VETERINARY PUBLIC HEALTH: AN HISTORICAL PERSPECTIVE

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Contents

Summary

Veterinary public health covers a very wide field of animal and human health, from diseases of wild animals to final consumer products. Its ramifications extend to trade in live animals as well as the management of disease. It has wide international implications in animal quarantine, the setting of standards in food quality, and international trade.

In the area of food quality, the WHO/FAO initiative of creating a global standard setting body (*Codex Alimentarius*) has resulted in a major advance in the harmonization of food quality standards. It may be noted, however, that veterinary public health is a wider

concept than just applied to food products, as it also encompasses animal health, international movement of animals, and resulting public health concerns.

Globally, a large set of resources is required to maintain and support worldwide animal and animal product inspection systems. It has been shown that economies in the delivery of these services can be achieved through point control inspection systems.

Maintaining animal and animal product food health quality involves a major interference with domestic and international trade. There is a critical interface between government and private enterprise within countries where regulations have been imposed and conflicts have arisen. Command and control systems are still largely prevalent with opportunities for underlying resentment to surface.

In international terms, governments face off against each other in using such non-tariff measures to protect domestic industry. The Agreement on Sanitary and Phytosanitary Measures was a major achievement of the Uruguay Round. Harmonization of regulations offers greater opportunities for trade in animals and animal products between nations, though minimum standards have to be maintained. Protection of domestic industry is difficult to prove.

At the technical level, international co-operation in veterinary public health matters has been encouraged by intergovernmental scientific co-ordination organizations such as the *Organisation Epizooties International*, *Codex Alimentarius*, and the Food and Agriculture Organisation. They have an enhanced role following the Agreement on Sanitary and Phytosanitary Measures agreed by member countries of the WTO in 1994.

1. The Food Safety/Public Health Paradigm

There is a long history of concern for human health being affected by problems with the food we eat. This article is particularly concerned with foods of animal origin. As animals are mostly warm-blooded creatures like man, they share with man a propensity to host many organisms which have deleterious effects on both species. They are also subject to contagions among themselves, e.g., such as rinderpest. In addition, because animal foods are derived from living tissues, they are susceptible to problems of storage and spoilage. Finally, because animals eat many things that humans can, the food cycle can be re-infected with agents that cause animal or human disease and hence continue the cycle of bad food and spoilage.

Given these facts, *public food safety* in this area has to be seen as a holistic system that monitors and manages the production, feeding, slaughter and inspection of farm animals and animal products from birth to final consumption. Governments have put in place in the past, and will continue to introduce in the future, appropriate public health and animal health measures that monitor the current status of animal diseases, human pathogens, feed contamination, and problems of food storage. All of these require mainly government sponsored and organized surveillance and inspection systems at some point.

There is some ambiguity in the literature about the nomenclature describing these systems. According to the OIE, *veterinary public health* includes zoonoses, food hygiene, drug residues and the environment. An American expert talks of *veterinary public health and preventative medicine.* A British author talks of *contemporary veterinary medicine,* but does not include food inspection. British legislation was oriented to *quarantine* against disease in live animal imports, and food quality was a matter for *local health authorities.* Since animal health is involved in this aspect of public health, the term veterinary public health is adopted here.

This paper is concerned with *public policy for food and agriculture*, with particular reference to animal health inspection. The following sections will therefore traverse most of the subject matter of *veterinary public health.* The WHO definition of veterinary public health is "veterinary public health comprises all the community efforts influencing and influenced by the veterinary medical arts and sciences applied to the prevention of disease, protection of life, and promotion of the well-being and efficiency of man", in its widest sense, as it applies to *monitoring and controlling food quality* in animal products entering the human food chain, and clarifying its role in public policy for food and agriculture. Obviously, the subject must include any veterinary, quarantine, or surveillance matter that affects the wholesomeness of food products derived from the animal kingdom.

2. Economics of Veterinary Public Health

Veterinary public health (v.p.h.) covers a wide range of economic issues. In the first place, it is a public service industry which provides animal and human health services to both producers, processors and consumers. These services add to the value of final goods produced at each stage of production. In a free market situation, extra services would not be demanded unless costs could be recovered. However, v.p.h. is not subject to free supply and demand because society requires that minimum standards of "quality" be maintained in all goods derived from animal products. Indeed, society operates to make such standards mandatory. The cost therefore has to be borne by the buyer/consumer or by the taxpayer.

Secondly, "quality" is very hard to define in goods derived from animals. In particular, as the following discussion will reveal, quality consists of characteristics that appeal to the senses (organoleptic) and characteristics that are hidden from the consumer (toxins etc). Therefore, the consumer has to be protected from what he/she cannot see.

Thirdly, animals and animal diseases are not static. In general, both are characterized by very high mobility which means that infectious agents are easily spread from animal to animal and from country to country. In economic terms, infection is the ultimate externality - it cannot be internalized in an animal, in a herd, or within a country without adequate control mechanisms (e.g., veterinary practice, quarantine, inspection).

Fourth, the means of control cannot be selective. There can be no exceptions with disease. Thus, in economic terms, hygiene restraints on production at all its stages must apply to everybody - in effect they have to be sanctions administered by and enforced by some central authority. Hence, hygiene controls are usually administered by Governments, and from an early stage in history, by international co-operation between the governments of different countries.

Fifth, very large organizational skills are required at government level to maintain animal disease surveillance (animal health), international trade in animals (animal quarantine), entry of animal food products into human consumption (meat inspection and food standards), and control of animal feeds (feed standards). These functions are usually found in Ministries or Departments of Agriculture under various differently named bureaux or sections.

3. Origins of Disease

The idea that diseases can be transmitted from one animal to another has its origins in antiquity. The Romans believed that disease could be spread by airborne seeds or *animalculae* (not necessarily living) that were taken in through the nose and mouth. The Jewish Talmud describes demons as hiding "everywhere" - in water, crumbs and air - implying contagiousness. The primitive Hindus associated sick rats with human plague, the first suggestion of a *zoonosis*. The Veronan Fracastorius, writing in the early 16th century, argued that diseases were transmitted by minute, invisible, particles. Lancisi, physician to Pope Clement XI, freed Rome from rinderpest by using a *slaughter policy* to prevent infection of unaffected animals.

The main advances in the identification of microbes as causes of infectious diseases occurred in the 19th century, although the concept of a living contagious agent, *contagium animatum,* was found in the 17th century. Edward Jenners development of a smallpox vaccine using cowpox infective material, and early biological warfare conducted by American settlers who gave blankets belonging to smallpox victims to Indians as presents, implicitly recognized contagion.

Viruses were also discovered in the late 19th century, although not actually "seen" until the invention of the electron microscope in the 1930s. In 1892, Iwanowsky demonstrated that tobacco mosaic could be transmitted by sap that had been filtered through bacteria-proof filters. Beijerinck serially transmitted the disease using bacteria-free filtrates, and coined the term *contagium vivum fluidum* to describe the infectious "living" agent. In 1898-99, Loeffler and Frosch discovered the first animal virus, and in 1911, Rous reported the first virus-induced transmissible tumour. Towards the end of the 19th century, the first arthropod carrier (a tick) of an infectious disease was identified by Kilborne, Smith and Curtis, investigating Texas fever of cattle.

3.1. Domestication and Distribution of Animals

The dog, naturally a hunter, was the first animal to be domesticated over 14 000 years ago, says Thrusfield. Sheep and goats were domesticated by 9 000BC in the fertile Nile valley and were the basis of early pastoral cultures. These societies were succeeded by cattle cultures (4 000 BC) and by pigs. The records demonstrate that animals had a religious as well as an economic significance in early civilisations. A European wild ox (extinct) was essential to the religion of the Sumerians who migrated throughout Asia, North Africa and Europe in the third millennium BC taking their animals and their beliefs with them. India is the largest cattle culture that remains.

Cattle cultures persist in North East Africa: the result of interaction between the Ancient Egyptians and early Nilotic (Bantu) tribes. Cattle still play an important part in these cultures; they are food, companionship, and status, and religious symbols to the Suk and Dinka tribes and many others.

Horse cultures came to succeed some cattle cultures. The horse is represented in Iranian, Greek, and Celtic pantheons. It has become a symbol of veterinary medicine in the form of a centaur, of which, Chiron was considered to be the mythological founder of Greek medicine. The Spanish introduced cattle, sheep, pigs and goats to North America in the 16th century. Haired sheep were introduced to Africa by European slave traders. The Spanish brought turkeys to Europe from North America.

3.2. Early Strategies for Disease Prevention

The initial domestication of animals brought man into close contact with animals, and therefore with their diseases. While primitive theories of disease prevailed, economic survival ensured that primitive techniques of disease treatment evolved. Quarantine (derived from the Italian word meaning “forty” - the traditional length, in days, of isolation in the Middle Ages) and slaughter became preventative strategies. The importance of the horse in military affairs led to the development of the profession of veterinarians. The bias towards horses lasted until the early 20th century when equine veterinary medicine was still considered to be a more respectable occupation than the care of other species!

There are records of animal plagues going back to the time of Christ. Anthrax was known in Rome in AD500, and foot-and-mouth disease in Italy in AD1400, and rinderpest in France in 1710-1714. Animal plagues, especially those of cattle, became particularly common in Europe in the mid 18th century with the introduction of rinderpest from Asia. Local outbreaks of disease were thought to be the result of local eruptions of noxious air: the *miasma.* The miasma were thought to originate from filth generated by man, rather than from natural sources. Again the theory, imperfect as it was, led to a stable phase of husbandry characterized by improvement of farm hygiene, slaughter, and treatment as control techniques. When rinderpest entered England from Holland in 1714, Thomas Bates, surgeon to George I, advocated fumigation of buildings, slaughter and burning of affected animals, and resting of contaminated pasture as typical tactics. Cattle owners were also compensated for loss.

Half the cattle in France were destroyed by rinderpest between 1710 and 1714. The disease occurred irregularly until 1750 when it again became a serious problem. Little was known about the disease. This provided impetus for the establishment of the first permanent veterinary school at Lyons in 1762. Alfort was founded in 1766, Hannover in 1778, London in 1791, Edinburgh in 1823, and Toulouse in 1825.

The lifting of *animal importation* restrictions in England in 1840-42 increased the risk of disease occurring in Britain. Sheep pox entered Britain in 1847 from Germany, and pleuropneumonia became a serious problem. Public concern, highlighted by the rinderpest outbreak of 1865, was responsible for the establishment of the British State

Veterinary Service in the same year. Similar services were founded in other countries. Disease control had become a public policy matter.

A new era dawned with the discovery of the microbial basis of disease in the late 19th century. This postulated a specific single cause of an infectious disease and therefore implied a suitable control strategy directed against the causal agent. Treatment of disease could be based on laboratory analysis involving isolation of agents and identification of lesions followed by therapy. Control of disease by prevention and, subsequently, eradication involved *mass testing* of animals and immunisation when an increasing number of vaccines became available. The discovery of disease vectors facilitated disease prevention by *vector control* (e.g., malarial mosquito). An improved understanding of infectious agents life histories enabled their life cycles to be broken by manipulating the environment: the draining of land to prevent fascioliasis (liver fluke) is a good example. Bacterial diseases remained as major clinical problems until the discovery and synthesis of antibiotics in the 20th century, which increased the therapeutic power of the veterinarian.

3.3. Animals as Food Sources

Man has cultivated animals not only for food sources but also for purposes of transport and war. In primitive societies, food derived from animals did not lend itself to storage. It is recorded that salt was a highly sought after commodity in early times because of its capacity to preserve the flesh of animals. The domestication of animals was thus marked by consistent patterns of feast and famine according to the availability of fresh meat.

The disposal of animal carcasses was a major problem in medieval society. Disposal of offal after slaughter went into open trenches and dead animals were sent to knackers yards. Knackers sold the skins of the animals and disposed of the carcasses in the field for birds and scavengers to dispose of. Knackers were segregated from normal society and even had their own cups in inns. There were some enlightened people who identified these problems early in the 19th century (see Box 1). It was later recognized that anthrax, a highly contagious disease of cattle, was spread from dead material. Cholera was also thought to be spread from such sites in the middle of the 19th century.

"The great poet Johann Wolfgang Goethe exercised the function of Minister of State under Grand Duke Carl August of Sachen-Weimar-Eisenach, founding a small veterinary school at Jena, in 1816, which operated for 30 years. In December 1831, a few months before his death, Goethe issued instructions to those in charge of the Jena Veterinary School to the effect that special attention should be paid to the burial of anatomical specimens, to ensure that the trenches and gardens of the school do not become overfilled, and were filled in promptly to be replaced by a new burial place. From the instructions contained in the manuscript and from his tribute paid to the personnel of this institution in a Jena newspaper, one can see how the poet was concerned about hygiene problems and carcass disposal in his capacity as an official in a small principality." From Schonherr, W. (1991), History of veterinary public health in Europe in the 19th Century, *OIE Revue Scientifique et Technique* **10 (4)**, 985-994.

Box 1. Goethe and Veterinary Public Health

The Smithfield market was in existence in 1253. In 1326, Edward III granted by charter, to the citizens (and Corporation) of London, *exclusive* market rights and privileges within seven miles from the city. There are records of an Urban Sanitary Act in Britain as early as 1388. There had been trade guilds in Britain, including butchers, since the 8th century. In Scotland, they were called Fleshers Guilds and were incorporated before 1488. In Aberdeen, the records of the city state that in 1399, four *appreciatores carnium* (meat inspectors) were appointed to examine the quality of the flesh sold in the town. There is a clear pattern of legislation in Britain governing the control of plagues (particularly rinderpest) going back to 1714. The main legislation governing adulteration of food to protect consumers dates from 1875 - the Food and Drug Act.

Food preservation was very rudimentary. Slaughter took place in the autumn when temperatures dropped. There are records of ice houses on English estates in the 17th century, so this means of preservation was known at that time. Ice-packed cool stores were in common use before the advent of refrigeration. The liquefaction of gases by Faraday and Lavoisier and the invention of compression machines (c. 1834) enabled the commercial production of ice by 1855. The advent of refrigeration completely revolutionized not only the food storage problem but also world trade in temperate agricultural products of animal origin. For example, the first shipment of refrigerated beef from the US to the UK took place in 1875.

3.4. Control of Live Animals

Another characteristic of animal hygiene and food safety is that animals themselves are mobile and contribute to re-infection. Given the medieval problems of storage, it was customary to transport *live animals* to where they were required. Thus, the diseases of animals, which were either fatal to themselves, such as rinderpest, or a threat to humans, such as tuberculosis, were easily spread from district to district and from country to country. Added to this were the problems of the disposal of dead animals and effluent.

In the UK, George I authorized an eradication program for rinderpest in 1714 which was very successful. In 1746, an Order in Council was introduced which authorized quarantine measures and eradication after a further infection of rinderpest was discovered. In 1770, an Order in Council banned imports of cattle. This was relaxed in 1840 or 1842 (according to which authority you quote) and imports of live animals resumed. Further controls were imposed in 1847, 1848, 1857, and in 1865 the Cattle Disease Prevention Act covering quarantine requirements, notification requirements, and a veterinary establishment act was passed. A Contagious Diseases (Animals) Act was passed in 1869, which, with subsequent amendments formed the basis of modern legislation in the UK.

In the United States, the Massachusetts legislature authorised eradication of pleuropneumonia in 1859. The Bureau of Animal Husbandry was established in 1884. In 1887, authority was given to purchase and destroy cattle infected with, or exposed to, pleuropneumonia. In 1890, importation of diseased animals was prohibited and others quarantined.

4. The Development of Hygiene Inspection

In Europe, scientific and technical knowledge in the late 19th century enabled the association between human tuberculosis and the consumption of beef infected with the tuberculosis bacteria to be established. Pasteur was the first (in 1870) to suspect microbes to be the agents of disease, and Gerlach (in 1875) described bovine "pearl disease" and suggested it might be transmissible to humans. When the agent of tuberculosis was discovered in 1882 by Koch, a causal relationship was assumed to exist for the first time. Ten years later, in 1892, having confirmed that tuberculosis could be transmitted to man by infected beef, Ostertag was appointed to the first academic chair established anywhere in the world to cover the fields of *meat inspection* and *milk hygiene* at the University of Berlin. Under his authorship, the first Meat Inspection Act "in the world" was drawn up in 1900, following the promulgation of the first Epizootics Act in 1880.

Brucellosis or contagious abortion of cattle was discovered by Bang in 1896. Infected animals may harbour the agent in all organs and tissues, including the placenta and the mammary glands. Man can be infected through contact with infected animals or through the consumption of milk. Pasteurisation is an effective preventative measure. Trichinellosis in pigs was discovered by Paget in 1835, but was not recognized as a serious health problem until 1860 when Zenker, Virchow and Leuckart made discoveries clearly demonstrating the life-cycle, transmission and pathogenicity of the parasite. As a result of these discoveries, *obligatory inspection* of pork for the presence of *trichinae* was introduced in Prussia in 1877.

Rabies is a disease of the canine family, which can be passed to man - usually by the dogs bite. Its prevalence has declined in the 20th century due to unknown causes. The incidence of rabies in man can be controlled by prophylactic vaccination and post-exposure treatment, by reducing the risk of human exposure and, conclusively, by disease elimination.

Latent infection is another problem area - latent infection is where animals and animal stocks do not show sign of infection in their lifetime and appear healthy on gross inspection. In the case of *Salmonella* bacteria, for example, feeds, excrement and ground water become contaminated with agents of infection and they may be passed on to humans unknowingly. This raises the case for government intervention to protect the consumer from what he/she cannot see. Testing for *Salmonella, Campylobacter, Toxoplasma*, and other latent organisms is now the basis of all modern inspection systems with public health implications [see Box 2].

Zoonosis	*Occurrence in animals*	*Ease of diagnosis at meat inspection*	*Public health relevance*
Salmonellosis	high	very low	high
Toxoplasmosis	low	extremely low	high
Cysticercosis	low	medium	high
Trichinellosis	very low	medium	high
Q fever	low	extremely low	high
Leptospirosis	medium	extremely low	low
Listeriosis	very low	extremely low	low

Sarcoporidiosis	high	medium	no data
Tuberculosis	extremely low	high	high
Brucellosis	extremely low	low	high

Box 2. Important zoonoses in meat hygiene in Europe (after Grossklaus *et al.*)

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