



COMMENTARY

# One Health, veterinarians and the nexus between disease and food security

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Achieving ecologically sustainable food systems for people and animals is one of the greatest challenges facing our world today. Four interdisciplinary approaches that promote a holistic, systems approach to disease prevention and food security are introduced. Current domestic and international initiatives that link disease prevention with food and nutrition security are presented, with an emphasis on animal-source food and examples from Australia, Tanzania and Timor-Leste. Veterinarians are uniquely placed to use their training in comparative physiology in support of the production of sustainable, nutritious, ethical and safe food delivered with minimal waste to promote human, animal and environmental health.

**Keywords** animal-source foods; ecohealth; food and nutrition security; livestock production; One Health; planetary health; sustainable development

**Abbreviations** NCD, non-communicable disease; ND, Newcastle disease

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The human population is set to reach 9 billion by 2050 and 11 billion by 2100.<sup>1</sup> Projections show that feeding a world population of 9 billion people in 2050 would require raising overall food production by some 70% between 2005–07 and 2050.<sup>2</sup> Despite increases in agricultural production during the past two decades, malnutrition rates have not diminished significantly.<sup>3</sup> Undernutrition remains a significant problem in many low- to middle-income countries, while overnutrition is becoming a major issue globally.

The domestication and production of animal species has been a significant driving force behind the emergence of infectious disease. Diseases have tended to emerge and maintain themselves in centres where human and animal density is high or where human activities encroach on previously untouched natural environments. Intensive systems of animal production have grown rapidly over the past 150 years and dominate modern livestock food systems, contributing to the emergence, spread and maintenance of new disease

agents through the increased interaction and movement of animals and people.<sup>4</sup> Concurrently, continued increases in the consumption of animal-source foods, as well as energy-rich, nutrient-poor processed foods, has been linked to the rise in overnutrition and associated non-communicable disease (NCDs) such as obesity.<sup>5,6</sup>

Interdisciplinary research with veterinarians at the helm is addressing the nexus between disease and food security in support of sustainable development. In addition, the profession has been encouraged to ensure that future veterinary graduates are prepared to engage with broader issues of sustainability, food security and poverty alleviation in low-income countries.<sup>7</sup>

## One Health – Ecohealth – Conservation Medicine – Planetary Health

Interdisciplinary research focussing on the intersection of human and animal health and environmental conditions has risen to prominence since the 1990s. This has been in response to complex health issues as varied as (i) highly pathogenic avian influenza, which connects humans, poultry management and wild birds; (ii) amphibian declines, which involve chytridiomycosis, an emerging fungal disease; (iii) poaching and consumption of 'bush meat', linked to population pressures, a lack of livelihood opportunities and infectious disease; and (iv) NCDs resulting from modern food systems that deliver food of poor nutritional value produced using technologies that have a significant negative effect on ecosystems.

There are currently four main interdisciplinary approaches working in parallel. 'One Health' is the integrative effort of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals and the environment, with which veterinarians have most been involved in recent years.<sup>8</sup> It built on the foundation of 'conservation medicine', which is an interdisciplinary field with a strong focus on the integrity of ecosystems.<sup>9</sup> 'Ecohealth' recognises that 'health and well-being are the result of complex and dynamic interactions between determinants, and between people, social and economic conditions, and ecosystems'.<sup>10</sup> 'Planetary health' was coined by the public health community in 2015 and aims to safeguard human health and the natural systems that underpin it.<sup>11</sup>

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### Chronic food and nutrition insecurity: a key driver of disease

As a result of the association between human food production activities and disease emergence, it is crucial that the drivers of chronic food insecurity be understood. The manifestations of these drivers are often context-specific, as they vary according to gender, cultural, socioeconomic and agro-ecological frameworks. Inadequate access to a balanced diet can lead to both undernutrition and overnutrition, resulting in lifelong effects on human health and inefficiencies in food utilisation.

### Veterinarians working to reduce disease, improve food security and support sustainable development

#### *In Tanzania and Zambia*

Strengthening food and nutrition security has long been central to development efforts. Substantial variation exists between geographic regions in progress towards international targets for addressing undernutrition.<sup>12</sup> Particularly high levels of undernutrition are seen in sub-Saharan Africa, where population growth has led to a substantial increase in the number of undernourished people in recent decades. At a national level, 34% of children in Tanzania<sup>13</sup> and 40% of children in Zambia<sup>14</sup> are affected by stunting (low height-for-age, an indicator of chronic undernutrition), with implications for school performance, income-earning potential and disease risk in adulthood.<sup>15</sup> Foods of animal-origin contain high-quality protein and bio-available micronutrients with the potential to greatly improve the nutrient content of carbohydrate-based diets.<sup>16</sup>

Small flocks of scavenging chickens are common in both rural and peri-urban households in Tanzania and Zambia, as in many low-income food-deficit countries. Although extensive management systems and their ability to seek out environmental food sources make village chickens an accessible form of livestock, infectious disease poses a significant threat when birds move freely between households and through markets, and there are limited options for biosecurity measures to be enforced. There is scope for veterinary interventions to improve chicken health and production, and increase the benefits obtained from poultry-keeping.

Newcastle disease (ND) is a major cause of deaths of poultry and a constraint to village chicken production.<sup>17</sup> Our current interdisciplinary research is assessing the effect of ND vaccination programs on chicken flocks in Tanzania and Zambia and evaluating the potential to improve human nutrition through greater sale and consumption of poultry products.<sup>18,19</sup> Taking a holistic approach, this One Health project also seeks to understand the contributions of wild foods to local diets and explores opportunities to enhance food and nutrition security through increased production of micronutrient-rich traditional vegetables.

#### *In Timor-Leste*

Moving closer to Australia, Timor-Leste also faces serious nutritional challenges, with just over 50% of children under 5 years of age affected by stunting.<sup>20</sup> Marked seasonal patterns of food availability exist, with the months preceding maize and rice harvests identified as the 'hungry season'.<sup>21</sup> There is potential for improved livestock

management to improve household food security during this time, while simultaneously addressing the issue of low diversity in children's diets because of the low intake of animal-source food.<sup>20</sup>

Village poultry are kept by the majority of rural households in Timor-Leste; however, current production is low and inconsistent because of high levels of loss from ND and predation.<sup>22</sup> The Village Poultry Health and Biosecurity Program, implemented by the Timorese Ministry of Agriculture and Fisheries and the Australian Government's Department of Agriculture and Water Resources, and supported technically by the University of Sydney, aimed to improve village poultry production through three avenues: (i) increasing functionality of the national cold chain, allowing the delivery of potent vaccines to rural regions; (ii) ND control via thermotolerant vaccine, administered by community assistants, together with improved poultry husbandry practices to decrease attrition rates; and (iii) enhancing biosecurity practices from the level of Timor island to within individual households, to decrease the introduction and spread of infectious agents.

Concurrent research, supported by the University of Sydney and the Australian Government, investigates the effect of improving village poultry production on maternal and child diets and nutrition, while exploring household practices around food consumption, including child feeding and the utilisation of non-cultivated foods.

#### *In Australia*

Non-communicable diseases are the leading cause of death in people globally. In Australia, greater than 90% of all deaths are attributable to NCDs. Unhealthy diet has been identified as one of four major risk factors contributing to the rise of NCDs.<sup>23</sup> The effect of unhealthy eating is reflected in the physical status of Australians, with more than 25% of the adult population obese and widespread inadequate intake of micronutrients, particularly by the elderly.<sup>24</sup>

Another challenge for Australia in coming decades is maintenance of adequate food production. By 2100, the Australian population is projected to reach up to 69 million.<sup>25</sup> Should this materialise, Australia may need to import core foods, which would increase the dependence of Australia's food and nutrition security on international markets and affect Australia's export of food and fibre commodities. Other factors putting pressure on agricultural systems include climate change and weather variability, land use conflicts and the rising cost of inputs, such as fertilisers.<sup>26</sup>

How can Australia deliver a national healthy, sustainable diet that is accessible to all? Greater utilisation of animals may be part of the solution. Mutton and sheep offal are nutrient-dense, energy-dense foods produced in abundance in Australia in parallel with fine wool, but rarely eaten today.<sup>27-29</sup> We are researching ways to redirect mutton and sheep offal to the human food chain to potentially improve the health of Australians, optimise the productivity of Merinos and lower greenhouse gas emissions.

### Conclusions

In both domestic and international settings, such examples show that veterinarians can provide a key link between primary producers,

dietitians, food retailers and environmental scientists. Through work in areas of biosecurity, animal welfare, animal health and production, and environmental impact, veterinarians are able to facilitate the sustainable production of animal-source foods, taking into consideration food nutrient content and diversity. Veterinarians can also make vital contributions to improving food systems, from largely localised food systems, such as in rural Tanzania, to complex, globalised food systems such as in Australia.<sup>30</sup>

Our veterinary training in comparative anatomy, physiology, medicine and animal management systems is unique and opens up many career pathways. Using these competencies in support of ecologically sustainable and ethical food systems for people and non-human animals makes a major contribution to the health and resilience of all life on our increasingly resource-limited planet.

### Conflicts of interest and sources of funding

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