

# Indigenous and Cross-Border Eco-Health Implications of Unethical Injectable Antimicrobial Drugs Administration under Bovine Livestock Farming and Commercial Conditions

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## Abstract

**Background:** Nomadic cattle-rearing in Nigeria has been inferred to have livestock-wildlife interface; whereas, animal trade plays an important role in the spread of infectious diseases and antimicrobial resistance in animal and human populations.

**Objective:** To assess and highlight the communal, national, and international trans-boundary-public-Eco-health implications of drug-injection malpractices during livestock-farming and livestock-trading in Nigeria, and the associated trans-boundary One Health interventions.

**Study-populations and methods:** Study was limited to the Southwest Nigeria, where the indigenous (nomadic) cattle-farmers could be interviewed under non-hostile and safer conditions. However, two of the nomads had travelled up to about 26 out of the 37 states of the country. Verbal informed-consents were obtained from six cattle-farmers and twelve cattle-traders, at six major cattle-farm-settlements and six cattle-markets, and eight veterinary doctors / three animal husbandmen, followed by informal oral interviews, questionnaire-administration and telephone-conversations. Relevant information were transcribed and analysed as textual data.

**Results:** Cattle-farmers and traders mostly dosed presumably healthy-cattle with vitamins and iron drugs, while ill-cattle were injected with iron-dextran, oxytetracycline, penstrep, ofloxacin, chloramphenicol, tylosin, ivermectin, diminazene aceturate, izonid, colistin, etc. Clinical implications and associated adverse public health significance of expiry dates and improper storage of medications; non-combination of different medications in the same containers or syringes; microbial contamination of administered medications by previously used needle and syringe or left-over medications; administration of adulterated or expired injection-drugs under veterinary conditions; as well as, zoonotic-infections, antimicrobial resistance and antimicrobial residues in food-animals, were not comprehended by the cattle-farmers and cattle-traders. Cattle-farmers and cattle-traders in Nigeria unethically inject their cattle with prescription veterinary-medications, especially antibiotics and antiparasitics, reportedly due to, lack of subsidy and non-compensation by governments, in cases of cattle morbidity and mortality; shortage of animal health professionals, due to nomadic-cattle-farming, and cattle-farmers' occasional refusal to pay for rendered veterinary services.

**Conclusion:** Antimicrobial-injections-in-livestock-health, due to unprofessional injection administration by cattle-farmers and cattle-traders, with significant clinical-public health implications on eco-health and cross-border health, were recorded, and must be addressed through appropriate implementable policies.

**Keywords:** Animal ethics; Antimicrobial injection administration; Eco-Health; Prudent antimicrobial use; Trans-boundary livestock health; Veterinary health malpractices

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## Introduction

Intensive food animal production systems and their associated value chains reportedly dominate in developed countries, and are also increasingly important in the developing countries [1-4]. Notwithstanding, livestock diseases that have devastating outcomes on animal health, and which impact on national and international animal trades remain endemic in many parts of the world, most especially in developing countries. Threats from old and emerging microbial pathogens also continue to present conditions that are especially favorable for the spread of diseases into new geographical areas [5-8], as well as introduction of pathogens to previously disease-free areas [9-11]. In addition, most zoonotic pathogens and infections of recent concerns to human health have reportedly originated in, or are transmitted either directly or indirectly between animals; to human populations, and from food animals, which are raised for human consumption [1,12-14], while the associated zoonotic infections are of critical threats to global health security [15]. Livestock pathogens are subjected to pressures resulting from the production, processing and retail environment, which together, alter the host contact rate, population size and/or microbial traffic flows in the food chain [16]. Transmission within and between animal reservoirs and humans can therefore, have important ecological and evolutionary consequences that lead to establishment of drug resistance, and provide selective pressures for spill-over, host switching, hybridisations and introgressions between animal and human parasites [17], and other microbial pathogens [18,19]. Multihost parasites, with transmission and evolutionary dynamics may then affect the success of human and animal diseases control programmes, particularly the neglected diseases of the developing world, which have also been declared as one of the major challenges of biomedical sciences in the 21<sup>st</sup> century [17]. It is agreeable that cattle rearing in Nigeria can be inferred to have livestock-wildlife interface, since the nomadic livestock farmers can travel through the entire 37 states of the country, while seeking pasture for their cattle, and at the same time selling their cattle. Meanwhile, animal trade plays an important role in the spread of infectious diseases in livestock populations [20-23], as pathogens have been known to benefit hugely from the dynamic states created by animal migrations [23,24]. Unfortunately, the principles, professional and animal ethics against infection control practices, as well as risks of zoonotic diseases, are not basically comprehended by the Nigerian nomadic cattle farmers and traders, who are mostly non-literate. Similarly, the various arms of the government and the populace are not adequately informed about the hazards of the intra-animal transmission of diseases, as well as, transmission to humans. For quite some time, the nomadic livestock farming/trading in Nigeria has somehow become a terrorism situation [25]. But considering that the cattle farmers and traders mostly personally inject their livestock with veterinary medications, the purpose of this study therefore, is to investigate the implications of the unprofessional veterinary practices of injection of livestock with antimicrobials and other medications, by livestock farmers and traders, on the local, national and cross-border One Health and environmental health.

## Methodology

### Study area

The study was limited to the Southwest Nigeria (Akungba, Ibadan, Ijebu-Ode, Lagos and Oyo), where the indigenous (nomadic) cattle farmers could be interviewed under non-hostile and safer conditions. However, two of the nomads had travelled up to about 26 out of the 37 states of the country.

### Questionnaire survey

Six livestock-cattle farmers, four of whom were Nomadic, and 12 cattle traders were consulted informally for briefing on how their cattle were treated in clinical and infectious cases. Guided, informed verbal consents were obtained from the cattle farmers/traders at six major cattle farms and settlements and six cattle markets in Southwest Nigeria (Akungba, Ibadan, Ijebu-Ode, Lagos and Oyo), while two farmers preferred total anonymity. Questionnaire was administered at a farm, while information from the questionnaires were also presented as informal oral interviews at other five cattle farms and six cattle markets. Some of the information sought from respondents included, the most-common clinical and infectious conditions of cattle, most-commonly administered drugs in such conditions, personnel involved in drug administrations, dosage(s) and modes of administering drugs, frequencies of drug administrations, personal experiences of drug administrations, and some enlightenment questions. Although the common language of the indigenous (nomadic) cattle farmers was Hausa-Fulani, majority of the cattle farmers and traders could communicate with minimally needed understanding in Yoruba, while only two who could not, had their responses adequately translated.

As a control, some of the obtained information from the cattle farmers and traders were also sought from veterinary doctors who were associated with cattle farming, including few who were resident in the Northern parts of the country. Veterinarians residing in far locations of the country were interviewed by one-on-one discussions through telephone conversations, while all the obtained information were transcribed and analysed as textual data.

## Results

According to few of the cattle-farmers (1) and cattle-traders (3), they were well-familiar with expiration dates on the container(s) of injection drugs, by considering the first and last dates that appear on the injection container(s), as manufacture and expiry dates respectively. Most (16) of the cattle-farmers (5) and cattle-traders (11) were however, confused when asked how they would interpret a single date (as date of manufacture or expiration) on an injection vial (container), as well as implications of administration of expired drugs.

The cattle-farmers and cattle-traders injected their cattle without considerations for age, size, weight etc., of the animals. One cattle-farmer thought that the choice of injection needle size is based on the quantity (volume) of drugs to be administered; two cattle-farmers and five cattle-traders did not know there

were different needle sizes, while five cattle farmers and nine cattle traders did not know the reason for choice of injection needle size, although their choice was based on the type used by veterinary doctors that had injected their animals at one time or the other.

The cattle-farmers and cattle-traders were not aware that vaccines or clinical drugs are not expected to be combined in the same container or syringe unless the label clearly states so. They did not also know that for proper storage of medications for veterinary conditions, all needles are expected to be removed from bottles, prior to storage in the fridge (if required) or in a cool dark place (for those that do not need refrigeration), until the next use. In some cases, used drugs were kept as left-over, after mixing of different medications, until when reused on same or other animals.

Most of the drugs commonly administered by the cattle-farmers and cattle-traders were, iron dextran, oxytetracycline, penstrep, ofloxacin, chloramphenicol, tylosin, ivermectin, diminazene aceturate and izonidic. According to the obtained information from the animal husbands, veterinary technologists and veterinary doctors, the targeted corresponding infectious diseases and clinical conditions of cattle with the drugs commonly administered by the cattle-farmers and cattle-traders in Nigeria, included iron dextran (anaemia), oxytetracycline (diarrhoea, mastitis, dermatophilosis), penstrep (inflammation / mastitis / streptococcal infections), ofloxacin (pneumonia), chloramphenicol (salmonellosis), tylosin (reinderpest, contagious bovine pleuropneumonia), ivermectin (ticks / mites infestations), diminazene aceturate (trypanosomiasis, babesiosis) and izonidic (tuberculosis).

The common symptoms considered by the cattle farmers and traders to indicate conditions of cattle ill health or / and the needs to administer medications on the cattle were basically, diarrhoea, sluggishness, loss of appetite, injury and immobility. It was discovered in this study that contrary to the ethics of animal welfare and veterinary and public health professionalism, some professional veterinary health practitioners either intentionally or unintentionally taught the livestock farmers and traders how to inject cattle.

## Discussion

Livestock trade have been generally considered as potential for zoonotic and environmental disease transmissions, as well as dissemination of antibiotic resistance, while the movement of such endemic diseases make their management more difficult and costly [6,23-31]. Similarly, animals found in close proximity to humans in low-and middle-income countries mostly harbour many pathogens capable of infecting humans, transmissible through their faeces and the environment [6-8,22,24,26,30]. It has also been considered that disease emergence may be depicted as a revolving response to anthropogenic changes in the environment [27] and such anthropogenic activity may involve the non-professional and abusive administration of antimicrobials and other medications on cattle by the livestock-cattle farmers and traders. It should therefore, be worrisome that, the mostly non-literate livestock-cattle farmers and traders,

who cannot adequately comprehend epidemiology of livestock health and public health issues, personally inject their cattle, even in inhumane manner [25].

For veterinary treatments, the containers of available medications in the Nigerian market, which are administered on livestock-cattle, mostly contain information on the quantities of the active ingredients or compositions of such medications, and usually not the actual dosage(s) to be administered on animals for various clinical or infectious conditions, except when the medications contain leaflets with details on the medications. Dosages of medications for treating animals are often according to body weight but follow proper volume-per-site instructions, without exceeding or administering less or more than appropriate doses of medications per injection site. Injection-site swelling, especially unacceptably high incidence of injection-site lesions in the muscles of slaughtered cattle can occur from injecting a subcutaneous drug too deep; thereby, penetrating part of the first layer of muscles [32]. In order to avoid injection-site lesions, there is suggestion for usage of appropriate -inch injection needle, and which must be sterile hypodermic needles [33]. Choice of injection needle, which is very important in drug administration, is for the purpose of quality assurance, and also to avoid injury to the injected animals. So, correct gauge and size of needles according to the size of animal being treated are expected to be used [32,34]. All these important factors however, could not be comprehended by the livestock-cattle farmers and traders, who were respondents in this study.

Vaccines and other clinical drugs are not expected to be combined in the same containers or syringes, unless the labels clearly state so, since drug mixing can adversely affect the medications, by changing the pH, the chemical composition or by causing components of the drug to precipitate out of solution [32]. Similarly, for proper storage of medications for veterinary cases, all needles are expected to be removed from bottles prior to storage [32,35], with such medications stored in the fridge (if required) or in cool dark places (for those medications that do not need refrigeration), until the next use [36]. Consideration for possibility of microbial contamination of drugs by previously used needles and syringes or the possibility of left-over drugs being contaminated ensures that it is safer to use different new needles and syringes for each different type of injection drug, and also for each animal. This is in order to prevent sepsis and bovine to bovine disease(s) transmission. Meanwhile, prior to the current study, these procedures were not usually followed by the livestock-cattle farmers and cattle-traders because these aseptic procedures were not basically understood by them. The understudied livestock-cattle farmers and cattle-traders unethically administered drugs on livestock, based on what they had seen veterinary doctors and / or animal husbands do, while treating their animals. Whereas, the fact that they could administer expired medications on their cattle, even when they are mostly not certain of such implications, calls for additional veterinary and human Eco-Health concerns. As earlier reported, apart from less- or non-efficacy, administration of expired antibiotics can lead to increased antibiotic resistance, clinical treatment failure, and adverse drug reactions [37]. These adverse effects can also be applicable to other medications

administered by the cattle farmers and traders. Moreover, Eco-Health / One Health implementations, which have been reported feasible and cost-effective for combating antimicrobial resistance [38,39], could be judiciously considered as an intervention in the reported cases of bovine diarrhoea, tuberculosis, mastitis, ticks / mites infestations, trypanosomiasis, and respiratory diseases, like bovine pleuropneumonia. These are among the most common cattle infections that can result in the use of antimicrobials and other clinical drugs [40].

As presented in this study, pen-strep, oxytetracycline, ofloxacin, chloramphenicol, izonidic and tylosin antibiotics, and other medications, were commonly administered (abused) by the livestock-cattle farmers and traders, without diagnosis and screening of the cows for clinical conditions, just as earlier reported by **Kifle and Tadesse** [41] that, clinical veterinary diagnoses were mainly established on a presumptive basis. This is a strong indication of anthropogenic influence, which also have contributed to the reported antibiotic resistance in the environment [26], as the environment is the single largest source and reservoir of antibiotic resistance [42,43]. Furthermore, alarming reports of indiscriminate use and antimicrobial residues in food animals, especially livestock animals have always been a global problem of concerned magnitude, particularly due to associated public health concerns, including, hypersensitivity reactions, teratogenicity, carcinogenicity, and toxicity in consumers [44]. Whereas, in developing countries, such as Nigeria, relatively little attention is being paid to how use of antibiotics in farm animals contributes to the overall problem of antibiotic resistance [28,31,45-53]. The deliberate administrations of antibiotics by the livestock-cattle farmers in the country could not be unconnected with the presumptive motive to dose their livestock-cattle with antibiotic regimens that promote livestock growth. However, without the knowledge or/and consideration that such antimicrobial abuse increases the danger of animal diseases crossing among the herds, and into humans. This may additionally cause treatment failures, due to antibiotic resistance, in addition to the fact that genetic diversity in animals has been reported to create more uniform susceptibility to animal (or zoonotic) diseases [54]. Furthermore, George et al. [55] had earlier made it abundantly clear that intramuscular administration of certain antibiotics can cause damage so severe that, it will be evident in beef muscle, even 7.5-12 months later, i.e., residues of veterinary medications in animals and animal products, which contain or contaminated with of antibiotic /drug residues, and when consumed by humans [56,57], can be a serious global public health issue.

The use of drugs in food animals also has the potential of generating cross-resistance to drugs used in human medicine [40]. In many African countries and other parts of the world, antibiotic residues in animal-derived foods have been extensively recorded, and in many cases, with values that exceeded the WHO maximum antibiotic residue levels [58,59]. Unfortunately, all the afore-mentioned clinical implications were very unclear to the cattle-farmers and traders, not only because the livestock cattle-farmers and traders cannot understand the implications of such clinical activity, with regards to zoonosis, Eco-Health, One-Health, [60] etc. but because their major aim is to maximise

profits. They are only interested in injecting their ill cattle with the medications they considered as essential drugs, and which they had seen the animal husbands or vets administered.

Considering that it has been continually confirmed that indicator multiple antibiotic-resistant bacterial species are being introduced into other countries, at rates that are higher than in the past [61], it then means that the issues relating to non-professional administration of antimicrobials and clinical drugs on cattle by the livestock cattle-farmers and traders [12,62], as addressed in this study, are also seriously of global importance. Much more importantly, findings of this study presented cogent reasons why injecting clinical and non-clinical drugs to animals by non-professionals must be seriously addressed. Animal husbands, technologists or veterinary doctors in Nigeria and other developing countries must also be more ethical with injection practices, by not preparing injections for treatments of livestock in the presence of the livestock farmers and traders. Similarly, emptying of drug containers and used disposable needles and syringes must not be left to the livestock farmers and traders. It is therefore, vital to propose continued implementation of farm practices and policies that foster the judicious use of antimicrobials, in order to assure animal health and productivity. Ultimately, incorporating EcoHealth (ecosystem approaches to health) and One-Health in the public health spheres can act as a mechanism for knowledge exchange, engagement, and play critical roles of governance and partnerships, with the ability to bridge the gap between environmental stewardship and public health [63,64].

The nomadic livestock cattle-farming in the country has been with much hostilities and terrorism in recent times, such that humans had been slaughtered at various times because of seeking pastures for the grazing animals. Notwithstanding, an enlightening/appraisal workshop that could address the concerns of animal healthcare providers teaching the nomadic and possibly, other livestock farmers and traders to inject their animals is being considered by the authors. In an earlier study, the implications of animal maltreatments, during injection with medications were briefly explained to most of the livestock cattle-farmers and traders [25]. However, it is not certain that the livestock cattle-farmers and traders understood the safer, healthier practices of tending to their livestock under considerations.

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## Competing Interests

Authors declared no competing interests. Preliminary findings of the study were accepted as abstract for the OIE 2018 Conference, which held at Marrakesh, Morocco, from 29-31 October 2018.

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