Improving Animal Production Biosecurity to Minimise Global One Health Risks

Despite remarkable advances in human and veterinary medicine over the past century, infectious diseases remain an important cause of morbidity and mortality for both humans and animals around the world[1–4]. At least 60% of existing human infectious diseases and up to 75% of newly emerging diseases in humans are thought to have an animal origin, underscoring that the health of animals and humans are irrevocably intertwined[5].

An estimate of the combined human and animal burdens of specific zoonotic diseases can be calculated to provide tangible evidence of the significant impact of a particular zoonotic disease on a given society[6,7]. For example, the World Health Organization (WHO) has estimated the annual global cost of cysticercosis, a parasitic infection transmitted through consumption of infected pork, to exceed $760,000 USD in terms of human health considerations and over $2 billion USD in terms of economic losses in livestock production[8]. Risks associated with spread of infectious diseases from animals are likely only to increase with increasing globalisation and transboundary movement of animals and animal products. The practice of routinely taking into account the health outcomes of humans and animals (and the environment), known as One Health (Figure 1), is essential for continued improvements in animal and human medicine for the future.

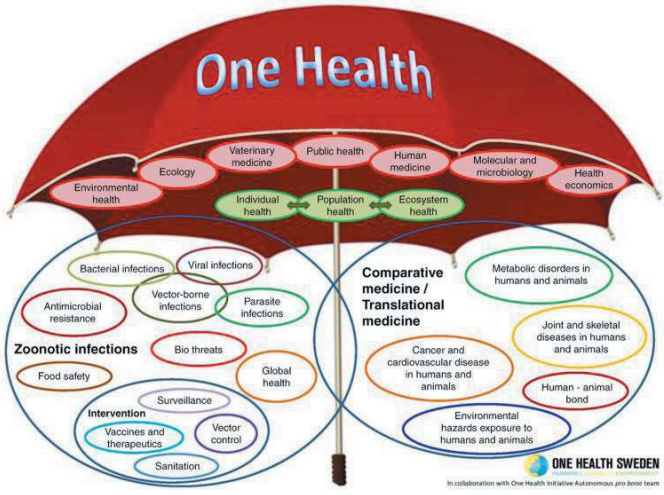

Figure 1: The 'One Health' umbrella, which recognises the intertwined fates of humans, animals, and the environment (from[9]).

There are many areas of consideration for minimising global One Health risks, such as prudent antimicrobial use, competent food inspection authorities, and the use of vaccines to reduce and eliminate key infections. Another significant area of attention is enhancement of biosecurity employed in animal production. In addition to improving animal health and welfare, improved biosecurity practices lead to an increased human health index, because of increased farm stability, better profitability of marketed goods and livestock, and improved food safety, and thus human health. Well defined animal biosecurity programmes are part of sustainable agricultural practices[10]. Because of its direct impact on human health outcomes, enhancing biosecurity for food animal production directly targets at least six of the UN's 17 sustainable development goals (https://www.un.org/sustainabledevelopment/sustainable-development-goals/).

Biosecurity – A Definition

In this context, biosecurity refers to the integrated practices and policies applied at a national, regional or local level to minimise and manage the various threats that may contribute to illness or unthriftiness in animals being raised for food or fibre. Biosecurity generally refers to keeping infectious agents out of an animal operation or farm, whereas biocontainment refers to keeping any infectious agent(s) present on a farm or within a region contained to that region.

A better understanding of basic biosecurity principles by farmers and more consistent application of them can significantly reduce the burden of zoonotic disease and pre-empt animal disease outbreaks in a given region or country. Recent epidemiologic modelling of known patterns of pathogen transmission across pig farms in countries with defined biosecurity practices have demonstrated that production efficiency and animal welfare could be improved with more consistent attention to enhanced biosecurity practices[11]. Further, biosecurity principles may be combined with vaccination or preventative therapeutic administration to reduce or eradicate diseases in a region, such as cysticercosis in swine[6]. An effective regional biosecurity programme therefore requires training of producers and dissemination of educational resources as well as respectful local support and oversite networks to be sustainable[12]. In extensive settings, assistance to farmers often can be effectively accomplished through grassroots or peer-to-peer organisations.

Basic Principles of Biosecurity in Animal Production and Management

Implementation of an effective on-farm or livestock management biosecurity programme does not have to be an expensive or complicated undertaking. Several key principles have been shown to be highly effective for promoting biosecurity, regardless of the species being considered, and these are discussed in more detail below[10]. These principles relate to access management, animal management, and operational management. Even in remote and extensive farming situations, basic biosecurity principles can be practised.

Controlled access to animals, through the use of pens, sheds, barns, and other shelters can minimise intra- and interspecies exposure to animals and transmission of pathogens. Routinely practising good hygiene, such as regular handwashing (particularly before eating or preparing human food), cleaning clothing and footwear heavily soiled with animal waste, and removing or burying human faeces to prevent animals, such as pigs, from contacting or consuming them is important for reducing bioburden and breaking parasitic transmission cycles between animals and humans. Exclusion of pests and vermin is important to reduce disease transmission by arthropod and rodent

vectors, and because insects and vermin can infest animal feeds, such as grain, and reduce feed quality. Physical separation of sick and healthy animals, and handling and attending to the needs of healthy animals first will help to reduce disease transmission within a group of animals. These practices also apply when introducing new animals into a herd or flock. A period of quarantine and stabilisation can be helpful to ensure that new stock are healthy and free from disease. Ensuring that animal feed is unspoiled and that water is clean and uncontaminated will help to minimise the spread of disease within a group of animals. Timely and appropriate disposal of deadstock is important as poorly managed disposal of carcasses can lead to persistence of pathogens in the environment and can also attract pests. Similarly, animal wastes and manure need to be appropriately managed to reduce pathogen burden. More sophisticated programmes can incorporate written plans, self-assessment schemes and ongoing monitoring.

Numerous examples of species-specific biosecurity guidelines are available to assist farmers with understanding these practices and developing robust programmes.

Biosecurity Risk Management

Despite the apparent sensibility of adopting better biosecurity practices there can be resistance to changing traditional management and husbandry practices as well as daily habits and routines. This has led to spectacular outbreaks of disease in animals and humans, such as multiple outbreaks of virulent and unusual forms of avian influenza in China when pigs, poultry and other animal species are mixed in public markets[4]. Even in economically well developed countries with regulated production oversight systems and national production standards, producers may fail to see the value of implementing robust biosecurity practices, leading to increased risks to both human and animal health[13-15].

Traditionally, the responsibility for biosecurity risk management, assessment, and communication has fallen largely on the shoulders of farmers, their veterinarians, and their associated marketing groups and these programmes have been managed for better or for worse within any given country. This has resulted in inconsistent implementation of recommended practices and gaps in programmes often aren't identified until health problems have occurred, for example, transmission of *Salmonella enteriditis* in farmed eggs[16]. Because all people have a vested interest in their own health as well as in the health and welfare of animals raised around them and because animals and animal byproducts are often shipped from the origin to distant places around the world it is critical that an integrated approach be taken for farmed animal biosecurity risk management. This builds on strengths that may already exist in local or regional oversight.

Health Security Interface – An Integrated Approach

The global interdependence of countries for food emphasises the need for better coordination and management of food animal biosecurity at national and international levels. The OIE (http://www.oie.int/for-the-media/press-releases/detail/article/investing-in-biosecurity-a-key-step-to-curb-the-spread-of-animal-diseases/), FAO (http://www.fao.org/biosecurity/) and WHO (http://www.who.int/influenza/human_animal_interface/en/) all strongly espouse the need for better integrated approaches to biosecurity management to protect human and animal health. With a One Health approach for biosecurity risk management, there can be better accounting and reporting of biosecurity risks at regional and national levels with assistance and support provided, as needed, at international levels. Additional benefits of an integrated approach to biosecurity risk management include improved monitoring for human health concerns, better information-sharing nationally when biosecurity concerns arise, minimising trade disruptions related to biosecurity risks, addressing consumer concerns about animal biosecurity and One Health issues, and providing a better perspective from which to observe, monitor and act on transboundary diseases in animals[10].

Conclusions

It is no longer possible for countries to consider the health and care of their food animals as an isolated and private affair. Increasing recognition of shared diseases between animals and humans together with a better understanding of foodborne pathogens and knowledge about complex global food distribution systems have only served to emphasise gaps in food animal biosecurity risk management around the world. To address these gaps and to ensure safer and more secure food for populations around the world, there is a need for governments to adopt a consistent, proactive and integrated approach to farm animal biosecurity risk management. Adoption of this approach should result in better biosecurity risk assessment, analysis, and preventative action to improve the lives of animals, humans, and their ecosystems.

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