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Use of veterinary medicinal products in the Philippines: regulations, impact, challenges, and recommendations

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ABSTRACT

Agricultural production is a major driver of the Philippine economy. Mass production of animal products, such as livestock and poultry farming, is one of the most prominent players in the field. Filipino farmers use veterinary medicinal products (VMPs) when raising agricultural animals to improve animal growth and prevent diseases. Unfortunately, the extensive use of VMPs, particularly antibiotics, has been linked to drug resistance in animals, particularly antibiotics. Antimicrobial gene products produced in animals due to the prolonged use of VMPs can passed on to humans when they consume animal products. This paper reviews information on the use of VMPs in the Philippines, including the regulations, their impact, challenges, and potential recommendations. The Philippines has existing legislation regulating VMP use. Several agencies were tasked to regulate the use of VMPs, such as the Department of Agriculture, the Department of Health, and the Philippine National Action Plan. Unfortunately, there is a challenge to implementing these regulations, which affects consumers. The unregulated use of VMPs influences the transmission of antibiotic residues from animals to crops to humans. This challenge should be addressed, with more focus on stricter regulation.

Keywords: Veterinary drugs; drug resistance; regulations; implementation; public health

INTRODUCTION

Agriculture plays a substantial role in the Philippine economy. Approximately 40% of Filipino agricultural workers contribute an average of 20% to its gross domestic product (GDP), mainly from agribusiness, accounting for approximately 70% of the total agricultural output. The maximum work in the total agricultural production is through crops (49%), followed by livestock, poultry, and fishing.

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Conflict of Interest

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In agrarian crop management, most farmers utilize inorganic and organic fertilizers to improve crop production. Inorganic fertilizers are products with major nutrients supplied by mineral or synthetic compounds. In contrast, organic fertilizers are products from a plant or animal origin, such as animal manure that have undergone decomposition. The use of animal manure as an organic fertilizer has been widely accepted for several advantages, such as cost-effectiveness, availability, ability to stimulate quality plant growth, enhanced crop production and healthy and mature fruit and vegetables, and improved soil [1]. Unfortunately, its use may pose a potential public health problem, particularly when the animals have been treated with veterinary medicinal products (VMPs). The use of animal manure from animals treated with VMPs, particularly antibiotics, may pose a risk of transmitting antibiotic residues to humans upon consumption of the crops fertilized with animal manure [2]. Nevertheless, definitions of the following terminologies are essential to avoid confusion:

1) Antimicrobials: agents used to reduce the possibility of infection and sepsis caused by microorganisms, such as bacteria, fungi, and viruses.
2) Antibiotics: antimicrobials that aim to kill bacteria (bactericidal) or stop the multiplication (bacteriostatic) of bacteria.
3) VMPs: agents used to treat, prevent, or diagnose diseases of animals, which may include antimicrobials and antibiotics.

Antibiotic residues have been detected in the manure of animals that had received VMPs, such as antibiotics. VMPs may vary in purpose. Some are used to improve animal growth and prevent diseases. Some drugs are considered feed supplements or additives to accelerate animal growth and allow easy and inexpensive marketing of animals to the market [3,4]. Other VMPs are antibiotics, regularly utilized to prevent susceptibility to diseases. Nevertheless, the use of VMPs, particularly that of antibiotics, is not adequately regulated because of misconceptions and limited knowledge of the pharmacological effects of the drugs [1]. This potentially causes antibiotic resistance in animals and humans, now considered a global public health concern.

The World Health Organization (WHO) escalated the situation into one of the top health challenges facing the 21st century [5]. The link between antimicrobial drug use in the agricultural sector and antimicrobial-resistant infections in humans remains disputed by critics [6]. Several studies have been conducted to show the possible implications of livestock antibiotic use on humans via the development of antimicrobial-resistant genes (ARGs) and dissemination to consumers of agricultural products. Antibiotic residues expedite the emergence and evolution of antimicrobial-resistant bacteria (ARB) and ARGs in the environment [7]. Moreover, the development of this environmental antibiotic resistance directly impacts drug resistance in humans [8]. The ARB and ARGs from the antibiotic residues serve as a reservoir containing metabolized antibiotics, which can be transferred to humans. Most common bacteria targeted by these antibiotics and their residues include but are not limited to Actinobacteria, Proteobacteria, or Bacteroidetes [8,9].

The high impact of antibiotics on livestock transmitted to crops and humans highlights the need to regulate their use in livestock farms should be managed appropriately. Farmers can easily purchase veterinary antimicrobial drugs in local agriculture-veterinary supply and retail outlets even without a prescription. The use of veterinary antimicrobial drugs is controlled by the veterinary profession or other parties with the required expertise and is part of good veterinary and good animal husbandry practice according to the Code of Practice to minimize and contain antimicrobial resistance. The code also specifies the limit

of use of antimicrobial VMPs according to their approved and intended use and should be based on resistance surveillance and monitoring studies. Similarly, the WHO published guidelines on the use of medically important antimicrobials in food-producing animals. The WHO recommends reducing the use of antimicrobial VMPs, restricting the use of all classes of medically important antimicrobials in food-producing animals for growth production, restricting the use of all classes of medically important antimicrobials in food-producing animals for preventing infectious diseases that have not been clinically diagnosed, and prohibiting the use of antimicrobials classified as highest-priority critically important for human medicine for treating clinically diagnosed infectious diseases in food-producing animals. The guidelines as best practice statements also emphasize that any new class of antimicrobials developed for human use are critically important for human medicine. In addition, medically important antimicrobials not currently used in food production should not be used in food production and food-producing animals or plants [10]. In the Philippines, the government developed several initiatives to combat the extensive use of antibiotics. For example, in 2014, the Inter-Agency Committee on Antimicrobial Resistance (ICAMR) was formed, headed by the Department of Health (DoH) and co-headed by the Department of Agriculture (DA). Moreover, surveillance programs were facilitated by the DoH and Research Institute of Tropical Medicine (RITM) that monitor nationwide resistance rates. In addition to these initiatives, the legislation also controls the use of VMPs. In the Philippines, VMPs are regulated by the Food and Drug Administration (FDA), which implemented the Republic Act 10918 "No Prescription No Dispensing" Policy. The VMPs are not exempted from the distribution and sales that require a prescription when purchased by commercial and backyard farmers. Despite the established regulations and policies, exposure of humans to antibiotic residues and antibiotic resistance still pose a threat because of gaps in the VMP regulation. In the Philippines, as a resource-limited country, the issuance of veterinary prescriptions to farmers has not been well implemented. With these challenges and limitations on regulating the use of VMPs, this article presents the various regulatory policies on the use of VMPs in the Philippines, including updates, gaps, and potential recommendations, with the ultimate goal of encouraging the appropriate use of antimicrobial VMPs to prevent the potential transmission of antibiotic residues to consumers.

REGULATORY GUIDELINES

In the Philippines, the FDA and the DA are the two regulatory agencies that mandate policies on VMPs for agricultural use. The FDA, formerly known as the Bureau of Food and Drugs (BFAD), is a health regulatory agency under the DoH formed in 1963 by Republic Act No. 3720, amended in 1987 by Executive Order 175, otherwise known as the "Food, Drugs and Devices, and Cosmetics Act", and subsequently reorganized by Republic Act No. 9711 otherwise known as "The Food and Drug Administration Act of 2009". The FDA is responsible for numerous activities, such as licensing, monitoring, and regulating drugs, medical devices, foods, cosmetics, household hazardous products, electromagnetic radiation emitting devices, and related products for efficacy, quality, and safety. On the other hand, the DA is responsible for agricultural and fisheries development and growth. It has eight bureaus, including the Bureau of Animal Industry (BAI), which focuses on VMPs for agricultural use.

Policies mandated by the FDA

The 1987 Constitution, Article II, Section 15 declares that "The State shall protect and promote the right to health of the people and instill health consciousness among them." In

Table 1. Policies mandated by the FDA and sections related to the use of VMPs

Policy number	Legislation title	Sections that relate to VMP use
Republic Act No. 3720	Food, Drug and Cosmetic Act	Section 10 (f) "Drug" Section 11 "Prohibited Acts"
Republic Act No. 9711	FDA Act of 2009	Section 9- Amendments of Section 10 of RA 3720 Section 10- Amendments of Section 11 of RA 3720
Republic Act No. 10611	Food Safety Act of 2013	Section 4, Section 15, Section 18
Republic Act No. 6675	Generics Act of 1988	Section 2 – Statement of Policy
Joint AO 2013-0026	Rules and Regulation of Veterinary Drugs and Products, Veterinary Biological Products, and Veterinary Drugs Establishments	Section VI- Specific Guidelines

FDA, Food and Administration; VMP, veterinary medicinal product.

addition, Article XIII on Social Justice and Human Rights on Health declares that it is the responsibility of the State to "establish and maintain an effective food and drug regulatory system and undertake appropriate health, manpower development, and research, responsive to the country's health needs and problems" (Section 12). Furthermore, Section 9, Article XVI provides that the State shall look into trade malpractices and substandard or hazardous products that will affect the consumers. Aligned with the mentioned provision of the 1987 Constitution, which is the basis of all laws in the Philippines, several laws were enacted that relate to the safety of VMPs. **Table 1** lists the essential legislation. The table also summarizes the policy number, the title of the legislation, and specific section numbers within each law relating to VMP. On June 22, 1963, the Republic Act No. 3720 (Food, Drug, and Cosmetic Act) was approved to ensure the safety of drugs being used by the public. In the RA 3720, "Drug" was defined in the United States Pharmacopoeia, Homeopathic Pharmacopoeia of the United States, or National Formulary as any material utilized in treating, diagnosing, mitigating, or preventing diseases. Thus, the regulation of VMPs, although not consumed directly by humans, is still covered by RA 3720. Furthermore, VMPs are prohibited from adulteration, misbranding, forging, counterfeiting, simulating, or falsely representing. Also stated is the requirement for allowing inspection of all VMPs. This was emphasized in Section 11, "Prohibited Acts" of RA 3720.

On August 18, 2009, the Republic Act 9711, known as the "Food and Drug Administration (FDA) Act of 2009," was approved. RA 9711 established testing laboratories and field offices, upgraded equipment, augmented human resource complement, and renamed the BFAD into the FDA. In addition, RA 9711 amended certain sections of RA 3720 to improve processes and mechanisms aimed and designed to protect and promote the right to health of the Filipino people. In Section 9 of RA 9711, "Drug" was defined similarly to the above definition and included the definition of 'Veterinary drugs' as any article intended for use for animals, including those incorporated in animal feed. Section 10 of the FDA Act prohibits the production and marketing of any drug product that is adulterated, unregistered, or misbranded. Section 6 of the FDA Act augmented the regulation of veterinary products by mandating the FDA to have a 'Center for Drug Regulation and Research' that includes monitoring veterinary medicines and biologicals. RA 10611, known as the "Food Safety Act of 2013," was approved on August 23, 2013. This legislation strengthened the food safety regulatory system in the country to protect health and facilitate market access to local foods and food products. RA 10611, Section 15, assigned the DA as one of the Food safety regulatory agencies to monitor the food supply chain from production to post-harvest to marketing and importation. The DA should also be involved in the implementation of monitoring and epidemiological surveys on food-borne illnesses. Section 4 of RA 10611 also mandated "Good agricultural practices," including environmental and economic social sustainability for on-farm processes to ensure the safety of agricultural food and non-food products. Section 18 of RA 10611 mentioned the specific responsibilities of the DoH under

the FDA. One is the implementation of the FDA Center for Food Regulation and Research, which also focuses on VMPs in agriculture. Another notable policy is the Republic Act 6675, which is the Generics Act of 1988 that ensures an adequate supply of drugs and medicines and that generic names are utilized. Section 2 of RA 6675 on the Statement of Policy mandated that the country should require generic terminology in the distribution, prescription, and dispensing of drugs, including VMPs. On September 25, 1991, a Memorandum of Agreement was executed between the FDA and the DA-BAI, identifying the functions of both agencies in regulating the manufacture, distribution, and registration of veterinary drugs and products. This partnership, through Administrative Order No 2013-0026, will regulate the existing establishments, including their registration and licensing procedures, that produce and sell veterinary drugs and products and will ensure adequate supply in the market.

Policies mandated by the DA

Department of Agriculture-Administrative Order No. 40 s.1990 stipulated the rules and regulations on the dispensing of veterinary drugs and products, which include regulations for the preparation, marketing, and importation of products used for treating domestic animals. Section 2 of this Order stated guidelines for "Veterinary Drugs" and Over-the-counter Veterinary Drugs. Section 3 of the abovementioned order contains additional guidelines on dispensing. Section 4 tackles the violations on the part of dispensers and veterinary drugs and products. **Table 2** lists the policy numbers mandated by the DA, title, and sections of the order regulating VMPs. The Department of Agriculture Administrative Order No. 33 s.1991 differentiated the veterinary drugs for "General Use" and for "Restricted Use". Furthermore, the Department of Agriculture Administrative Order No. 33 s.1991 added general standards for the establishments applying to register a veterinary drug and products, which was stated in Section 2. Section 3 of this order discusses the specific classifications of veterinary drugs and products that require evaluation and registration based on specific requirements. Annex A of the same order listed the Dangerous Drug Board's pharmaceutical products classified as prohibited drugs or regulated drugs. On the other hand, Annex B contains the list of veterinary drugs and products requiring strict precaution in prescribing, dispensing, and use. The Department of Agriculture Administrative Order No. 39 s.1991 defined the veterinarian-client-patient relationship (VCPR) as a written agreement between the client and veterinarian, wherein the veterinarian has the responsibility to make clinical judgments regarding the health of animals, and the client has agreed to follow the veterinarian's instructions.

The VCPR also states that the veterinarian has knowledge of the animal to provide at least a general or initial diagnosis of the medical condition of the animal. This means that the

Table 2. Policies mandated by the Department of Agriculture and sections related to the use of veterinary medicinal product s

Policy number	Title	Sections that relate to VMP use
Department of Agriculture Administrative Order No. 40 s.1990	Rules and Regulations on Dispensing of Veterinary Drugs and Products	Section 2- *Guidelines on Dispensing* Section 3- *Additional Guidelines on Dispensing to implement Generics Act of 1989* Section 4- *Violations on the Part of Dispensers and Veterinary Drug and Product Outlets*
Department of Agriculture Administrative Order No. 33 s.1991	Rules and Regulations on Dispensing of Veterinary Drugs and Products	Section 2- *General Standards* Section 3- *Classification* Section 4- *Initial Registration* Annex A- *List of Pharmaceutical Products* Annex B- *List of Veterinary Drugs and Products requiring strict precaution in prescribing, dispensing and use*
Department of Agriculture Administrative Order No. 39 s.1991	Rules and Regulations to Implement prescribing requirements for the veterinary drugs and products	Section 1- *Definition of VCPR* Section 2- *Guidelines on prescribing based on prior laws*

VCPR, veterinarian-client-patient relationship.

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veterinarian has recently seen and is personally acquainted with the keeping and care of the animal by virtue of an examination of the animal or by medically appropriate and timely visits to the premises where the animal is kept. Section 2 states that prescription of drugs should only be made by duly licensed veterinarians. Unauthorized persons caught prescribing drugs is an illegal practice of veterinary medicine that is punishable under RA 382 or the Veterinary Practice Act.

Updates on the implementation of the guidelines

Table 3 lists the updates on implementing guidelines regarding VMPs from the latest to the oldest. Domingo F. Panganiban, Secretary of the DA in 2006, issued Administrative Order No14 S. 2006, which covers the implementation of programs related to the control of veterinary drug residues. The committee comprises Undersecretary for Livestock and Fisheries as chair and the Director, Bureau of Agriculture Fisheries and Product Standards as vice-chair. The committee formulated a long-term National Veterinary Drug Residues Control Program with other government agencies: livestock, fishery, poultry, and feed milling industry associations. Various DA agencies collaborated under the immediate term Veterinary Drug Residues Control Program in Foods with their respective roles. The State formed an inter-agency committee to formulate and implement a national plan against antimicrobial resistance and control the monitoring of antimicrobial resistance in animal health. The inter-agency committee is composed of representatives from DoH and DA, the Department of Science and Technology, the Department of Interior and Local Government (DILG), and the Department of Trade and Industry (DTI). The plan included the development of utilizable essential medicines for veterinary use and ensuring proper prescription, promotion, and marketing of antimicrobial agents based on the licensed indication.

The FDA circular No. 2014-025, dated November 21, 2014, implemented a policy that only when there is a written prescription of drugs from a licensed doctor can pharmacists and owners of drugstores and other drug-dispensing establishments dispense drugs. In 2015, the Antimicrobial Resistance Surveillance Program was launched by the RITM and the ICAMR. The Antimicrobial Resistance Surveillance Reference Laboratory aims to form a professional network of regional and central laboratories that will conduct quality antimicrobial resistance surveillance by providing standardized methods of in-vitro antimicrobial susceptibility testing. This will give the country the status and trends of bacterial resistance to antimicrobial agents. The surveillance included bacterial resistance in animal health in agriculture. In 2016, the National Antibiotic Guidelines were published. On the other hand, the guidelines did not mention recommendations for veterinary medicines.

In 2017, the Philippine National Health Research System formulated the National Unified Health Research Agenda (NUHRA) 2017-2022, which summarizes the health research and

Table 3. Summary on the updates of the implementation of guidelines for the use of veterinary medicinal products

Year	Updates
2017	Publication of the National Unified Health Research Agenda (NUHRA) 2017–2022 highlighting support for antimicrobial resistance and research on drug discovery, innovation and health technologies
2016	Antimicrobial Stewardship Training
2016	National Antibiotic Guidelines published
2015	Antimicrobial Resistance Surveillance Program (ARSP) launched by RITM and ICAMR
2014	FDA No Prescription No Dispensing Policy
2014	Formation of the Inter-Agency Committee on Antimicrobial Resistance (ICAMR) (DoH AO. No. 42)
2006	Implementation of the national veterinary drug residues control program and creation of the interagency committee
1991	Implementation of the policy that mandates prescribing requirements for the veterinary drugs and products

RITM, Research Institute of Tropical Medicine; ICAMR, Inter-Agency Committee on Antimicrobial Resistance; FDA, Food and Drug Administration; DoH, Department of Health.

development directions of the country. This agenda included the prevalence of unregulated veterinary antimicrobial products and corresponding resistance rates in animals. The NUHRA 2017–2022 was formed through the combined efforts of academics, researchers, government officials, health professionals, and health policy experts over the Philippines.

DISCUSSION

Challenges in implementation

The need to properly regulate and implement policies on the use of antimicrobial VMPs has been emphasized by studies mentioning the potential transmission of antibiotic residues to consumers, leading to the development and transmission of drug resistance. This explains why regulation and implementation of policies become problematic and challenging. These challenges were divided based on the stakeholders involved in the implementation:

1) Regulatory agencies: challenges brought about by monitoring the implementation of policies and regulations

The Republic of the Philippines had policies on the sale, prescription, and distribution of antimicrobial VMPs long before AMR became a global public health issue [11]. On the other hand, the easy accessibility of farmers to antimicrobial VMPs in local agriculture-veterinary retail outlets, the challenges in the implementation of standards for VMPs, weakness in the enforcement of issuing veterinary prescriptions to farmers, and the lack of awareness of the judicious use of antimicrobials may increase the occurrence of AMR in the Philippines [2]. The stakeholders involved in this challenge are the Department of Environment and Natural Resources (DENRs), which monitors agricultural pollutants in the industry, and the DA, which is responsible for ensuring food safety during the primary production and post-harvest stages [2].

2) Retail outlets of agricultural products: challenges brought about by the need for local agricultural retail outlets to earn from the sales of VMPs

The Philippine FDA had the initiative to discontinue broadcasting TV and print ads that promote the use of veterinary antimicrobials for food-producing animals and fighting cocks. In its Advisory 2013-006, dated April 3, 2013, the FDA said the indiscriminate use of antimicrobials in raising poultry and livestock might lead to harmful bacteria resistant to antimicrobials. The advisory warned the public against indiscriminate use of antimicrobials in raising poultry and livestock animals. In addition, all veterinary drug outlets are prohibited from dispensing veterinary antimicrobials without the written Order of a licensed veterinarian. A study assessing antimicrobials in backyard and commercial poultry and swine farms in the Philippines identified that the spectrum of antimicrobials in swine farms is more diverse than in poultry farms. Poultry farms utilize norfloxacin, erythromycin, and fosfomycin. Swine farms use oxytetracycline, tylosin, tiamulin, and gentamicin more frequently than poultry farms. They also observed that enrofloxacin is the most commonly reported antimicrobial active ingredient. A comparison of commercial and backyard farms revealed amoxicillin and colistin to be utilized more frequently in commercial farms; oxytetracycline is preferred in backyard farms.

Furthermore, these antimicrobials are commonly purchased by backyard farm owners via over-the-counter processes at retail outlets with limited veterinary oversight [2]. The FDA cited the DoH's Administrative Order No. 65 issued in 1989, which "prohibits the advertisement and promotion of all prescription or ethical drugs in mass media." Veterinary

antimicrobial products control infections and restore an animal's health. On the other hand, the FDA noted that some veterinary antimicrobials are "admixed" in feeds or added to drinking water to promote growth, improve feed efficiency or conversion rate, and prevent disease. The FDA stated that the root of the problem is the indiscriminate, improper, and irrational use of veterinary antimicrobials in raising food-producing animals, which favors the emergence and possible spread of antimicrobial-resistant pathogenic or disease-causing bacteria in animal and human populations. Food animals in the Philippines are also traded worldwide. Hence, antimicrobial resistance affecting the animal food supply of one country can become a potential problem for other countries.

3) Livestock Industry owners: challenges brought about by the need of farmers to prevent animal diseases

Licensed veterinarians working in various agrifood companies and allied industries provide numerous services to the livestock and poultry sectors but in limited areas only. On the other hand, veterinarians servicing food animals in rural settings, such as villages within municipalities and cities, are limited. Animal health services are typically provided by a network of regional and provincial veterinarians and para-veterinarians, catering to a huge work area. Para-veterinarians, commonly known as livestock inspectors, meat inspectors, and agricultural technicians, are employed by local government units to reach municipalities/cities in remote areas. They have formal training in animal husbandry and some animal health and AMU dispensing training provided by national or regional veterinary authorities [2]. Unfortunately, scarcity still exists in this area, which makes livestock industry owners "self-medicate" and use VMPs without prescription.

Impact of the improper regulation of the use of VMPs

The irrational use of VMPs can exacerbate the development of antimicrobial resistance. In the Philippines, recent studies were conducted on the impact of improper regulation of the use of VMPs. One of the studies involved the detection of *Escherichia coli* with extended-spectrum beta-lactamase conferring genes (ESBLs) among swine. ESBL *E. coli* from 54 randomly selected pig farms in Luzon showed 14 different phenotypic multidrug resistance patterns. A diverse antibiogram profile, increased prevalence, and genotypic resistance pattern of ESBL-EC isolates from swine were observed, which could result in the development of susceptible bacteria, human transmission, and environmental hazards [12]. Gundran et al. also determined a 66.67% prevalence and distribution of bla CTX-M, bla SHV, and bla TEM genes in extended-spectrum β-Lactamase-producing *E. coli* isolates in several broiler farms in the Philippines. Hence, the *E. coli* isolates have a high prevalence of ESBL genes, diversity of patterns, and coexistence of ESBL genes, which pose high risks of transmission to the environment, other animals, and humans [13]. *Campylobacter* spp. isolates from chicken parts collected in wet markets and supermarkets in Metro Manila exhibited drug resistance to clindamycin (98.6%), erythromycin (98.6%), nalidixic acid (98.1%), tetracycline (94.2%), gentamicin (65.2%), and chloramphenicol (52.7%) [14]. In Metro Manila, the isolates of *Salmonella enterica* from tissue samples of tonsil and jejunum with lymph nodes of swine showed resistance to at least one antimicrobial agent: amikacin (100%), cefazolin (100%), cefuroxime (100%), cefuroxime axetil (100%), cefoxitin (100%), and gentamicin (100%), ampicillin (50%), and sulfamethoxazole-trimethoprim (30%) [15]. In Valencia City, Bukidnon, the Philippines, isolates of *E. coli* and Salmonella spp. Collected from retail chicken meat at selected markets were resistant to amoxicillin and ampicillin [16]. Legario et al. [17] reported recovery of Streptococci from Nile tilapia farmed in the Philippines, exhibiting resistance to oxolinic acid and sulphamethoxazole–trimethoprim. In Taiwan, a multidrug-resistant *Salmonella enterica* serotype *Anatum* strain was

isolated from seafood imported from Asia, one from a shrimp imported from the Philippines. Eleven resistance-determinant genes were isolated, including quinolone and inducible cephalosporin resistance genes. These findings emphasize the need for global One Health and antimicrobial resistance surveillance in animal health, particularly in the Philippines [18]. In the Philippine shrimp aquaculture industry, antibiotics treat bacterial diseases during the production cycle. Saloma et al. reported the draft genome of *Vibrio parahaemolyticus* PH698, a multidrug-resistant strain isolated from a Philippine shrimp farm [19]. Antibiotic resistance from shrimp ponds was also detected among the Vibrios, with *V. harveyi* commonly isolated [20]. Furthermore, high levels of bacterial resistance to oxytetracycline and oxolinic acid were also isolated from shrimp ponds in the Philippines [21].

Cetaceans stranded in the Philippines were screened for antibiotic resistance, showing either single or multiple resistances to the antibiotics tested. The development of antibiotic resistance in a rough-toothed dolphin (*Steno bredanensis*) was observed after the administration of antibiotics during rehabilitation [22]. Tetracycline and sulfonimide resistance genes were also reported through molecular detection in the respiratory and gastrointestinal isolates of ruminants. The organisms showing resistance were *Acinetobacter schindleri, Arthrobacter, Bacillus megaterium, Bacillus pumilus, Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, ruminants, Staphylococcus, Staphylococcus sciuri* [23]. In addition, multiple resistance to medically essential antimicrobials of commensal *E. coli* isolated from dressed broiler chickens in Calabarzon, Philippines, with the most common MDR pattern of ampicillin ciprofloxacin–nalidixic acid–streptomycin–kanamycin-tetracycline (7.5%) against critically important antimicrobials. Bacteria were observed to be resistant to the following antimicrobials: nalidixic acid (97.5%), ampicillin (90%), ciprofloxacin (85%), tetracycline (80%), streptomycin (72.5%), trimethoprim (62.5%), and trimethoprim-sulfamethoxazole (62.5%). These patterns and the percentage of resistance are a public concern because drug-resistant bacteria can be transferred to humans [24]. From healthy pigs, high-level resistance, and multi-resistance to chloramphenicol (78%), trimethoprim (68%), sulfamethoxazole-trimethoprim (65%), ampicillin (62%), and tetracycline (60%) in *E. coli* were also isolated at slaughter in Laguna, Philippines [25].

Recommendations on the regulation of the use of VMPs

The DoH and the DA play critical roles in regulating VMPs because human and animal health ultimately suffers from the effects of VMPs, such as antimicrobial resistance. DENR, DTI, DILG, DepEd, and CHED are also important players. DENR is the environmental arm of the One Health approach, addressing the antimicrobial residues found in the environment and the microbes that can be changed as a result. In addition, DENR has monitoring and policy-development duties that can address industry-related ones. As with imported products, the safety and quality are monitored by DTI. For local policy development and implementation, DILG is essential to strengthen the capacity of local governments. PRC, CHED, and DepEd are included in the list of stakeholders to emphasize their essential roles in education and information dissemination to increase public awareness about regulating VMPs.

The Philippine National Action Plan on Antimicrobial Resistance for 2019 to 2023 included the key strategy of regulating and promoting the optimal use of antimicrobials, including veterinary medical products. The key strategy has three main objectives in relation to animal health. These objectives include the following: full implementation of guidelines for the prudent use of VMPs, development of an enabling environment for the prudent use of VMPs, and monitoring policy enforcement on the rational use of VMPs in markets, farms, and communities. **Table 4** lists the recommended activities to satisfy each objective.

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Table 4. Objectives and recommendations for the regulation of VMPs in the Philippines

Objectives	Recommended activities
To completely implement guidelines for the prudent use of VMPs	1. Review regulations and regulatory controls for registration, advertising, importation, and end-use 2. Develop national antibiotic guidelines for animal health 3. Development of national guidelines based on international or regional guidelines for an Antimicrobial Stewardship Program in animal health 4. Translate Good Animal Husbandry Practices (GAHP) and Good Aquaculture Practices (GAqP) into technical regulations 5. Documentation of good practices of GAHP and GAqP 6. Institutionalize Philippine practice standards for veterinarians in relation to prudent prescribing of antimicrobials 7. Conduct monitoring and surveillance of animal feeds and veterinary drug establishments
To construct an enabling environment for the prudent use of VMPs	1. Assign regional coordinators to AMR activities 2. Develop and implement a strategy for the regulation of the use of antibiotics common to both human and animal health as growth promoters and the continuous monitoring of banned antimicrobials 3. Register existing aquafarm sources of raw materials, as well as swine and poultry, feeds, in processing plants 4. Registration of Veterinary Drug and Product Establishments 5. Strict enforcement of existing regulations regarding medicated feeds 6. Development of guidelines for the regulation of antimicrobials in drinking water 7. Incentivize practitioners on the prudent use of antibiotics 8. Incentivize farms and operations by rewarding approvals for labeling their meat products with an official marketing tagline
To monitor policy enforcement on the rational use of VMPs in markets, farms, and communities	1. Conduct dialogue with stakeholders, industry, and LGUs 2. Develop a system for monitoring the implementation of issued regulations 3. Engage LGUs in the implementation of regulations, especially in the use of antimicrobials on backyard farms

VMP, veterinary medicinal product; LGU, local government unit.

Although not felt by livestock industry owners, this paper emphasizes the impact of the improper use of VMPs, leading to the transmission of antibiotic residues, which might spread antimicrobial resistance. With the numerous regulatory agencies and policies available on hand, a more focused and stricter regulations will be needed. The availability of veterinarians with lower professional fees might also be helpful. As emphasized by the One Health approach, a collaborative strategy is needed for an optimal health outcome, recognizing the interconnection of people, animals, plants, and their shared environment.

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