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Research Article

Survey Study on Food Safety, Animal Welfare, One Health Policy Formulation and Implementation through Legislation

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MAR conducted research and wrote the manuscript. AZD supervised the research. MHS and KA helped in research. AZD, MHS and KA reviewed the article. MMA, NR and KHA facilitated in lab procedures. KHA collected the samples. NR and KHA compiled data.

Keywords
One health, Animal health, Animal welfare, Antibiotic residues, Food safety

Abstract | The One Health (OH) institutions need dire attention of all the stakeholders i.e. legislative, administration, policymaker, corporate sector, professionals for animal welfare and human health, and environmental safety. A survey was conducted through questionnaire distribution among 1000 literate persons who could easily read English i.e. physicians, veterinarians, lawyers, livestock farmers, managers and other literate stakeholders. This survey comprised of a variety of questions related to one-health, use of antibiotics, antibiotics (ABs) residues in milk, meat and yogourt, the role of food safety, organizations, antibiotic resistance, compromise on human health and harmful implications upon animal welfare and eventually one-health due to unnecessary over or under label use of ABs. The results have delineated the educated individuals had a very little knowledge about OH i.e. 18.2% persons knew about the term. Regarding the abuse of ABs, 91.1% believed about the occurrence of ABs in milk, meat and yogourt, and 76.8% opined that there happens misuse of ABs which is against the Animal Welfare. The OH requires an institutional paradigm shift and dire attention of all the aforementioned stakeholders i.e. legislative, administration, policy makers, corporate sector, and the OH professionals. The research can be expanded prospectively at a provincial and national level as an emerging challenge, prospectively.

Novelty Statement | Survey study has been conducted through questionnaire regarding OH, antibiotic residues having implications upon animal welfare and human health, public awareness and role of the legislative. For the protection of public health, the research has been conducted for the first time in Lahore.

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Introduction

According to the contemporary emerging phenomenon of One Health (OH), health of human beings is very profoundly related to the animal health along with

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environment. The OH approach focuses on management of health in both humans and animals (Acharya *et al.*, 2020). The initiative of "One World-One Health" endeavours to figure out emerging or re-emerging human and animal diseases and to prevent environmental challenges (Miró and López-Vélez, 2018). It has been strongly endorsed the concept of integrated approach to improve the health of human beings, animals and the environment from health perspective. The association of surveillance and monitoring is indispensable. The OH necessitates a paradigm shift in developing, implementing and sustaining health policies within the realms of human, animal and environmental health. The core objective is promotion of interdisciplinary teamwork among a variety of domains of study to attain optimal health for humans, animals and the environment. It is critical that all sectors collaborate in these endeavours including the policy formulation and implementation through legislation (Kardjadj and Ben-Mahdi, 2019).

The OH promises the health of all; nevertheless, many of the authors have indicated hurdles in designing and implementing the OH initiatives. The OH practitioners render arduous and assiduous endeavours to collaborate across a variety of disciplines and domains for assurance of collective health. The 56 papers which were included in the study described that 21 challenges were endured by the OH initiatives that are related to different themes i.e. policy-formulation and funding; education and training; surveillance; multi-actor, multi-domain, and multi-level collaborations. During the 21st century, diverse global health problems have been highlighted from the OH perspective that is aimed at addressing animal-human interface. Prospectively, it was recommended by the scholars that the research should focus on this theme in order to provide clear evidence on benefits of using the OH approach (Dos *et al.*, 2019). The term OH is related to the integration of separately considered subjects of humans, animals and their environment. A variety of departments and agencies play their role from public health perspective in different countries of the world. The OH methods emphasize on the data sharing specially to inculcate the full integration of the public health (Allard *et al.*, 2020). According to the expert speakers from Kingdom of Saudi Arabia (KSA), the main recommendation falls in collaboration. The scientists need to benefit from a variety of sectors and it is indispensable to work in collaboration for aim of the OH achievement. According to the participants of meeting on the OH at the global level, the World Health Organization (WHO) and ministries of health are committed to achieve the OH. It is a shared responsibility, each and every sector has to perform their role. Above all, there is dire need to work together on integrated surveillance. It is need of the hour to share data and information from the human and animal sectors and also from the environmental sector to tackle emerging issues from the OH perspective. All the local communities need to contribute for a global achievement of OH (Balkhy *et al.*, 2018). In year 2010, the WHO, the Food and Agriculture Organization (FAO) and the World Organization for Animal Health (OIE) engaged in a tripartite collaboration to coordinate the OH (Humboldt-Dachroeden *et al.*, 2020).

Both of the sectors i.e. academics and policy-makers which discharge out endeavours pertaining to the interdependencies between human, animal and environmental health. There is a need to expand the boundaries of OH (Davis and Sharp, 2020). The increasingly known term is regarded as "One World -One Health" and most of the times denoted as 'OH'. The OH is the study in a collaborative and multi-disciplinary manner. As a matter of fact, it is still unclear whether there is sufficient education and training being provided to the veterinary students regarding OH and its importance (Franco-Martínez *et al.*, 2020).

The OH education through Massive Open Online Courses (MOOC) programs were initiated. The development, implementation and evaluation of an innovative two-module blended-learning programme. Thus, this has emphasized on the need for scientific research in the realm of OH through interdisciplinary and international collaborations (Bolon *et al.*, 2020).

Due to the contemporary challenges to the health systems and emerging issues pertaining to health, there is a growing interest in the OH which is reflected by the rising number of publications related to the OH literature. The scholars have analysed to explore the state of OH in academic literature to visualize the trends within the realm of OH. The prospective studies may highlight in future to bridge between different fields of study and create enough room for social sciences for integration into medical and natural sciences. The core objective is to achieve better public health through learning and implementation of prevention. This effort should be repeated both at the academic and public health level. In public health departments the collaboration between hygienists, physicians, general medical practitioners (GMPs) and veterinarians could provide a robust to implement the monitoring activities (Humboldt-Dachroeden *et al.*, 2020). As a matter of fact, the OH practices are helpful for effective zoonoses management. Nevertheless, these are hampered by less understanding of medical practices. Inculcation of the OH concepts into medical and veterinary clinical programs will equip GMPs and veterinarians to play their crucial roles as a 'frontline' responders (Steele *et al.*, 2019).

It has been figured out by the scholars that substantial pollution is occurring in the freshwaters due to the use of ABs. In the United States, antibiotic concentrations have been measured while those were reported higher from European and African studies. These were also

detected in Asian-pacific countries. These residues might not be considered detrimental to the human beings; however, the fresh-water living beings could be affected. Bioassays have revealed that some of the antibiotics were present in surface waters. However, the point of concern is that the sub-lethal concentrations of these drugs may contribute towards increased bacterial resistance. It has been demonstrated in experiments by many of the research scholars. This has serious implications like interactions between bacteria, among bacteria and their protozoan consumers. Consequences of the ABs highly pose a number of challenges and grave threats to public health. The researchers have suggested that the prospective research boulevards are: the food-web experimentations and antibiotics interaction with one another (Danner *et al*., 2019). Throughout the world, the antibiotic usage exceeds hundred thousand tons per annum. There is increasing apprehension over the fate of such kind of materials. The high concentrations of the ABs have been detected that threat to the environment ultimately pose a challenge for One Health. In current review, the researchers have contemporarily highlighted that the concentrations of ABs are considerable in waters. The micro-organisms are prone to these substances and also the bacterium will evolve resistance. The antibiotic (AB) pollution affects natural food-webs whereas interacting with different factors that poses a variety of threats to the living creatures and environment (Danner *et al*., 2019). Antibiotics (ABs) are one of the foremost agents exploited in the alleviation of microorganism infections in human beings as well as in the animals. As a matter of truth, this signifies the increasing issue of AB resistance. Researchers have examined that the wastewater in German clinics contained noticeable antibiotics (ABs) residues. Keeping in view, the study shown that the bogs, sink-siphons and the shower-drains contained antibiotic (AB) residues. The researchers are of the view point that the study has depicted, the clinical waste product systems cause potential threats of antibiotic resistance (Voigt *et al*., 2019). Of the several demands for freshwater, irrigation accounts for up to 70% of water abstracted from rivers and groundwater. The ABs residues present in this water pose a grave threat to one health (Sorinolu *et al*., 2021).

As a plan to handle the emerging issue of drug resistance in livestock, the policy approaches towards drug management have prioritized the advancement and distribution of technical methods (Bellet, 2018). The indiscriminated use of antimicrobials (AMs) is one of the most important factors contributing towards the antimicrobial resistance (AMR). There is dire need for joint and collaborative efforts in educating the consumers regarding AMR (Ekakoro and Okafor, 2019). The eighty percent (80%) of the animals which are used in food production are currently being treated with veterinary drugs (Bacanli and Başaran, 2019). Additional analyses ought to be conducted unitedly with regulatory agencies to develop policy for bar on excessive usage of ABs (Rodrigues *et al*., 2017). There are a lot of various other factors that delineate the presence of residues in livestock based products. Moreover, these antibiotics (ABs) enhance the growth. These may cause harmful residual effects. To reduce this, withdrawal periods should be discovered and implemented. The staunch control of those residues in animal based food is indispensable to boost human health (Menkem *et al*., 2018). The use of ABs in the foodstuffs and their effects on the human health is crucial issue of one health (Bacanli and Basaran, 2019). The results have indicated that there is a dire need to improve the quality and safety of milk regarding presence of ABs residues (Nyokabi *et al*., 2021). This can prove very significant in order to protect human beings by controlling the undesirable residues in meat (Kyriakides *et al*., 2020). The intake of excessive amounts of these antimicrobial substances in any form like injectables is of tremendous concern since they have serious harmful implications on human health like allergic and toxic reactions as well as increasing bacterial resistance (Teixeira *et al*., 2020). After applying treatment, the carelessness of the workers is 30%, the inadequate use of antibiotics is 29% and the incorrect withdrawal remained 22% as a result of the studies. The use of extra-label drugs treatments is also one of the major causes directly related to the issue of ABs residues in animal food products (Majdinasab *et al*., 2020).

Antibiotic resistant bacteria with diverse resistance phenotypes and genotypes are ubiquitous in the environments that have become a global health concern (Yuan *et al*., 2021). The results indicated that various veterinary medicines possess potential anti-sexual hormone implications. However, there's dire need for further studies to explore harmful effects of veterinary medicines in human beings (Lee *et al*., 2019).

It is indispensable to strengthen the legislation and make sure implementation through policymakers and administrators that regulate the health system in order to prevent the development of resistance. It is also pertinent to mention that all the initiatives are implemented through multi-disciplinary collaborative endeavours (Bungau *et al*., 2020). Multidisciplinary endeavours are indispensable in the implementation of programmes, policies, and research with a common objective of helping the humans as well as animals in disease prediction, prevention, and preparedness (Pugajeva *et al*., 2019). The American Veterinary Medical Association (AVMA) has clearly outlined the sensible and conscientious use of antimicrobials (AMBs) in livestock. Such guidelines are meant to serve the veterinarians in prudent use of ABs. Regulatory authorities in each country

ought to outline law, rules and regulations and to make sure implementation through checking the prudent use of ABs by the operators and veterinarians. It will eventually benefit the OH in forms of animal health, food safety and human health (Garcia *et al.*, 2019). The risk to OH has shown high-risk affecting human health. We should follow the concept of the OH to make corresponding legislation by formulating laws and regulations and implementation in letter and spirit. Veterinary authorities and health authorities were empowered in order to the principle of comprehensive health management, the system of collaborative governance and alleviation of potentially zoonotic animal diseases. China had initiated legal practices since then to improve the relationship animal health, human health and safe environment (Fang and Song, 2021).

It is the requirement of the hour to innovate and encompass the veterinary education from animal welfare strategy (AWS) point of view. A range of approaches can be adopted for the said purpose inculcating the tutorial, societal and trade aspects of study. A number of the developed states of the globe have started following it. The researchers have recommended that animal welfare teaching ought to be obligatory. Aims and objectives of the researchers were to investigate the up-to-date drifts of modification of teaching AWS from professional and educational facets. The recommendations from international education organizations for the various regions of the globe and likewise to supply the contents for the programme referring to the AWS for the veterinarians should be added in curriculum. Despite the fact that a variety of tremendous advances have been introduced into veterinary coaching programs from AWS perspective, there remains a dire need for further advancements. It would be indispensable to link-up a number of factors to the long term goals of this field in teaching veterinary science, inculcating this science as an important course-work in programs at distinct levels to integrate the scientific, moral and legislative aspects of animal welfare (Mota-Rojas *et al.*, 2018).

Materials and Methods

According to the researchers, the current study provides an insight and information regarding a module of activities created to teach the OH to the veterinary students. Consisting of online surveys, which were filled in before (questionnaire 1, Q1) and after teaching the module (questionnaire 2, Q2) (Hopper *et al.*, 2018). The survey study has revealed that some of the major lacuna found in students were unawareness about the lack of communication between human and animal health stakeholders along with the underestimation of environmental health (Franco-Martínez *et al.*, 2020).

A survey was conducted comprising of a variety of questions related to one-health, use of ABs, antibiotic residues in milk, meat and yogourt, role of food safety organizations, antibiotic resistance, compromise on human health and harmful implications upon animal welfare and eventually one health due to unnecessary over or under label use of antibiotics. The questionnaire was distributed among 1000 literate persons who could easily read English and respond the questionnaire i.e. physicians, veterinarians, lawyers, livestock-farmers, managers and other literate stakeholders. These were distributed and collected from different areas of Lahore i.e. Valencia, Johar Town, Faisal Town, WAPDA Town, Thokar Canal, Wahdat Road, Niqsha, Mazang, Iqbal Town, Bheiky waal, Scheme Moor, Multan Road, Bakar Mandi, Muslim Town Moor, Liton Road, Shadman, Jail Road, Mall Road, Gulberg, Model Town, Kalma Chowk, Qasoor road, Kahna Kacha, Cantonment, Garhi Shahu, Railway Station, Mughal Pura, Bhagwan Pura, Islam Pura, Sannat Nagar, Walled city, Darbar and Bhaati.

Results

The questionnaire was distributed among 1000 literate persons who could easily read English and respond the questionnaire i.e. physicians, veterinarians, lawyers, livestock-farmers, managers and other literate stakeholders. The results were as per following:

- Do you know One Health (OH) means multi-disciplinary collaborative efforts made by local, national, and global level to attain optimum health for people, animals and our environment?

Yes	No
18.2%	81.8%
182	818

- Did you ever observed un-necessary use of antibiotics in animals which could be harmful to the environment?

Yes	No	Don't know
82.6%	6.8%	10.6%
826	68	106

- Do you believe that antibiotic residues occur in milk, meat, yogourt and diary other products?

Yes	No	Don't know
91.1%	1.7%	7.2%
911	17	72

- Is milk regulated and tested for the presence of antibiotic drug residues?

Yes	No	Don't know
11.8%	82.8%	5.4%
118	828	54

- Does any of the government authorities i.e. Ministry of National Food Security and Research (MONFS and R) or Punjab Food Authority or Ministry of National Health Services Regulations and Coordination (MONHSR and C) or Livestock and Diary Development (L and DD) conduct sampling assignment related to antibiotic drug residues?

Yes	No	Don't know
2.6%	81.3%	16.1%
26	813	161

- Are drug residues in animal food harmful for the human consumption?

Yes	No	Don't know
87.3%	1.9%	10.8%
873	19	108

- Is any of the government agency taking any kind of regulatory action against the violators who use under-label (less use than requirement) or over-label (excessive use) or un-necessary use of the antibiotics in animals for human consumption?

Yes	No	Don't know
11.7%	72.2%	16.1%
117	722	161

- Is milk, meat, yogourt and alternative animal food supply safe in Pakistan particularly from antibiotic residues point of view?

Yes	No	Don't know
2.7%	91.6%	5.7%
27	916	57

- Does antibiotic residues cause antibiotic resistance in human beings (OH issue)?

Yes	No	Don't know
73.5%	0.9%	25.6%
735	09	256

- Is health risk assessment being performed by any of the government agency pertaining to the animal food containing antibiotic residues?

Yes	No	Don't know
14.1%	78.3%	7.6%
141	783	76

- Do you think that antibiotics are used/administered for recommended period of time along with recommended dose?

Yes	No	Don't know
1.8%	88.7%	9.5%
18	887	95

- Is it awaited for elimination time of antibiotics from the animal and the animal food/ products are used after waiting the certain time period required for it?

Yes	No	Don't know
2.1%	90.6%	7.3%
21	906	73

- Does misuse of antibiotics cause harm to the animal welfare?

Yes	No	Don't know
76.8%	14.9%	8.3%
768	149	83

- Can proper use (which includes recommendation by a registered practitioner, use of required dose and for the required time) of antibiotics in animals (used for human food) lead to animal health welfare?

Yes	No	Don't know
79.2%	8.7%	12.1%
792	87	121

- Can animal health welfare due to the proper use of antibiotics lead to human health by avoiding antibiotic residues in animal food?

Yes	No	Don't know
81.3%	5.9%	12.8%
813	59	128

Discussion

It is need of the hour to innovate and encompass the veterinary education from AWS perspective. A range of approaches can be adopted for the said purpose inculcating the tutorial, societal and trade aspects of study. A number of the developed states of the globe have started following it. The researchers have recommended that animal welfare teaching should be obligatory. It would be indispensable to link-up a number of factors to the long term goals of this field in teaching veterinary science, inculcating this science as an important course-work in programs to integrate the scientific, moral and legislative aspects of animal welfare. To reaffirm this, the veterinary researchers, graduates, and professionals need be excel with pace of OIE. The up-to-date teaching methodologies are required for project based learning including mandatory and censorious thinking, reflection, and multi-disciplinary learning (Mota-Rojas *et al.*, 2018).

Conclusions and Recommendations

The objectives of the current studies have been achieved as per following:

- The analyzed data has shown implications of antibiotic

residues on national food safety, public health and eventually one-health due to the excessive use of antibiotic use in livestock.

- The baseline data is helpful to suggest pragmatic way-forward for concerned quarter of legislative, judiciary, prescription policy-makers and the stake-holders in the light research data. The data have shown woes and concerns regarding one health, public health, misuse of antibiotics, animal welfare and implementation at legislative and administrative levels pertaining to the antibiotic residues in human consumable livestock items.
- Extension article has been published extension material from analyzed data pertaining to general public health awareness regarding antibiotic residues in national dailies

Since many of the research scholars have delineated the issue, thus, livestock products being consumed by the human beings may therefore contain residues of active pharmaceuticals and this may lead to antibiotic resistance in human beings. Eventually, it may become a challenge to the triad of one health i.e. healthy animals, healthy human beings and healthy environment. Thus, this makes it an indispensable question to be further explored and figured out to mitigate this very emerging issue of tremendous importance. Furthermore, the OH training should include cross-cultural communication skills, team building, and trust development. One Health (OH) requires processes that cultivate expertise in realms such as leadership, advocacy, partnership, knowledge translation, evidence based decision making and capacity building. This also needs dire attention of all the stakeholders i.e. legislative, administration, policy makers, corporate sector, professionals especially related to medical and biological studies and above all the general public itself. This could be a pragmatic way forward to achieve better public and eventually the OH.

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Conflict of interest

The authors have declared no conflict of interest.

Refernces

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