



The role of environmental health in One Health: A Uganda perspective



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ARTICLE INFO

Article history:

Received 27 November 2015
 Received in revised form 12 October 2016
 Accepted 27 October 2016
 Available online 28 October 2016

Keywords:

Environmental health
 Environmental health practitioners
 One Health
 Uganda

ABSTRACT

Background: One Health is the integrative effort of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals and the environment. As the human population continues to increase across the world, the interface of people, animals and the environment becomes more significant and impactful. For the past few years, the One Health concept has brought together experts in the areas of animal and human health. It has provided a new synthesis for public health and veterinary communities across the world. One Health initiatives have majorly focused on veterinarians, medical doctors and public health professionals. However, the Environmental Health profession has a major role to play in One Health activities based on Uganda's experiences.

Contribution of environmental health to One Health: In Uganda, Environmental Health Practitioners (EHPs) carry out several duties that contribute towards One Health. These include: inspection of animals before slaughter (antemortem) and meat in abattoirs (postmortem); inspection of meat in butcheries; destruction of condemned meat; disease surveillance; outbreak investigation and control of zoonoses; control of vectors and vermin such as rats, fleas, mosquitoes and monkeys; health education on pertinent issues such as vaccination of dogs; and food safety including meat and milk. EHPs also play an important role in prevention, detection and abatement of microbial and chemical pollution of land, air and water sources that have created new threats to the health of both animals and humans. EHPs carry out house to house inspections on water, sanitation and hygiene hence involved in abating nuisances at households that could pose a threat to public health. Such threats could be emerging from the environment including animals. Enforcement of public health legislation is also a key contribution of EHPs to One Health in Uganda.

Conclusion: EHPs play an important role in disease surveillance, prevention and control. Therefore, Environmental Health professionals should be involved as stakeholders in local, national and global One Health initiatives.

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1. Introduction

One of the challenges currently facing humanity is the spread of infectious diseases that emerge or re-emerge [1]. It is estimated that at least 75% of emerging and re-emerging diseases are either zoonotic (spread between humans and animals) or vector-borne (carried from infected animals to others through insects) [2]. A number of well-known and preventable zoonoses continue to occur in many countries, especially in the developing world including Uganda where they mostly affect the poorest segment of the population. Zoonoses are transmissible to humans through food (such as brucellosis and tuberculosis), bites from infected animals (such as rabies) and insects (such as rift valley fever) or through contact (such as Ebola) [3]. This results from the increasing association of humans, animals and their products [1,4]. Rapid urbanization, changing farming systems and ecosystems, and

globalization of trade in animals and their products have also contributed to this effect [1].

One Health is the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals and the environment [5]. This concept promotes collaboration among veterinarians, physicians, scientists, and other professions to promote human, animal and ecosystem health. A One Health approach considers the role of changing environments with regard to infectious and chronic disease risks affecting humans and animals [6]. This approach illustrates the interconnectedness and interdependence of humans, animals and the environment. While this concept has traditionally focused on zoonoses that are infectious diseases, there is also evidence that the One Health approach may improve chemical associated outbreak investigations and facilitate appropriate intervention strategies [7].

Generally, there has been a rapid growth in embracing the concept of One Health particularly in developed countries over the past decade. The advantages and benefits of this approach in tackling zoonoses are manifold, yet they are still not outwardly being embraced in developing countries where these diseases have the greatest impact [8]. This is

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critical because most of the public health and economic impacts that take place within the concept of One Health occur in developing countries. The lack of basic health infrastructure in these countries implies that the environment, human and animal health are all affected [8].

2. Environmental health and One Health

One Health themes have been included throughout numerous literature, though gaps related to the approach remain [9]. One Health initiatives have majorly focused on veterinarians, medical doctors and public health professionals. There is overwhelming evidence among environmental health practitioners (EHPs) that One Health disease reporting concepts are essential to the early detection of, and recovery from epidemic disease events. However, the local public health is not prepared, and potentially unaware of their responsibility to be the initiator of zoonotic infectious disease information intelligence necessary to make such early event mitigation possible [10]. In the modern age, the speed at which infections can spread globally and transition into deadly pandemics means that surveillance must be able to monitor infections that have the potential to cause outbreaks and also capture unknown threats that may emerge from a wide variety of sources [11]. There is therefore need for a variety of interventions to address the situation. Eddt et al. [10] highlighted the importance of establishing a community-focused, integrated disease prevention strategy that cautions people about the risks associated with food, water, animal and contaminated environmental media, both prior to and during epidemic and pandemic events. This is one of the roles of EHPs who have a major part to play in One Health initiatives. Indeed, in Uganda, EHPs carry out several duties which contribute towards One Health described in this paper. EHPs in Uganda are trained at 3 levels: certificate, diploma and degree. Certificate holders, referred to as Health Assistants, are normally situated at parish level. EHPs with diplomas are referred to as Health Inspectors and are primarily employed at sub-county level. Degree holders are called Environmental Health Officers and are mainly situated at district level. Whereas all EHPs are involved in environmental health practice at community level, some Environmental Health Officers are employed to manage environmental health service delivery at districts as Assistant District Health Officers in charge of Environmental Health. In the Uganda local government structure, other professionals are employed by districts such as veterinary, agricultural, fisheries and community development officers. Despite being mandated to oversee activities in their respective disciplines, these officers work closely with EHPs whenever need arises. It is also important to note that Environmental Health practice is broad and interdisciplinary. For example, veterinary officers work with EHPs during inspection of abattoirs and in some places without veterinary personnel, such inspections are carried out by EHPs.

3. Meat safety

Meat is a major source of protein and is consumed extensively around the world. However, meat has been associated with several foodborne illnesses [12] which many times indicates deficiency in the processing system. To achieve good quality meat, requirements of animal health and meat inspection must be met. EHPs play a significant role in meat safety and hygiene. Although the primary responsibility of meat inspection in Uganda is held by veterinary officers, EHPs have the knowledge and skills to carry out the activity based on their training. Indeed, in communities where no veterinary personnel exist or are inadequate in number, the expertise of EHPs is normally used. EHPs are therefore involved in inspection of animals before slaughter (antemortem) and meat in abattoirs (postmortem). Whereas antemortem inspection helps in identifying animals which may not be fit for slaughter, postmortem detects meat which is not desirable for human consumption. Both activities are critical in preventing zoonotic diseases hence protecting public health [13]. A key role of EHPs in meat safety is played after meat leaves the slaughter house. Some of the issues

EHPs are concerned with in this regard are transportation of meat, inspection of butcheries and their licensing [14]. Meat is meant to be transported in a vehicle that meets all sanitary requirements as prescribed by the local authority. In addition, EHPs ensure that all sanitary requirements of butcheries in relation to water, sanitation and hygiene are met before they are issued with an annually renewable license [14]. These roles played by EHPs in meat safety are to ensure that meat is handled appropriately and sold in places with minimal risk of contamination hence protecting public health and promoting One Health.

4. Disease outbreak investigation

Uganda has faced several disease outbreaks in recent years including zoonoses such as Ebola and Marburg fever [15]. Investigation and control of these zoonoses have impacted on the health system with immense national resources involved. In some of the outbreak investigations and control including the recent Marburg epidemic in Kabale, western Uganda in 2012, EHPs have been at the forefront of the response. Indeed, EHPs have been involved in contact tracing, collection of samples, community mobilization and sensitization. Through these roles, EHPs have contributed immensely to reducing morbidity and mortality from outbreaks. The role of community mobilization and sensitization, which are a key component in environmental health work, are particularly important in advising communities on ways to prevent spread of infectious diseases.

5. Control of vectors and vermin

There has been a worldwide resurgence of vector-borne diseases since the 1970s including malaria, dengue, yellow fever, louse-borne typhus, plague, leishmaniasis, sleeping sickness, lyme disease, Japanese encephalitis and rift valley fever [16,17]. Many insects and other arthropods are of medical and veterinary importance as they either cause pathological conditions or transmit pathogenic organisms to man or animals. Some bacterial diseases like plague and viral infections such as yellow fever, dengue, and Japanese encephalitis are also of public health concern. Most vector borne diseases survive in nature by utilizing animals as their vertebrate hosts, and are therefore zoonoses [16]. Due to the complex nature of these diseases, a One Health approach involving Environmental Health is required to tackle them.

EHPs carry out several roles that are related to the control of vectors and vermin. Indeed, they are concerned with ensuring that people's living and working surroundings are safe and hygienic. These practitioners mobilize communities to keep vectors and vermin from their surroundings through source reduction and other control measures such as closing doors and windows early in the evening, installing screening in windows and ventilators, elimination of breeding sites, indoor residual spraying and installation of rodent traps. These measures are important in combating vectors and vermin some of which have been known to spread pathogens to humans. EHPs also collaborate with other sectors such as vector control on operational research for the control of disease vectors. These measures ensure the prevention and control of vectors and vermin which promotes a healthy, safe and hygienic living environment for both animals and humans thus promoting One Health.

6. Health education

Health education is a component of One Health that mainly pertains to local authorities. It involves increasing awareness on pandemic preparedness, adaptation to climate change, animal control and vaccination requirements, transportation and land use planning affecting public wellness, water quality protection, waste management, energy choices, food safety and systems, and ecological protection and restoration. Facilitating communication among increasingly specialized experts improves health outcomes for communities [18]. However, if the One Health approach is to be implemented effectively, there is need for a

more community based means of health educating the public so as to achieve increased awareness of connections between climate variability, food production, infectious diseases, human and animal health conditions. For example, most families living and farming immediately outside the game parks in Uganda do not have sanitation facilities, 78% report defecating directly in their gardens, and 50% report using nearby bushes. When it rains, fecal matter is washed into waterways that livestock, wildlife and people share for drinking and bathing [19]. In addition, poor sanitation and animal management can result in fecal contamination of both animal and human food. Likewise, the manner in which water is used for agricultural and animal production affects food safety and health of animals and humans which drink and bathe in it. Improving water safety including sanitation, in ecologically appropriate ways that reduce disease risk requires a transdisciplinary approach in which EHPs also play important roles such as health education [20]. Health education of local populations is therefore important for successful conservation efforts and for comprehensive surveillance of potential health threats [21]. For example, healthy people are less likely to access forests for medicinal herbs, or knowledgeable community poaching wild animals for food, activities which are related with animal-human conflicts. Similarly, if people received adequate information about the importance of hygiene and sanitation in addition to other basic needs like health care and disease prevention such as use of mosquito bed nets to prevent malaria, there would be reduced incidence of illnesses which would mean less foraging for medicinal herbs [19]. Therefore, EHPs role of carrying out health education of the population on pertinent issues such as hygiene and sanitation, food and water handling, protection of water sources, proper waste and excreta management, and vaccination of dogs among others is a major contribution to One Health.

7. Food safety and hygiene

Food safety challenges are complex both in the developed and developing world. Food is the fundamental fuel for human health but also a potential vehicle for disease transmission. In addition to the traditional food-borne disease species such as *Escherichia*, *Salmonella*, *Campylobacter*, and *Listeria*, new pathogens are emerging and more foods can now transmit potential food-borne pathogens [22]. Central to food safety is the occurrence of food borne diseases many of which are complex and thus require diverse stakeholder participation such as the One Health approach to combat [22]. Foodborne diseases have taken on new dimensions due to international transport of foodstuffs, increasing demands for animal protein, and opportunities for spread of infectious diseases [23].

EHPs are involved in promoting food safety and hygiene during production, handling, storage, processing and distribution. They also ensure that foods are wholesome, fit for human consumption and conform to quality and safety requirements. They achieve this by inspecting places where food is handled forming the basis for licensing and certification for suitability. Such premises which handle food include eating houses, ports, schools, markets and other public places. During inspection of these premises, EHPs are not only concerned about the hygienic conditions of the places but also prevention of food contamination. They advise food handlers on best practices and provide necessary training regarding the promotion of food safety. In addition, they are also concerned with enforcement of food safety laws and regulations which are important for maintenance of food safety and hygiene standards. EHPs are also charged with medical examination of food handlers. The medical examination focuses on diseases that can be easily transmitted through food such as tuberculosis, typhoid and skin conditions some of which can also be transmitted from animals to humans or vice versa. EHPs participate in surveillance of food borne illnesses. Indeed, they follow up on complaints and investigate outbreaks of food poisoning. EHPs also set up robust food safety management systems with adequate process controls including the hazard analysis critical control points

(HACCP). These are vital in improving food quality, prevention of disease outbreaks and maintaining food safety. These measures by EHPs contribute to the maintenance of a healthy environment and disease prevention which contribute to One Health.

8. Control of environmental pollution

Over the last three decades, there has been increasing global concern over the public health impacts attributed to environmental pollution [24]. Environmental pollution is the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected. On the other hand, pollution is the introduction of contaminants into the environment that cause harm or discomfort to humans or other living organisms, or that damage the environment which can come in the form of chemical substances or energy such as noise, heat and light [25].

The World Health Organization estimates that about a quarter of the diseases facing mankind today occur due to prolonged exposure to environmental pollution [24]. Though not directly resulting from One Health initiatives, significant adverse indirect environmental impacts could occur during emergency operation activities for containment of outbreaks such as from inappropriate transportation of infected and at-risk birds, disposal of carcasses and use of chemicals for disinfection. Other issues of concern are disposal of dead birds and lack of/improper use of personal protection equipment, release of chemicals in the environment, exposure during the process of disinfection, inadequate laboratory waste management including transportation, and environmental pollution from farms [26]. One way of minimizing these impacts to acceptable levels is by integrating environmental health safety aspects in the design and implementation of One Health activities. According to Eddy et al. [10], veterinarians and physicians are both subject-matter experts in their respective fields, who should reside within the broader realm of environmental health. As serving as a bridge or mediator, the environmental health profession offers expert technical advice in various areas including environmental sources of zoonotic disease. EHPs are therefore more relevant in this aspect of One Health. These professionals play an important role of detection and abatement of microbial and chemical pollution of land, air and water sources that have created new threats to the health of both animals and humans.

9. Water, sanitation and hygiene

It is estimated that nearly 10% of the global burden of disease is associated with lack of access to adequate sanitation, safe drinking water, proper hygiene and effective water management [27]. The high burden of sanitation related diseases is particularly common in developing countries including Uganda. In communities where animals share water sources with humans, water becomes a medium for zoonotic diseases transmission [28]. Improving access to safe water and basic sanitation have indeed direct implications for better health, as they lead to the interruption of transmission pathways for many gastro-intestinal and other infectious diseases. Furthermore, such access increases the likelihood of hygiene practices such as hand washing with soap within homesteads and communities. Improvement in water resources management also has a significant potential to reduce vector borne diseases such as malaria, dengue and schistosomiasis.

EHPs play several roles to ensure improvements in water, sanitation and hygiene. Regarding water quality, EHPs collect and analyze samples from drinking water sources thus playing a significant role in water surveillance. This helps in ensuring compliance to standards by water supply agencies and local authorities. In addition, they carry out sanitary inspections of water sources aimed at identifying actual and potential sources of water contamination that can impact the quality of water hence public health. They then work with communities to rectify identified contamination risks as well as providing recommendations to all stakeholders such as water user committees, village leaders, water

supply agencies and the general public. They also ensure a safe water chain from source to consumption hence safeguarding water from contamination thus protecting the public from water related diseases such as cholera, typhoid, diarrhea, hepatitis A and E. Many of these diseases are of One Health importance due to their link to the environment including the role played by animals in their transmission.

In the promotion of sanitation, EHPs make visits to homes, institutions and public places to ensure that they provide for adequate sanitary measures. They also ensure that other components of sanitation such as solid and liquid waste management are embraced and properly handled. In addition, they educate communities and encourage them to have sanitary facilities and adopt proper sanitary practices. They thus ensure the promotion of hygiene at household and community levels including environmental and personal hygiene. These measures promote environmental, animal and human health thus contributing to One Health.

10. Enforcement of legislation

In most of the above roles as discussed, EHPs are entrusted with the duty of enforcing public health laws, rules and regulations. The Public Health Act is the mother law protecting the health of the public in Uganda and as such, other subsidiary regulations should be in line with it [14]. Some of the existing regulations that EHPs are involved in enforcing include the: Meat rules, Eating House rules, Bakery rules, School Building rules, and Drainage and Sanitation rules. Therefore, this makes EHPs key players in abating various nuisances related to housing, environmental sanitation, vector and vermin control, food safety and hygiene, and water safety hence preventing zoonotic related infections therefore making a significant contribution to One Health.

11. Conclusion

It is evident that environmental health practitioners play an important role in disease surveillance, prevention and control associated with meat safety, vectors and vermin, food safety, environmental pollution, and water, sanitation and hygiene which relate to One Health. Therefore, environmental health professionals should be involved as stakeholders in local, national and global One Health initiatives to contribute towards protecting animal and human health, and the environment. This can be achieved through ensuring that environmental health practitioners are part of planning, implementation, management and advisory processes of One Health activities at all levels locally and globally.

Competing interests

The authors declare that they have no competing interests.

Author contributions

DM initiated writing the manuscript. DM, RN, EA and AAH were all involved in writing the manuscript. All authors read and approved the final version of the manuscript.

Acknowledgements

We thank the One Health Eastern and Central African (OHCEA) network for organizing the 1st OHCEA One Health conference held in Addis Ababa, Ethiopia from 23rd to 27th September 2013 where this paper was presented.

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