efficacy of EVM.
Initially, we worked with a small mixture machine at a farmer’s homestead. In 2016, we realised the importance of EVM in restricting the use of antibiotics, and initially, we distributed around Rs 22 lakh as an incentive to the artificial insemination technician.
About 500,000 cases of different diseases have been effectively managed using Ethnoveterinary Preparations (EVP), without any antibiotic. All these cases are documented.
However, for EVM to sustain in the long run, it is essential to have an uninterrupted supply of EVPs. The Sabar Milk Union fills this gap by providing EVPs on a no-profit and loss basis. The union prepares formulations for some ailments daily for supply during veterinary and village-level visits.

DB: What were the benefits and challenges in introducing this approach at the ground level?
AKB: The presence of antibiotic residues in milk and milk products may be an issue due to indiscriminate use and non-adherence to the withdrawal period. Antibiotic residues interfere with the manufacture of several dairy products by delaying starter culture activity for cheese, curd, and other fermented products.
EVM is cost-effective, simple and efficacious. It can be prepared by the farmer himself from ingredients mostly available in his/her household.
With AMR emerging as a threat in animals and humans, EVM is the easiest way to rationalise the use of drugs and antibiotics.

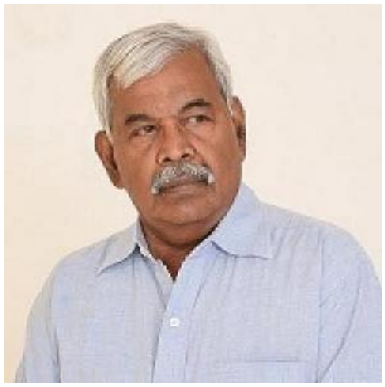
But there are challenges too. There is a lack of confidence in EVM. Other issues include the use of calcium hydroxide (slaked lime) and the quality of calcium oxide; improper paste preparations and less support from field veterinarians at an initial stage.
The result is dependent upon the correct procedure of preparation and application. For instance, the EVP for mastitis must be thin. It must be applied firmly on the udder. But, farmers are not willing for frequent application of EVPs.

DB: How has EVM been received among farmers?
AKB: The EVP concept can be showcased to the entire country as a sustainable model that could benefit millions of poor and marginal farmers and significantly reduce antibiotic residues in milk, thereby helping stall the emergence of AMR.
There has been a significant reduction of veterinary calls after establishing the EVM facility in 2018-19 at the Sabar Dairy, indicating the increased usage of EVM preparations by farmers.

DB: Was it difficult or easy to change farmer attitudes in favour of EVM? What is the status today?
AKB: It was not easy to change farmers' preferences from modern medicine to EVM. But it became possible in our organisation with sincere efforts.
A drastic reduction of Rs 135 lakh per year in antibiotics purchased by the Sabar Milk Union compared to 2017-18 indicates that EVM preparations swiftly replaced antibiotics.

DB: Should EVM be introduced in intensive / mechanised dairy farms?
AKB: Yes, antibiotic residues in milk and milk products may be an issue due to indiscriminate use and non-adherence to the milk withdrawal period by the farmer. Antibiotic residues also interfere with the manufacture of several dairy products by delaying starter culture activity for buttermilk, shrikhand, curd, and other fermented products.
EVM is a simple, cost-effective, and farmer-friendly tool that has also helped us rationalise antibiotic use. In a mechanised farm, it should be easy to implement with a motto of quality milk and a drastic reduction in treatment cost.

‘Ethnoveterinary medicines can be used as preventives and curatives’



Down To Earth spoke to MNB Nair from the Center for Ethno-Veterinary Science and Practice, The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru about the science of EVM

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Down To Earth spoke to MNB Nair from the Center for Ethno-Veterinary Science and Practice, The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru about the science of EVM and how it is being taught to farmers. Edited excerpts:

Deepak Bhati: What is the science behind the use of ethnoveterinary medicines? How does it act at the site of infection?
MNB Nair: These practices were used effectively by the community for a long time.
We have assessed the safety and efficacy of all the documented ethnoveterinary practices (EVP) using Ayurveda pharmacology.
The EVP formulation for mastitis has antimicrobial activity and the milk becomes normal within six days. This preparation possesses anti-inflammatory and anti-microbial properties.
A study indicates that after six days of treatment with herbal formulations, the mastitis-causing microbes become minimum, indicating that the mastitis has been cured.
A sequential administration of raddish, aloe, moringa and cissus sand curry leaf for a period of 20 days is an effective therapy for inducing cyclicity and improving conception rate among cows that do not conceive.
There is a successful evaluation of an EVM formulation used against endometritis. There is a very effective formulation to treat warts in cattle.
Feedback from various milk societies on the efficacy of EVPs for 30 clinical conditions in cattle from 2017-18 to 2021-22 (a field observational study, not a double blind controlled clinical one) consisting of 750,000 cattle indicates 80 per cent efficacy.
An alternative approach for management of mastitis, diarrhoea and pyrexia in dairy animals indicated that the overall clinical success rate for mastitis; diarrhoea and pyrexia were 92.09 per cent, 97.41 per cent and 97.79 per cent, respectively.
An intervention impact study indicated 87.8 per cent reduction of antibiotic residue in the milk (intervention area) and reduced the incidence of mastitis, enteritis, udder pox, etc.

DB: What drove you to introduce this treatment method?

MNB Nair: We found that the use of antibiotics fails in many cases and farmers are helpless. The cost of conventional treatment was not affordable to poor farmers. EVP can be used as a preventive and curative. It can be used as a first response to any conditions by the farmers themselves 24X7.

DB: How did you take the EVM method from the laboratory to large-scale practice?
MNB Nair: We promoted EVP as an Ayurveda method for treating common diseases. We partnered with Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) to implement this programme.
We have trained 150 veterinarians from Kerala (through the Kerala State Veterinary Council), Karnataka (KMF, BAMUL) and Tamil Nadu (AVIN) to field test these formulations and the efficacy was 75-97 per cent. An intervention impact study indicates a 49 per cent reduction of antibiotic residues in milk even during the outbreak of Foot-and-Mouth Disease (FMD) in 2014.
We also initiated a PG Diploma course jointly with TANUVAS for field veterinarians and conducted international exchange programmes to the Netherlands, Uganda and Ethiopia. Veterinarians from these countries came to India to understand how we practice EVP. This improved the confidence of veterinarians and farmers in India.
We conducted an international conference which was publicised through print media and caught the attention of the national Dairy Development Board (NDDB). The Board invited us to give a presentation at its headquarters.
NDDB integrated EVP with their mastitis control popularisation programme as they found it to be efficacious. We trained 227 veterinarians from various milk unions like Mehsana, AMUL, BAMUL, KMF and MILMA, and veterinarians from Sikkim, LUVAS.
NDDB has promoted EVP by developing videos and booklets in 13 local languages.

DB: Can you give a few instances where EVM has performed better than allopathic treatment?
MNB Nair: EVM saved thousands of animals during the FMD outbreak in Thanjavur. The Kerala Department of Animal Husbandry also used EVM preparations to mitigate FMD .
NDDB tested EVP formulations for mastitis on 29 chronic cases. The mastitis, which could not be cured by conventional veterinary medicine, healed in 27 of these animals.

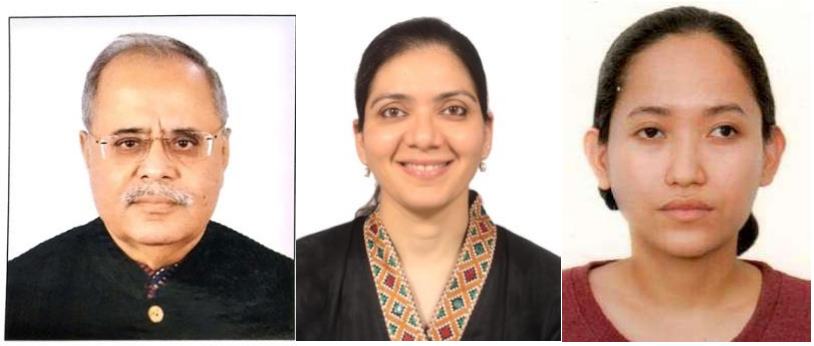
DB: What are the roadblocks or challenges you see with scaling up EVM?
MNB Nair: The EVP formulations need to be validated using trans-disciplinary methodology. Many European countries do not understand the theory and practice of EVP (Pashu Ayurveda). There is very little financial support for validating EVP formulations.
There is no policy to allow people (veterinarians and other stakeholders) who have undergone training, to practice EVP along with conventional medicine. There is also no support for investing in research and development that will help convert EVP formulations to products for wider use.

DB: What are your future plans?
MNB Nair: Mainstreaming EVP through educational programmes; undertaking research to understand EVP formulations with western science parameters wherever possible; the inclusion of EVP in One Health programmes; spreading awareness among stakeholders on the benefit of using EVP; integrating EVP with conventional practices and the development of good EVM-based products.

Containing AMR in Environment

Here's what can be done to address environmental AMR in India

India is the world's largest consumer of antibiotics in terms of total volume



By Atul Bagai, Divya Datt, Neha Dharmshaktu
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Antimicrobial resistance (AMR) has been declared one of the top global public health threats by the World Health Organization (WHO). The United Nations has also called it a global health emergency.

In 2019, antibiotic-resistant infections caused 1.27 million deaths worldwide, with an overall 4.95 million deaths from associated complications.

AMR may cause a global annual GDP loss of $3.4 trillion by 2030 and it may push 24 million people into extreme poverty.

The main sources which contribute to the development, transmission and spread of AMR in the environment are — poor sanitation, sewage and waste; effluent and waste from the pharmaceutical industry; effluent and waste from healthcare facilities; use of antimicrobials and manure in crop production; and releases, effluent and waste in animal production.

In 2021, the Food and Agriculture Organization, UN Environment Programme (UNEP), WHO and World Organisation for Animal Health joined forces to constitute the One Health Quadripartite to combat health risks, including AMR, at the human, animal and plant and ecosystems interface.

Environmental Dimensions of Antimicrobial Resistance Summary for Policymakers report, released on the margins of the UN Environment Assembly 5.2 in February 2022, recommended stakeholder action in four key areas.

First, by strengthening environmental governance and regulatory frameworks by including environmental ministries and agencies while developing and implementing national action plans for AMR.

Second, by targeting priority chemical pollutants like antimicrobials, metals and biocides and biological pollutants like antibiotic-resistant bacteria (ARB) and antibiotic-resistant genes (ARG).

The third key area is enhancing reporting, surveillance and monitoring of AMR by recording data on antimicrobials, AMR microbes and their genetic material releases in the environment.

Lastly, it recommends prioritising innovative and sustainable financing to address AMR through sustainable public procurement.

In parallel, there is a need for more research to better understand the spread of AMR in environmental media.

This includes — research into the role of sewage and waste effluent from pharmaceutical manufacturing and healthcare facilities, the interaction of antimicrobial residue with other chemical and biological pollutants, the evolutionary history and possible environmental origin of ARGs and the environment's role in the development of AMR microbes.

India has the highest infectious disease burden in the world, including infections due to multi-resistant pathogens. It is also the world's largest consumer of antibiotics in terms of total volume.

In 2019, 2,807 million packs of anti-infectives were sold in India, of which systemic antibiotics comprised 2,165 million packs (77.1 per cent).

India's National Action Plan on AMR (NAP-AMR) for 2017-2021 addresses six critical issues. It focuses on:

- Creating 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.
- Optimising the use of antimicrobial agents in health, animals and food.
- Promoting investments for AMR activities, research and innovations.
- Strengthening India's leadership on AMR.

The country is in the process of updating its NAP-AMR for the period 2022-2026 through an extensive consultative process. The environmental dimension must receive due attention and relevant agencies and stakeholders must be engaged.

The Indian Council of Medical Research-National Institute for Cholera and Enteric Diseases, with support from UNEP, has collated scientific studies on the environmental aspects of AMR to support the process.

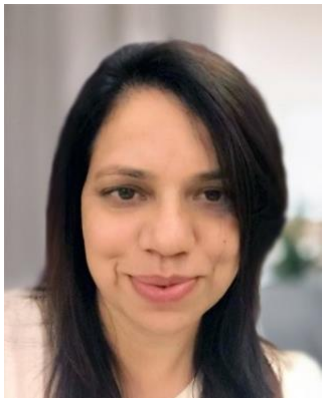
Some studies have reported bacteria with high levels of resistance to broad-spectrum antibiotics in specific river locations and potable water sources.

The study recommended the following short-term and long-term action points related to policy, institutional framework, research, surveillance, engagement and awareness.

With India taking over the G20 Presidency in December 2022 and One Health being one of the priority areas for discussion, the time is opportune for India to also address environmental aspects as it updates its NAP-AMR to help strengthen knowledge and capacity.

About the authors:
Atul Bagai is the head of the UN Environment Programme, Country Office, India
Divya Datt is programme management officer at UNEP's India Office
Neha Dharmshaktu is associate programme management officer at UNEP's India Office

India needs waste management, process control to prevent antibiotic pollution



Manufacturing process needs control measures; 43% of world's rivers contaminated with active pharmaceutical ingredients

By Suman Sharma
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The domestic pharmaceutical industry needs to take the lead in limiting antibiotic pollution — one of the biggest problems the world is staring at.

Almost half, or 43 per cent, of the world's rivers are contaminated with active pharmaceutical ingredients in concentrations that can have disastrous ramifications on health. The industry must prioritise wastewater management and process controls to limit antibiotic pollution and AMR.

There is widespread acknowledgement of the interconnectivity between humans, animals, and the environmental ecosystem. But unsustainable development patterns due to anthropological activities continue to usher in a climate crisis that has far-reaching consequences.

The interdependence between human and animal health was first recognised in 1856 by Rudolf Virchow, the father of modern medicine. World leaders later put it together to form the Manhattan Principles that formed the basis of the One Health concept.

The recently adopted Glasgow Climate Pact has called upon countries to facilitate the adoption of greener technologies to phase out the use of fossil fuels. The development and deployment of such technologies is also critical for the pharmaceutical sector that has formed the backbone of the growth of many economies including India.

While the sector plays a fundamental role in improving health outcomes through the invention of life-saving products, its emission intensity is 55 per cent more than the automotive sector.

The release of untreated effluents into the soil and water bodies add to the pollution of the environment during the manufacturing of various pharmaceuticals, including antibiotics. Further, untreated antibiotic residues also accelerate the build-up of antimicrobial resistance (AMR).

AMR is often dubbed as one of the top 10 public health threats facing humanity. It occurs when disease-causing pathogens develop a resistance against the pharmaceuticals that could have neutralised them.

The build-up of AMR can happen due to several factors across the human, animal, and environmental ecosystems. In 2019, AMR accounted for more than half a million deaths in the European region and about five million globally.

Pivoting to sustainable waste management and process-control practices assumes acute significance in the Indian context. India already accounts for 20 per cent of the global supply of medication, making it the largest supplier of generic medicines worldwide.

India's production capacity is all set to expand further with the government's recent impetus on the domestic production of pharmaceuticals. Against this background, the country's National Action Plan on AMR (NAP-AMR) called for limiting pharmaceutical pollution.

Strategic Pillars 2 and 3 under the NAP-AMR focused on developing frameworks for the surveillance of residues discharged in the environment and developing a plan to reduce the environmental impact on AMR, respectively. However, this policy impetus is yet to translate into on-ground implementation.

Recently, widescale pharmaceutical pollution has been reported across the country, particularly in pharmaceutical hubs like Himachal Pradesh, Andhra Pradesh, and Telangana. This was also reiterated by a study that reported dangerous levels of antibiotic residues in Indian rivers.

Apart from government regulation, there is a need for the domestic Indian pharmaceutical industry to optimise its waste management and process control to limit the rising antibiotic pollution in the country. Adopting innovative technology and self-regulation can help the industry reduce its carbon footprint and minimise its environmental impact.

The former is also evident from Centrient Pharmaceuticals Netherlands BV's plant at Toansa, Punjab, where the adoption of state-of-art API technology led to a 60-62 per cent reduction in the plant's carbon footprint.

The AMR Industry Alliance (AMRIA) has developed the Predicted No-Effect Concentrations (PNEC) criteria further to facilitate the industry in regulating its discharge of effluents. The compliance to PNEC value for Centrient's oral API product line and supply chain has helped the company reduce the environmental impact of manufacturing.

Additionally, the efforts of the industry must be supported by the government by incentivising sustainable procurement practices. The government can take a cue from countries like the United Kingdom, Norway, Sweden and Germany, among others, which have policies in place that provide benefits to manufacturers with greener practices.

Adherence to these practices will also prevent the Indian pharmaceutical industry from losing its competitive advantage in export markets.

The containment of AMR in India is crucial for realising several policy goals, including the United Nations Sustainable Development Goals.

While collective action is needed from various stakeholders, the domestic pharmaceutical industry should also take the lead, especially in limiting antibiotic pollution.

AMR is everybody's problem and in line with the theme of the seventh World Antimicrobial Awareness Week, I would like to urge the policymakers, academia, healthcare experts,

industry, environmentalists and the government to join hands and prevent the silent pandemic of AMR.

About the author:
Suman Sharma is the director for sustainable antibiotic manufacturing, Centrient Pharmaceutical

India needs to enhance framework for monitoring antibiotics

Global procurement focus shifting to monitoring drug manufacturing practices

By Siddhartha Prakash
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Antimicrobial Resistance (AMR) is a growing and significant health challenge worldwide. Though there is growing knowledge and efforts about the issue, it needs to be scaled up at factory, cluster and policy levels for manufacturing practices to meet global standards.

Without effective action on AMR, it is estimated that nearly 2 million deaths are projected to occur in India due to AMR by the year 2050, according to the Indian Journal of Community Medicine, 2019.

AMR refers to the ability of microorganisms such as bacteria, fungi, parasites and viruses to proliferate despite exposure to drugs designed to kill them or slow down their growth.

India is a global drug manufacturing hub but also suffers from the highest levels of drug resistance globally. There are many causes of rising resistance today. The environmental contributions to AMR include the discharge of untreated antibiotic residues from factories and hospitals into local water bodies.

However, there is limited data that is scientifically verified and universally accepted to ascertain the cause-effect relationship specific to antibiotic manufacturing. Hence, the global focus has been on mitigating the human, agricultural and water, sanitation and hygiene contributions to AMR.

There is an urgent need to address the environmental contributions from antibiotic manufacturing to complete the missing part of the One Health approach to tackling AMR successfully.

India is the world's largest producer of antibiotics, supplying over 40 per cent of the global market. The industry is diverse, with small, medium, and large companies engaged in active pharmaceutical ingredients and formulation manufacturing.

Over the last few years, there has been a growing concern due to the presence of high levels of antibiotic compounds in water resources near pharmaceutical manufacturing clusters due to the discharge of untreated effluents from the factories.

The emergence of cases across the country, from Baddi in Himachal Pradesh, Musi river in Telangana to Rangpo in Sikkim, is contributing to evidence of the growing concerns.

The National Green Tribunal has directed drug manufacturers in these states to reduce the discharge of untreated antibiotics into the environment and the central pollution control board to develop monitoring guidelines.

These practices are also leading to changes in global procurement practices of European governments, as shown by the Swedish National Agency for Public Procurement's environmental criteria for procurement of medicinal products, including antibiotics.

The practices have also led to multinationals prioritising environmental goals in their procurement of antibiotics. Some Nordic countries have revised the selection criteria for the procurement of drugs based on the supplier's environmental performance.

In Norway, for example, "environmentally friendly production will be weighted by 30 per cent as allocation criteria" under the new system.

Global and multilateral financial institutions are also moving towards green financing as sustainability becomes a priority in environmental, social and corporate governance. The global shift towards green procurement could have adverse effects on the competitiveness of the Indian pharmaceutical industry.

Therefore, it is now critical to measure and monitor the impact of manufacturing antibiotics on the environment and human health. This must be validated based on scientific studies and water quality monitoring data.

Consumers, regulators, scientists, laboratories and the pharmaceutical industry are all struggling to determine the best approaches to address these challenges.

Since, at present, there is no universally accepted methodology for monitoring antibiotics, stakeholders need to collaborate to develop a common understanding and scientific basis for monitoring antibiotics in the environment.

The complexity of their manufacturing process in batches demands a more rigorous process of monitoring beyond the existing pollution control monitoring parameters.

The Union Ministry of Health and Family Welfare has spearheaded the efforts to develop a national action plan on AMR.

The Central Pollution Control Board (CPCB), under the Union Ministry of Environment, Forest and Climate Change, has spearheaded efforts to develop environmental standards and protocols for antibiotic monitoring in water bodies.

Draft antibiotic discharge and monitoring standards were proposed in 2020 and 2022. However, the guidelines still need to be formalised as many questions around monitoring and related processes still need to be answered.

Despite the recent efforts, there are gaps in establishing a common understanding of the presence of antibiotics in the environment and their impact on AMR.

In order to further our understanding of this relationship, it is important to enhance the monitoring framework by developing guidelines and policy recommendations for monitoring antibiotics in India.

We must also identify capacity-building, technology and infrastructure gaps, needs, and resources to implement the guidelines. These will require laboratory infrastructure investments, testing, monitoring capacity and training of industry and regulators.

Some companies have begun to monitor and adopt sustainable antibiotic manufacturing practices to meet global environmental standards. These efforts need to be scaled up at the factory, cluster and policy levels through incorporation into environmental components of national and state AMR action plans.

About the author:
Siddhartha Prakash is the director for advisory firm Shawview Consulting

Here is how pharma companies can reduce antibiotic pollution in effluents

There is a high risk of antibiotic residues entering the environment from wastewater used in manufacturing pharmaceuticals

By Ashok Kumar Podisetty
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Pharmaceutical industries manufacture major antibiotic products. There is a high risk of antibiotic residues entering the environment from wastewater used in manufacturing. Controlling antibiotic pollution in the environment eventually becomes a challenge for pharma companies.

But some innovative methods can be used to counter antibiotic pollution. For instance, losses in wastewater can be reduced by employing good management practices. This can be done by eliminating direct sewer discharges of rejected / spilled material; using dry cleaning practices as much as possible and minimising wet cleaning practices.

Wastewater can be collected at the point of generation and treated by providing dedicated collection and storage tanks; a wastewater transfer system through pumping for treatment; adopting zero liquid discharge for all the wastewater generated and ensuring that there is no release of untreated wastewater from manufacturing plants at all times.

Modifications can be made in wastewater treatment plants by understanding existing operations and capacities; assessing API removal mechanisms and upgrading effluent treatment plant infrastructure by adopting innovative devices to improve efforts at reducing API losses to wastewater.

Runoff control can be attained by providing RCC storage tank for stormwater collection of first runoff rainwater; providing secondary containment for all storage of hazardous chemicals; containment of API storage; introduction of loading / unloading activities through checklist; eliminating outdoor process activities; maintaining registers for tank overflow / spillages / leakages; storage of hazardous waste with bunding; leachate collection facility; site tour to identify the gaps and analysis of all stormwater before and after release.

About the author:
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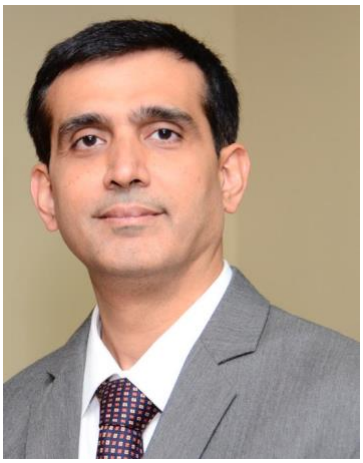
Zero Liquid Discharge can help contain environmental AMR



Pharmaceutical company in Gujarat designed a ZLD unit to remove antibiotics from manufacturing wastewater

By Dharmesh Kharwar
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Within the environmental dimension of antimicrobial resistance (AMR), the point sources of antibiotic pollution include waste from antibiotic manufacturing industries, hospitals, households and farms.

The pharmaceutical sector needs to employ appropriate waste management technologies in order to ensure the elimination of antibiotic residues from the effluents generated. One such waste management technology is Zero Liquid Discharge (ZLD).

ZLD is a water treatment process designed to recover and recycle all the liquid waste from an effluent system.

The focus of a ZLD is to reduce wastewater economically and produce clean water that is suitable for reuse (For example, boilers or cooling towers), thereby saving money and being beneficial to the environment.

ZLD systems employ advanced wastewater/desalination treatment technologies to purify and recycle all of the wastewater produced. ZLD technologies also help industries meet discharge and water reuse requirements, enabling businesses to:

- Meet stringent government discharge regulations
- Reach higher water recovery
- Treat and recover valuable materials from the wastewater streams

The conventional methods to reach ZLD uses technologies such as evaporators, multi-stage flash, multi-effect distillation, mechanical vapour compression and crystallisers.

ZLD technology includes pre-treatment and evaporation of the industrial effluent until the dissolved solids precipitate as crystals. These crystals are removed and dewatered with a filter press or a centrifuge. The water vapour from evaporation is condensed and returned to the process.

In the last decades, though, there has been an effort from the water treatment industry to revolutionise high water recovery and ZLD technologies. This has led to adoption of processes like electrodialysis, forward osmosis and membrane distillation.

A success story

A pharmaceutical company in Gujarat designed a ZLD unit to remove antibiotics from manufacturing wastewater.

This investment was necessary as the government-approved Central Effluent Treatment Plant was already at full capacity and could not receive liquid discharge from the company's effluent treatment.

To design an effective ZLD, the company formed a cross-functional team consisting of internal planning, manufacturing, engineering and environment Health Safety team and externally certified analytical environment testing laboratory and a consultant.

The work involved performing a mass balance based on all inputs and outputs and the subsequent design included pre-treatment, treatment, reverse osmosis and multiple types of evaporators.

The ability of the company to identify appropriate vendors to establish the design and implement installation and operation of the Effluent Treatment Plant (ETP) were key enablers.

However, analytical testing of the API proved challenging and was not possible. Guidance was received from another lead association involved with AMR to develop the mass balance approach to calculate the antibiotic discharge in their own ETP system instead.

With the ZLD in place, the company was granted an environmental clearance consent after due verification by the authorities with certifications available on record. As a result of designing and operating a ZLD plant, the company is no longer concerned about antibiotics liquid discharge.

Measurement (by electronic flow meter at the inlet of the ETP plant and measurement of the consumption of the treated water in cooling towers / boiler) demonstrates the efficiency of the evaporators, which fully utilise all the treated water.

Industrial water supply is only used when there are excess requirements. Furthermore, installing ZLD reduced the company's concern related to antibiotic emissions.

The company hopes that these improvements will position the company well in manufacturing supplier tenders, given 'AMR-compliant' manufacturing.

About the author
Dharmesh Kharwar is Director at Ngb Laboratories Pvt.Ltd.

Ongoing Initiatives to Contain AMR

Madhya Pradesh's action plan needs targeted and specific interventions

Antibiotics in food animals an essential environmental and public health issue

By Jayant Tapase
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Antibiotics in food animals play a significant role in human health, making antimicrobial resistance (AMR) an essential environmental and public health issue. Madhya Pradesh's action plan to deal with AMR needs specific interventions to succeed.

World Antimicrobial Awareness Week began November 18, 2022. It is a global campaign that is celebrated annually to improve awareness and understanding of AMR.

AMR represents one of the most important human- and animal health-threatening issues in developing countries like India. Antibiotic-resistant bacteria can be transmitted between humans and animals through contact, in food products and from the environment.

The prevalence of antimicrobial resistance among pathogens has increased during the recent decade. This is likely the result of selection pressure created by using antimicrobials in food-producing and pet animals. There is indiscriminate use of antimicrobials in the veterinary field.

Madhya Pradesh State Action Plan for Containment of Antimicrobial Resistance (MP-SAPCAR) was released at a stakeholder meeting in Bhopal July 26, 2019. MP became the second state in India after Kerala to develop an action plan to manage AMR.

The MP-SAPCAR focuses on a One Health approach to containing AMR through strategic priority areas and multi-sectoral involvement.

MP is the second-largest state in India with a considerable livestock population of 40.6 million and 16.7 million poultry. It also has a vast framework of 50 polyclinics, 1,012 veterinary hospitals and 1,583 veterinary dispensaries — all of which have a vast potential for antibiotic usage.

The veterinary department is rolling out its action plan on AMR containment by involving relevant stakeholders with an emphasis on restricting the use of antibiotics in livestock and poultry in various ways.

The department has taken several steps to identify district nodal officers and facilitating human resource development through information communication and education for field veterinarians, para-vets, farmers and the community.

Laboratories were strengthened for antibiotic sensitivity testing; the restriction of the over-the-counter sale of schedule H drugs (medicine that can not be bought without a prescription) and hospital bio-waste management was carried out.

Several other steps are yet to begin, like formulation of standard treatment guidelines; guidelines for prescription audits and quality improvement in veterinary infrastructure.

Monitoring government and private veterinary care units and dairy farms and strengthening infection prevention and control measures in veterinary institutes are also on their way.

The veterinary department is also placing emphasis on equipping laboratories with antibiotic sensitivity testing facilities so that farmers and animal owners get a confirmed antibiogram for the exact curative antibiotic, preventing them from following quacks.

Challenges in implementation

Implementation of legal regulations for the use of antimicrobials in food animals and availability of common treatment facilities for veterinary biowaste at the rural level are some of the major challenges to implementing MP-SAPCAR.

Monitoring antibiotic residue studies in animal products and establishing a state surveillance system for antimicrobial use in animal food are also significant hurdles.

The biggest challenge is the availability of sufficient manpower and funds for implementing AMR policy, which is a crucial requirement towards AMR containment goals. Budgetary allocation for the veterinary sector for time-bound AMR targets needs to be addressed.

The ground realities and challenges in the state need targeted and specific interventions. Identifying the leaders across the sectors is crucial. Once identified, their commitment to the cause is the sole reason for success.

Although the veterinary sector faces many challenges in developing and implementing MP-SAPCAR, strong support from policymakers and dedicated stakeholders can bring successful outcomes for AMR containment in the state.

About the author

Dr Jayant Tapase works with State Animal Disease Investigation Laboratory, Bhopal

5 years after AMR national plan came out, only 3 states have one of their own

The state action plans of Kerala, Madhya Pradesh and Delhi too make only passing remarks about inter-sectoral cooperation, with measurable outcomes

By Sagar Khadanga
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The Global Action Plan on Anti Microbial Resistance (GAP AMR) was declared by World Health Organization (WHO) in 2015. India launched its National Action Plan on AMR (NAP AMR) in 2017.

Health being a matter of individual states, all Indian states and Union Territories (UT) were advised to develop their respective State Action Plans (SAP) within the framework of NAP AMR. Time and again, it has been advocated to develop the AMR action plans holistically with the concept of One Health.

After five years of NAP AMR, it is time to look back and assess it and the various SAPs through the lens of One Health.

There were only three states that had come up with their SAP on AMR by November 18, when the World Antibiotic Awareness Week 2022 began. Kerala was the first of these. It developed the Kerala Antimicrobial Resistance Strategic Action Plan or KARSAP in October 2018.

Madhya Pradesh was the second state to declare its Action Plan in July 2019 (Madhya Pradesh State Action Plan for Containment of Antimicrobial Resistance or MP-SAPCAR).

Delhi was the third state to develop its SAP (State Action Plan to Combat Antimicrobial Resistance in Delhi or SAPCARD) in Jan 2020. None of the other states or UTs have their SAP ready as of today.

The Indian Council of Medical Research-initiated Anti Microbial Resistance Surveillance Network mentions Carbapenem (one of the highest generation of antibiotics) susceptibility of E. coli has dropped steadily to 64 per cent in 2021, from 86 per cent in 2016.

The susceptibility of Klebsiella pneumoniae has dropped steadily to 43 per cent for the year 2021, from 65 per cent in 2016.

Though most of these data have been contributed by tertiary care institutes, it is shocking to imagine the corresponding AMR in the community. Being an infectious disease clinician and active in this field for more than a decade now, I strongly believe this dreaded trend will be similar at community-level in primary and secondary healthcare delivery centres also.

India is a large country with 28 states and eight UTs. Hence, it is shocking to know that only three states have some sort of action plan in place.

The question that naturally arises is whether India is committed enough to combat AMR. The NAP AMR-2017 has revolved around human health and at tertiary care centres.

When the framework itself has no distinct component of Community level Anti Microbial Stewardship (Community AMS), it is imperative that the SAPs will also be reflective of that framework.

Analysing each of the three SAPs through the lens of One Health, it seems there are only passing remarks about inter-sectoral action plans with measurable outcomes.

Kerala is the best among the three. The states of Madhya Pradesh and Delhi also recognise animal health, agriculture, fishery and environment as collaborating partners to human health in the fight against AMR.

In the fifth year of declaration of NAP AMR, the time has come to re-strategise our priorities with a holistic One Health approach. Nurses, paramedics, animal health practitioners, environmentalists, food and soil scientists should be regular features in all AMR initiatives.

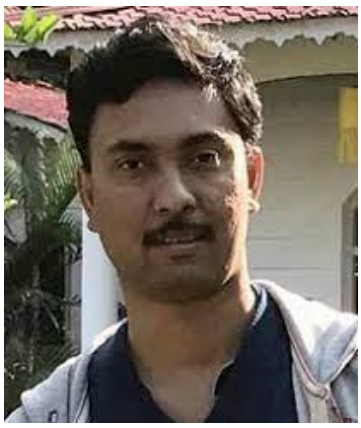
As a matter of policy, we have to develop generations of animal health practitioners, agriculture, food, soil and environmental scientists equipped with solutions to AMR or rather the mindset of tackling the unseen enemy of AMR.

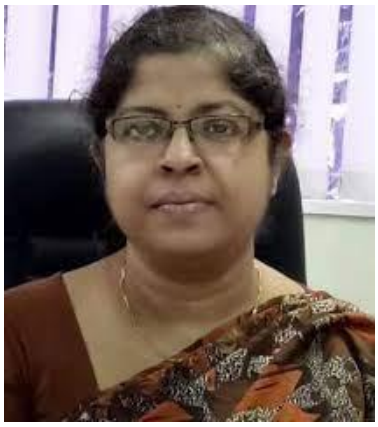
Till that time, the AMR campaign will remain an armchair campaign for elite practitioners of human health.

About the author:
Sagar Khadanga is Nodal Officer, Technical Committee, Madhya Pradesh State Action Plan on AMR

Here is how National AMR hub helps contain the silent pandemic

India was the highest consumer of antimicrobials, followed by China and the United States





By Debjit Chakraborty, Shanta Dutta
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Antimicrobial resistance (AMR) is a potential public health threat and is recognised as a silent pandemic. Around two million people are infected with antimicrobial-resistant bacteria every year and at least 23,000 deaths can be directly attributed to this.

In order to address this issue, a National Action Plan for AMR (NAP-AMR) was launched in 2017. The revised version is ready to be published in 2022.

The strategic objectives of NAP-AMR are aligned with the global action plan. At the same time, it is based on national needs and priorities. In light of these facts, numerous initiatives have been undertaken globally as well as nationally.

India was the highest consumer of antimicrobials, followed by China and the United States in 2010. The most commonly consumed antibiotics include broad-spectrum penicillin, cephalosporin and fluoroquinolones.

Similarly, antibiotics of last resort, like Polymyxin and Carbapenems, usually reserved for multidrug-resistant infections, have also seen a steep increase in consumption rates over time.

All these indicate the extent of AMR in India. In response to this, the Indian Council of Medical Research (ICMR) established a national repository of antimicrobial-resistant bacteria at ICMR-National Institute of Cholera and Enteric Diseases (ICMR-NICED), Kolkata, in 2019.

The first meeting of the ICMR-AMR repository discussed various issues, including roles of nodal and regional centres, mode of data collection, referral laboratories, designated nodal centres for each species of organisms, and entry and analysis of data.

Following this, a National AMR Hub was inaugurated in September. It was established with the broader objective of steering and promoting AMR research in the country.

The National Repository of AMR bacteria aims to preserve AMR bacterial isolates shared by the nodal centres of the National AMR Surveillance and Research Network (AMRSN) of ICMR across India.

The mission stood for distributing antimicrobial-resistant bacterial strains to the researchers at the national level after due consideration of their requests. It also promoted the nationwide capacity building of AMR research through training/workshops.

Under the aegis of the National AMR Hub, a multi-tier community-based study has been undertaken in collaboration with the West Bengal State Health Department across three districts in the state.

ICMR-NICED intends to develop a policy recommendation for the advocacy of strategic frameworks for tier-specific AMR surveillance based on the findings of the study.

Recognising the multidimensional nature of the AMR problem, ICMR- NICED National AMR Hub took up a project on the environmental dimension of AMR in India.

It came up with a robust State of Art Report and policy brief after analysing the various dimensions of 'One Health'.

The sector-specific recommendations mentioned in this report would serve as the guidelines for conducting future research and innovations to develop cost-effective indigenous measures, bolstered by best practices from other nations.

A paradigm shift is warranted to modify the existing acts and guidelines. The policy documents should address the six pillars of the National Action Plan on AMR.

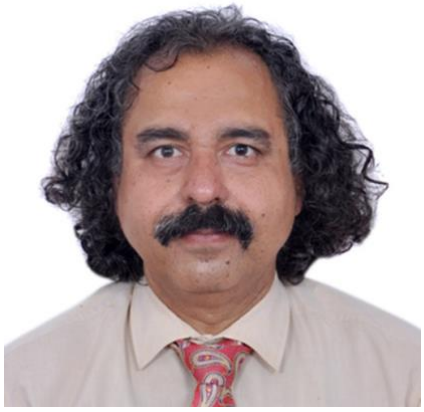
Scientists at ICMR-NICED are engaged in determining the genetics and molecular mechanism and pathways of AMR pathogens and identifying herbal alternatives to antimicrobials for prophylactic and therapeutic purposes.

We can expect that the activities and achievements of the National AMR Hub will increase manifold in the coming years, boosting AMR research in the country.

About the authors:
Authors are Scientist at ICMR- National Institute of Cholera and Enteric Diseases, Kolkata

‘We must understand the phenomenon and how it can be tackled’

We need to remember that lower the chances of infection, lower would be the use of antibiotics / antimicrobials



By Raman Sardana
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“The greatest danger...[is] that people will consume antibiotics too often... at too low doses... so that instead of eradicating the microbes, a host of antibiotic-fast organisms will be bred-out; and we will no longer be able to treat septicemia and pneumonia with penicillin,” Sir Alexander Fleming said in The Antibiotic Paradox: How Miracle Drugs Are Destroying the Miracle by Levy S, the New York Times, 1945.

Microbes or microorganisms, the first life forms, are the ancient inhabitants of planet Earth and will be present when humans have exited. They reproduce ferociously, doubling their population in as little as twenty minutes (some take longer). So, this is actually “their planet”.

They are great survivors, have adopted to any changes in the environment over millions of years, can live in salty environments or at extremely hot or unusually cold temperatures as well as acidic or alkaline surroundings. They have developed mechanisms to counter all and any attacks from their own types and from different types and from other environmental beings, using the same mechanism to ward off different threats or biogeochemical survival with conservation.

With that background, look at what we have done! We introduced antimicrobials / antibiotics one after the other and what we got was more and more survival of microbes. They either made their site of vulnerability inaccessible or made antimicrobials useless, rendering them ineffective by producing substances to destroy them or throwing them out of their bodies.

The collective phenomenon is called antimicrobial resistance (AMR). The microbes, most significantly, share this information through gene swaps of counter attack with other of their kin as well as distant relatives. This also makes those microbes survivors through the spread of AMR throughout the microbial world.

We have thoughtlessly used antimicrobials in human health and mostly irrationally, either in healthcare institutions or in community — from over-the-counter sale of medicine by profit-seeking pharmaceuticals to the last in the supply chain, the neighbourly ever-helping chemists!

Our insistence to use antimicrobials is also proportional to our faith in our best friends and our siblings as well as the internet, to treat symptoms with the use of certain medicine-self medication.

Coupled with this is the enormous use of antibiotics and antimicrobials in poultry, animal husbandry, fisheries, aquaculture, agriculture farming and so on as growth promoters as well as for animal and farm health. These enter the food chains for human beings.

This is a recipe for disaster! There are interactions between different microbes and microbes and humans in the gut — the food and the number connection. Add-on the untreated or semi-treated effluents from pharmaceuticals and other industries.

We don't need rocket science to explain what has been occurring in the internal or external environment. It has been evidenced that areas like war zones have plenty of metals in the environment which pose an additional threat and promote antimicrobial resistance.

In a healthcare institution or the hospital milieu, the chances of usage of antimicrobials is much more and more prolonged, especially in the intensive care units and emergency wards as infective episodes are combated in critically ill patients.

Most such patients already have been exposed to antimicrobial agents and drugs, thus harbouring microbes which carry AMR genes.

Role of government, citizens

Is containment, slowing down a natural process and mitigation possible? Yes! It has been evidenced that whenever the pressure of antimicrobials is released, most of the peace keepers return and overwhelm the goonda (thug) which may not be eliminated completely but would be kept in check.

Governments have put a thrust on the containment of AMR and irrational use of antimicrobials. Action points have been laid down and implementation strategies formed. Various ministries and departments have come together and some states are getting over the initial inertia of implementation.

We need to remember that lower the chances of infection, lower would be the use of antibiotics / antimicrobials. Prevention is always better than cure.

Here's a summary of our responsivities and action points (and we can add on more, practically and rationally):

- Hygiene and health go side by side. Washing hands before eating is an age-old preventive measure advocated by our culture and a good fallout of the pandemic. Washing raw and washable food properly and cooking appropriately are also important.
- Hand and body hygiene and cleanliness by caregivers, including healthcare workers and patient's relatives and visitors, maintaining rational disinfection and sterilisation activity, food and water hygiene, proper sanitation, appropriate and segregated waste disposal, effluent and waste water treatment with quality control over proper functionality of all mechanisms and processes before discharge into environment.
- Rationalising prophylactic or precautionary antibiotics or antimicrobial agent usage
- Stop irrational usage of antimicrobials and pressuring the doctor or healthcare personnel to hasten up recovery by adding antimicrobials when not required.
- Implementing rational antimicrobial and diagnostic stewardship programmes
- Changing lifestyle to decrease dependence on medicines — allopathic, ayurvedic or Unani
- Medications for health-related infectious concerns in animals and plants need to be used only when required and never as growth promoters.

- Appropriate research to find new antimicrobial molecules and ways of delivery, so that these are targeted to infection sites only and minimise development of AMR
- Explore non antimicrobial growth promoters
- Being extremely careful on discarding waste: We tend to discard expired or non-used medicines as common waste, which then intermingle with our surroundings and find their way to soil and water
- Stopping over-the-counter sale of antimicrobials and imposing a better mechanism of waste collection and disposal of medicines separately
- Always asking for a proper bill from the chemist for all medications as this will decrease spurious drugs usage
- Use of non-disinfectant, non-medicated soap and water, which are as effective and much less damaging to the environment
- Vaccination for vaccine preventable diseases, wherever and whenever possible, for both children and adults

We, the people, have to change our mindset. If we are ready for it and put our might and force behind it, the future may not be as bleak. Otherwise, we do not have the time or mechanisms to prevent human catastrophe — most of us won't survive infections. The time is now or never.

About the author
Raman Sardana is Secretary of Hospital Infection Society, India

Zimbabwe has created momentum for success, but more work needed

Country's drug resistance index at 66.6% against a benchmark of 25%

By Tapiwanashe Kujinga
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Zimbabwe was one of the first African countries to take immediate action against antimicrobial resistance (AMR). Substantial effort in the country has paved the path, but more work is needed in that direction.

Recent data published by the Mapping AMR and AMU Partnership (MAAP) consortium confirmed that the drug resistance index (DRI) score for Zimbabwe stood at 66.6 per cent against a benchmark of 25 per cent. Other countries with high DRI scores were Senegal (79.8 per cent), Malawi (74.1 per cent) and Uganda (69 per cent).

In May 2015, the World Health Assembly passed a resolution directing all member states to have an AMR national action plan by May 2017. The resolution was passed after evidence came to light of AMR posing a threat to global public health, hence the need for all countries to mount a robust response.

Social movement Pan-African Treatment Access Movement, with support from the global network, ReAct Africa, held the first AMR meeting in Zimbabwe July 30, 2015. The government, human and animal health sectors, the laboratory sector, academia, civil society and technical experts participated in the meeting.

A multi-sectoral national AMR Core Group was formed at the end of the meeting. The group incorporated more members to reflect the changing dynamics of the national AMR response with time.

There was little guidance on creating structures for a national AMR response in 2015. The core group relied heavily on technical support and expertise from ReAct Africa and the Centre for Disease Dynamics, Economics & Policy.

The first national AMR coordinator, the late Sekesai Zinyowera, conducted the bulk of the research and work on the AMR situational analysis began through this collaboration. In the interim, the first One Health meeting was held June 2016, resulting in forming five technical working groups along the line of the five strategic pillars proposed in the AMR Global Action Plan.

Work on the AMR national action plan (NAP) commenced after the AMR situational analysis was completed. The five technical working groups contributed to the strategic objectives and the result was an ambitious plan to roll out a comprehensive national response against AMR.

One of the programme's main priority areas was collecting laboratory data to establish the prevalence of drug resistance. Samples from the main sectors were collected and analysed through a grant from World Health.

This provided an insight into the scale of the AMR problem. WHO gave a further grant for implementing the 'Tricycle Project' for the surveillance of AMR, allowing for the collection of human, animal and environmental samples for analysis.

A point prevalence study was conducted simultaneously with the Medicines Utilisation Research In Africa (MURIA) Group. Implementation of awareness activities also received support, especially during World Antibiotic Awareness Week every November.

Television and radio sessions reached many households in the country, stakeholder meetings were held in various cities and AMR quiz competitions were held among medical students.

In 2019, the Fleming Fund became the first substantial resource provider to the national programme when a grant agreement for the renovation and upgrading of 14 laboratories was signed.

This grant helped set up an AMR laboratory at the national reference laboratory and this development provided cutting-edge technology for pathogen identification and drug sensitivity testing.

The Central Veterinary laboratory was also upgraded to conduct sensitivity testing, while 12 other laboratories in the human health, animal health, food and environment sectors were similarly upgraded.

The national laboratory system had previously submitted samples to international institutions — the human health samples were submitted to a WHO portal called GLASS and the animal samples were submitted to an independent company SILAB's portal.

The upgrading of the laboratory system and an efficient integrated sample system allowed for more samples to be submitted for analysis.

The Fleming Fund grant also supported several other activities, including training staff on the cost of the AMR national action plan, training AMR champions, and supporting the strengthening of the AMR governance structures.

The second substantial grant to be secured by the national AMR programme was from the Multi-Partner Trust Fund (MPTF). This grant supported a wide range of activities and projects.

These include promoting the use of vaccines as an alternative to the irrational use of antibiotics for theileriosis in cattle and typhoid in humans, revising the National IPC Policy and Strategic Action Plan and the National IPC guidelines and training programme to strengthen evidence-based practices to address AMR transmission.

Conducting supply chain mapping of the distribution of human and veterinary medicines, including cross-border trade and trade in illegal, falsified and substandard drugs and

conducting knowledge, attitudes and practices (KAP) studies to understand key drivers of AMR within different stakeholder groups were also undertaken.

The grant also allowed the development of specific behaviour change intervention targets relevant for each stakeholder and conducting of a prospective study embedded within an existing broiler value chain on AMR and antimicrobial use surveillance in broiler farms. Implementation of most of the activities is currently ongoing.

The Zimbabwe national AMR programme has made some tremendous strides over the last seven years since its commencement and this momentum will hopefully be maintained and accelerated. Indeed, this trajectory is critical given the AMR data that has recently been published.

Other Zimbabwe-relevant data extrapolated from the MAAP study shows antibiotic agent carbapenem-resistant Enterobacterales rising to 12 per cent in 2018 from 2 per cent in 2016, 3rd generation antibiotic agent cephalosporin-resistant Enterobacterales rising to 54 per cent in 2018 from 41 per cent in 2016.

Some studies have noted the rise in the use of antibiotics, while another study found evidence of inappropriate use of antibiotics during the COVID-19 pandemic. At the same time, the sale of illegal and counterfeit medicines is conducted in markets where the public can purchase them without a prescription.

A lot of work is needed to contain AMR in Zimbabwe, but momentum has been created for success.

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Here is how Malaysia endeavours to protect its people from AMR

Public awareness campaigns related to the prudent use of antimicrobial agents can reduce the misuse of antimicrobials in animals

By Rohaya Mohd Ali
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Antimicrobial Resistance (AMR) remains a major public health crisis and is emerging as a global health threat. AMR refers to the ability of microrganisms such as bacteria, fungi, parasites and viruses to proliferate despite exposure to drugs designed to kill them or slow down their growth.

The indiscriminate use of antibiotics in factory-farmed animals leads to AMR in poultry and people. In Malaysia, factory-farming is one of the major contributors to the economy.

Broilers account for a major portion of factory farmed animals in the country. They are followed by broiler ducks, pigs, cattle, goats, sheep and buffalo, according to the data from the country's department of veterinary services.

The country's Poison Act of 1952 mandates the registration of antimicrobials used in humans and animals with the National Pharmaceutical Regulatory Agency (NPRA). Animal feeds are also required to be registered with the Department of Veterinary Services under the Feed Act 2009.

Generally, antimicrobials are used for treating infections. However, they have been routinely used for disease prevention and for promoting growth.

Tetracyclines are the most widely used class of antimicrobials in Malaysia, according to the available data. It is followed by polypeptides, penicillin, macrolides, sulphonamides and aminoglycosides.

Many countries have policies to reduce the use of antimicrobials in industrially farmed animals.

WHO strongly recommends reducing the use of all classes of medically important antimicrobials in food-producing animals. It urges complete restriction of these antimicrobials for growth promotion and disease prevention.

Some initiatives

National Antimicrobial Resistance Committee:

In 2017, Malaysia established a National Antimicrobial Resistance Committee (NARC). The committee comprises members from various disciplines. The first phase of the Malaysian Action Plan on Antimicrobial Resistance for 2017–2021 was created in collaboration with NARC. The action plan's implementation is carried out in stages through four technical working groups.

AMR surveillance:
Malaysia has conducted continuous AMR surveillance on foodborne pathogen Salmonella and commensal E.coli in food-producing animals.

In general, Salmonella and E.coli , isolated from broilers, pigs and chicken, were found to be highly resistant (above 50 per cent) to drugs such as — erythromycin, tetracycline ampicillin, chloramphenicol, streptomycin and sulfamethoxazole-trimethoprim.

Policies on antimicrobial usage:
The government of Malaysia has established an AMR policy which aims at prohibiting the use of Critically Important Antimicrobials in humans and Veterinary Critically Important Antimicrobials in food-producing animals for growth promotion and prevention.

So far, Malaysia has completely banned the use of Nitrofuran, Chloramphenicol, Beta-agonists and Colistin. The use of six more antimicrobials as growth stimulants and prophylaxis in animal feed was banned in 2021.

These antimicrobials are Erythromycin, Enrofloxacin, Tylosin, Ceftiofur, Tetracycline and Fosfomycin. Malaysia has also developed a three-year roadmap (2023-2025) to guide the phase-out of 23 more medically important antimicrobials as growth promoters and prophylactics in animal feed.

AMR awareness:
Public awareness campaigns related to the prudent use of antimicrobial agents can reduce the misuse of antimicrobials in food production animals.

The department of veterinary Services, Malaysia (DVS) supports and conducts a series of activities to enhance and strengthen the awareness of AMR among — pharmaceutical wholesalers, veterinary practitioners, animal feed producers, students, health care workers, environmentalists and others.

DVS is also very committed to organising World Antimicrobial Awareness Week every year.

We have developed an Antimicrobial Resistance Awareness Toolkit (ARAT) for the training and education of extension workers, health workers and technical staff in the field in a targeted and effective way.

ARAT's objective is to ensure they receive sufficient education and training to become good trainers in their roles.

Vaccines:
Vaccines are considered among the most cost-effective ways to prevent morbidity and mortality from infectious diseases. The Malaysian government, through DVS, has funded the procurement of vaccines for diseases such as FMD and Brucellosis.

In addition, DVS also aims to ensure the availability of vaccines for endemic and newly emerging diseases in the country.

Farm biosecurity:

Farmers can avoid antimicrobial misuse by improving farm's biosecurity. DVS has introduced certification schemes such as MyGAP, Veterinary Health Mark (VHM and Good Veterinary Hygiene Practice (GVHP)to promote the same.

Challenges:

- Awareness of AMR and prudent use of antimicrobials is still not satisfactory.
- The knowledge of the farmers concerning antibiotics, withdrawal periods, prescription and dosages was found to be low.
- Lack of funds to strengthen AMR surveillance, laboratories and research.
- Lack of farmers' cooperation in reporting the use of antimicrobials.
- Antimicrobials are widely available online. It is difficult to be controlled by the authorities.

Misuse and overuse of antimicrobials in animals contribute to the increasing threat of antimicrobial resistance. Vaccines, good husbandry practices, probiotics, herbal products, essential oils and antioxidants can prevent possible infections and help limit the use of antibiotics.

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