One Health and the food chain: maintaining safety in a globalised industry

In the second of Veterinary Record’s series of articles promoting One Health, Patrick Wall discusses how the health of food-producing animals affects public health, the challenges of an increasingly complex food chain and the contribution that vets can make to improving the safety and quality of the food we eat.

ONE Health is a global strategy for expanding interdisciplinary collaborations and communications in all aspects of healthcare for people, animals and the environment. Vets have a huge role to play in this, as they have the knowledge and the competencies to span many areas and to facilitate better interdisciplinary cooperation.

Many professionals in the agri-food sector work within their confined areas without realising the real objective of their activities. Phenomenal advances have been and continue to be made in the genetics of food-producing animals and fish. Relentless selection for production traits has delivered us very different livestock from those our forefathers tended. Animal nutritionists are far ahead of their human counterparts when it comes to diet formulation and performance. In many species they control the totality of the diet, the rearing environment and have clear outcome measures, such as food conversion efficiency, weight gain, milk yield or egg production. Furthermore, breed types have dramatically reduced individual variability, and for broilers, pigs and fish species, the stock are very closely genetically related.

Genetics creates the potential and nutrition delivers on it, but suboptimal animal health or welfare can undermine any gains these may offer. Good animal health status is essential for safe food, and stressed animals are more prone to disease, so the production of safe food should be a goal for all engaged in agri-food activities. Those working in animal genetics, in feed mills and on farms are as much in the food business as those operating processing facilities or hotels and restaurants.

Food samples being tested for traces of horsemeat at a veterinary laboratory in Prague, Czech Republic, in February 2013. Laboratories across Europe had to test food products after horsemeat was found to have been mixed in with other meats and sold as beef across the continent.

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animal health or welfare can undermine any gains these may offer. Good animal health status is essential for safe food, and stressed animals are more prone to disease, so the production of safe food should be a goal for all engaged in agri-food activities. Those working in animal genetics, in feed mills and on farms are as much in the food business as those operating processing facilities or hotels and restaurants. The role of the veterinarian encompasses many areas, including food security, animal health and biosecurity, zoonosis control, animal remedies, using animals as sentinels of environmental hazards and the contribution of animal waste to pollution of other foodstuffs and water supplies. However, producing safe food is not the final end game. Food is the fundamental fuel for human health and 'you are what you eat' is a true dictum. Diet-related disease and obesity-related health problems in people are major public health issues in both developed and developing countries. Increasingly, primary agricultural output is coming under the spotlight in both the scientific and general media for contributing to human health problems. Headlines such as 'Red meat causes cancer' and 'Dairy products clog up your arteries' now join those of 'Superbugs on farms' to undermine consumer confidence in some of the output from the agri-food sector.

However, it is now possible to modify the composition of the final output from farms by genetic selection of animals and altering the rations fed. Increasingly, animals are being bred, and micronutrients are being fed to livestock, to deliver a healthier final product, whether this is less saturated fat, more omega 3 or any number of other outcomes. Human nutrition is key to health, so the final objective for most activities in the agri-food sector should be improved human health, and all engaged in activities along the food chain should consider themselves in the 'human health business' (Fig 1). Doctors and nurses are not in the health business; rather they are in the sickness business. Vets are often stuck in the animal health 'box', focusing on the care of individual ill animals. With the interest in companion animals.
and equids predominating in many veterinary schools, getting undergraduates and postgraduates interested in herd health is proving difficult enough, never mind getting them interested in human health. Stimulating interest in public health medicine and making the curriculum interesting, and relevant, to veterinary students is a major challenge for veterinary educators. Vets can make a greater contribution to ensuring that food is both safe and nutritious than they are currently making.

**Globalisation**

The food chain is increasingly complex and consumers have been naively convinced that it is a straight line, with the words ‘farm to fork’ written into the food legislation in many jurisdictions. The food chain is now more like a maze and, even at farm level, inputs such as agri-chemicals, animal remedies, animal commodity feed and micronutrients are globally sourced; for example, most of the vitamins and minerals currently added to animal rations in the EU come from China. This illustrates that we truly live in a global village and a huge interdependency exists between nations when it comes to protecting the food supply. The health of a country’s citizens often depends on controls in operation in other jurisdictions completely.

Processed foodstuffs can contain ingredients from many processors and manufacturers in different countries or even different continents. If you consider all of the ingredients in something like a pizza, and where they might come from, you literally could have the world on your plate! The flour, vegetables, cheese, processed meats, olive oil, spices and herbs are all globally sourced, posing a challenge if one wanted to put a picture of the farm of origin on the packaging. Standards vary between manufacturers and processors both within and between countries, so the safety of the final product is governed by the standards of the weakest supplier of ingredients. Co-mingling of ingredients from several sources in a finished product has made precise recalls nigh on impossible. This was well illustrated in Ireland in 2008 when recycled bread, contaminated with dioxin, was fed on only 10 pig farms and an inability to trace the contaminated pork after secondary processing necessitated a global recall of Irish pork (Casey and others 2010).

Enforcement capabilities vary by country and, although food laws are the same across the EU, and we have harmonised controls with our trading partners, not every jurisdiction has the same resources for enforcement and surveillance; this situation is far from ideal.

The more steps in the food chain, the more opportunities that exist for things to go wrong – and the likelihood of one of the people involved being a shoddy operator or, worse still, a criminal, is significantly increased. The recent EU horsemeat scandal highlighted the vulnerability of our current supply chain and exposed weaknesses that can easily be exploited by those motivated to engage in criminal activity. While analytical chemists are now capable of detecting contaminants at parts per billion or parts per trillion, and microbiologists are able to detect the presence of lower and lower numbers of microbes, lorry loads of horsemeat appeared to be moving around the EU masquerading as beef, and horsemeat was illegally included into a range of processed meat products.

**Pre-harvest food safety**

Reducing the microbial load entering the food chain by implementing herd, flock and shoal health initiatives reduces the challenges to food safety management systems and controls in food processing plants, commercial catering establishments and domestic kitchens. Intensification of farming systems creates increasing opportunities for disease to spread, but can also present the opportunity to control the feed, water and environment to ensure disease incidence is kept to a minimum. Vets need to be able to address local (on farm), regional, national and international issues to improve the health status of livestock (Collins and Wall 2004). The importance of the safety of animal feed should not be underestimated, as feed contamination jeopardises the safety of the entire food chain. The major feed-related problems of BSE and the Belgian dioxin crisis triggered a major reform of EU food law (Bernard and others 2002, Bradley and others 2006).

There is a role for the use of antimicrobials and other pharmaceutical agents in livestock production, but they are not a replacement for good husbandry practices and veterinarians must be aware of when, and how, they should be used appropriately to avoid residues in the food chain and the generation of organisms resistant to antimicrobials (Angulo and others 2004, Tollefson and Karp 2004, Walsh and Fanning 2005).

**Post-harvest food safety and process controls**

The traditional role of the vet in meat inspection, both ante-mortem and post-mortem, is under the spotlight in many jurisdictions as food production and processing more complex (Grant 1931, Lundén and others 2008).

It remains important to ensure that only clinically healthy animals are slaughtered and diseased animals are not allowed into the food chain. The role of vets is two-fold here, in that they must protect consumer health and identify animal health issues that need to be addressed on farm. In postmortem inspections, many of the visual inspection approaches and compulsory incisions that have been mandatory in the past are now under review and are being enhanced or replaced by microbial monitoring to validate hygiene measures. In June 2013, the European Food Safety Authority (EFSA) published its report on a risk-based approach to modernising meat inspection. The onus is on the meat businesses to produce safe food and to engage in criminal activity.”

‘Vets can make a greater contribution to ensuring that food is both safe and nutritious than they are currently making’
present carcasses for inspection that are fit for human consumption (EFSA 2013).

Changing consumer lifestyles are creating a demand for more ready-to-cook, and ready-to-eat meals, and the distance to the final consumer from the farms of origin is getting longer each year. The increasingly competitive commercial environment is driving the need for efficiency, leading to consolidation and economies of scale that result in the mass production of increasing volumes at all stages of the food chain. In this environment, the consequences of a contamination incident can have devastating effects on health – with people falling ill over large geographical areas – and cause massive damage to the reputation of food companies and brand names. Reputations and brands that take years to build can be irreparably damaged overnight by being associated with a food scare or adverse health effects.

There are several factors that continually contribute to the occurrence of outbreaks of foodborne disease. Often several of these occur simultaneously, thus amplifying outbreaks. These factors include: contaminated raw ingredients (including water), inadequate refrigeration or storage, insufficient cooking, cross-contamination between raw and cooked food, poor personal hygiene of staff, poor general hygiene on premises, and untrained staff. The tragedy is that, although these factors continuously contribute to illness and deaths, they are all easily preventable.

Enhanced surveillance

Enhanced surveillance capabilities are required to establish public health priorities, detect, delineate and investigate outbreaks, evaluate interventions and provide a detection service compatible with a modern food industry operating ‘just-in-time’ delivery systems in a global marketplace (Swaminathan and others 2006, Tauze 2006). In most jurisdictions, multidisciplinary teams, including veterinarians, microbiologists and epidemiologists, participate in outbreak investigations, and, increasingly, international networks are facilitating the identification of globally distributed contaminated products.

Positioning the vet in the role of ‘disease detective’, hunting down dangerous microbes and tracking them back through the food chain to their source, or forward to identify foods in the marketplace that must be recalled to prevent human illness, raises the profile of the public health veterinarian. It demonstrates the importance, the excitement and the challenge of this area of activity, which can easily rival colic surgery, small animal oncology or the care of exotic species. Molecular typing of organisms has been given the higher profile name ‘forensic microbiology’, which generates more enthusiasm for the subject among students. An ability to understand and use the information from genotyping, and to undertake case control and cohort studies, needs to be part of the armoury of the veterinary investigator.

The public health vet needs to be proficient in setting up surveillance systems to monitor trends, establish priorities, inform policymakers and control interventions. Vets need to be aware of the need for consistency if the data sets collected are to be useful, compatible and comparable with other systems globally. An integrated approach to surveillance of both environmental and communicable disease hazards is required if consumers are to be reassured that their health is being protected. Effective surveillance of animals, of food and of people is essential and forms part of the foundation of any consumer protection strategy.

Robust food safety management systems with adequate process controls are vital. The public health veterinarian can play a huge role in the prevention of outbreaks, but to do this they require knowledge of good manufacturing practice and hazard analysis and critical control points (HACCP). HACCP systems are not a replacement for other food hygiene requirements, but part of a package of food hygiene measures that contribute to ensuring food safety. Before establishing HACCP, good food hygiene standards must already be in place, particularly in the following areas:

- Infrastructural and equipment requirements;
- Food safety specifications for raw materials;
- Safe handling of food (packaging and transport);
- Sanitation (cleaning and disinfection);
- Water quality;
- Maintenance of the cold chain;
- Staff health;
- Personal hygiene;
- Training;
- Food waste handling;
- Pest control.

Examples of where process failures contributed to outbreaks of zoonotic disease should be highlighted in veterinary education, so that students can see the relevance of appropriate food safety management systems and process controls. In 2008, two cooked meat factories were in the limelight: one in Canada that produced a product contaminated with Listeria monocytogenes, which resulted in 26 deaths, and another in Ireland which caused an outbreak of Salmonella Agona which resulted in over 160 laboratory confirmed infections in people in seven EU countries (Attaran and others 2008, O’Flanagan and others 2008).

Many modern cooked meat facilities can cook in excess of 1000 metric tons of meat per week, which, in terms of sandwich fillers or pizza toppings, is the equivalent of approximately 20 million individual servings, emphasising the importance of robust process controls to ensure that the output is always safe.

Communication

When veterinary public health issues are in the media, veterinarians are reminded of the importance of their work.

Contamination of animal feed with harmful substances can have wide-ranging consequences. In 2011, more than 4700 farms in southern Germany, including poultry enterprises, were forced to close temporarily after livestock feed was found to be contaminated with dioxin.
no shortage of media coverage of zoonotic outbreaks and contamination incidents, and the media is regularly ahead of risk managers and surveillance scientists in highlighting problems. Many public health bodies monitor the global media as part of their early warning systems. Increasingly, the conventional media feeds off social media, and vice versa, and speculation and misinformation can become widely disseminated.

Public perception is often informed by sensational news coverage and items are placed higher on the agendas of policymakers as a result of the intensity of the media coverage of an issue. Policymakers and regulators are not consistent in how they address risk along the food chain or in society at large, and often their response is in proportion to the media coverage rather than the risk to public health (Knowles and others 2007). Many vets are great communicators and can translate complex scientific issues into something comprehensible to the general public. Veterinarians competent in communication can play a role in communicating residual risks to consumers or explaining risks, or non-risks, associated not just with zoonotic agents but also with genetically modified organisms, radiation, nanotechnology, and so on.

Animal welfare

High animal welfare standards are an integral part of good animal husbandry. The adverse treatment of livestock during rearing, transport or slaughter cannot be tolerated by any vet and any form of cruelty is unacceptable. Stressed animals are less likely to thrive and stress facilitates disease transmission. The public believe that vets are the custodians of animal health and welfare and they will hold them accountable if untreated treatment of animals is identified. Consumers across many jurisdictions are concerned about animal welfare and this influences their purchasing patterns. A YouTube video showing cruelty to cows in the lairage of a slaughterhouse in the USA led, in February 2008, to a meatpacker being forced by the US Department of Agriculture to make the largest meat recall in the history of the USA: 143 million lbs of ground mince (Washington Post 2008).

Trade-disrupting diseases

Veterinarians need to be aware of the consequences of outbreaks of those non-zoonotic diseases which, although they pose no risk to human health, disrupt the trade in food and damage both commercial interests and consumer confidence (for example, foot-and-mouth disease, swine fever, bluetongue and avian influenza).

Vulnerability to contamination

In 2005, in one of the largest food recalls ever to take place in the EU, processed food containing chilli contaminated with the carcinogenic dye Sudan Red was taken off the market in several countries. The Sudan Red was added by four spice-exporting companies in India to brighten the colour of the chilli, creating the impression that the product was fresher than it actually was. There were no adverse human health effects but consumer confidence was damaged and this incident demonstrated that there is the potential for large sections of the food chain to become contaminated as a result of the global sourcing of ingredients used in processed foods. The 2008 melamine contamination of dairy products in China did cause human illness, with over 300,000 babies falling ill, 53,000 people being hospitalised and six deaths. These two incidents were linked to chemical, rather than bacterial, contamination, and were not linked to bioterrorism, but they highlight how vulnerable the food chain is to deliberate contamination.

Conclusion

The public health veterinarian needs a range of competencies, and the foundations for these should be acquired in veterinary schools by emphasising the connections that exist between veterinary public health and the many and varied other subjects in the veterinary curriculum, the roles of other professionals and the benefit of collaboration. Highlighting the relevance of different subjects to veterinary public health and vice versa helps to maintain students’ interest and enables them to better understand the importance of clinical and laboratory work to public health protection. Veterinary public health should not be taught in isolation as tribalism can become established at undergraduate level and can mitigate against interdisciplinary working later in careers. The challenge for educators is to enthuse students about the concept of One Health by making the subject vibrant and stimulating (Wall 2009).

References


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