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A history of animal diseases in the food supply of the United Kingdom since the nineteenth century

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Abstract

Zoonoses are diseases that can pass between animals and humans. Emphasis in this paper is given to infections acquired through the food supply, with particular reference to the United Kingdom in the nineteenth and twentieth centuries. It is argued that the prion disease Bovine Spongiform Encephalopathy and the mycobacterial disease bovine tuberculosis are iconic examples of foodborne zoonoses that show how the veterinary public health system of the UK has failed. Zoonoses of this type are illustrative of the new types and scales of risk that have arisen in the Risk Society.

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Introduction

Zoonoses are animal diseases that can affect humans and this paper is about their mediation by the food supply. This might sound like a surprising topic since the proximity of people in wealthy countries to food producing animals has been greatly reduced over the last 150 years, and one might therefore reasonably expect the risk of infectious zoonoses to have declined. Yet we are told that of 1407 species of human pathogen, 58 per cent are zoonotic, and 73 per cent of so called emerging or re emerging pathogens are from animals.[1] The spread of disease from animals to humans is also sometimes claimed to be an increasing trend, as the result of a number of factors. For instance, at the beginning of the 21st century the greater intensity of modern livestock husbandry and the increased speed of connections worldwide have created hazards that are qualitatively different from, say, one hundred years ago.[2]

There are various classifications of zoonoses, for instance based on the life cycle of the pathogen, the type of causative organism (bacterial, viral, rickettsial, fungal, parasitic and protozoan), or the mechanisms of transmission.[3] For present purposes a relatively narrow definition will be adopted. We will be excluding any disease not mediated by the food supply, which will therefore rule out three recent high profile pandemics: Severe Acute Respiratory Syndrome (SARS)(2002-3) caused by a coronavirus in wild animals sold in markets in China but then passed largely from person to person; highly pathogenic avian influenza caused by subtype Influenza A (H5N1); and so called swine flu (subtype H1N1), which came to global prominence in 2009, was again an airborne infection between humans.[4]

Our focus instead will be on zoonoses with two vertebrate hosts, mainly humans and their domesticated farm animals, spread through the food chain (Table 1). There are many potential risk scenarios but

1. Woolhouse and Gowtage-Sequeria, 2005; Jones et al., 2008.
2. Greger, 2007; Coker et al., 2011.
3. Steele, 1979-82; Acha and Szyfres, 1987; Bell et al., 1988.
4. The related Spanish Flu (also H1N1) killed upwards of 50 million people 1918-20.

to simplify the present discussion we will choose three interesting situations: food poisoning, recent food scares, and the long run, quiet but devastating example of bovine tuberculosis. The emphasis will be historical, although it is worth noting from the outset that data is in short supply in most countries for the period before the Second World War. The quality even of the more recent data is questionable, as we will see.

Table 1. Principal foodborne zoonoses in Europe.

Salmonella
Campylobacter
Listeria
Verocytotoxigenic *Escherichia coli*
Mycobacterium bovis
Brucella melitensis
Trichinella
Echinococcus
Yersinia
Hepatitis E
Coxiella burnetii (Q fever)
Cryptosporidium
Viruses: calicivirus, rotavirus

Note: Not all serotypes of *Salmonella*, *Campylobacter* and *Yersinia* are zoonotic.

Zoonotic food poisoning

The European Food Safety Agency (EFSA) and the European Centre for Disease Prevention and Control produce regular joint reports on zoonoses, the most recent of which is rich in different ways of relating these diseases to the food supply. The overwhelming preponderance of notifications is for the agents of what we would normally call food poisoning. Between them campylobacteriosis, salmonellosis, verocytotoxigenic *Escherichia coli* and listeriosis account for 99.5 per cent of confirmed human cases of zoonoses in 27 EU countries, 97.9 per cent of hospitalizations, and 93.0 per cent of deaths.[5] Although campylobacteriosis is by far the most common zoonosis in Europe, the most deadly is listeriosis.[6]

Campylobacter is found most often in fresh broiler meat and milk, a staggering 31.3 per cent of EU poultry samples being positive for this bacterium in 2011. This average for the EU is dwarfed, however, by the over 50 per cent contamination in the slaughterhouses and meat cutting plants in the Czech Republic, Poland, Slovenia and Spain, and over 80 per cent at retail in Luxembourg. In human subjects campylobacteriosis is found most often in the Czech Republic, the United Kingdom, Luxembourg, Slovakia, and Sweden. The number of cases is increasing steadily.[7]

Salmonellosis is reported as the principal cause of serious foodborne outbreaks in the EU in 2012, especially serovars *Enteritidis* and *Typhimurium*. This is mainly via eggs and egg products, cheese and various meats. Salmanellosis is, however, on the decline in Europe, as a result of a concerted effort since 2006 by the EU to encourage better monitoring and regulation of conditions of production. The number of confirmed human cases in 2012 was one third lower than in 2008.[8]

Putting all of the zoonoses together, the EFSA report indicates that eggs and egg products are the causes of 22.0 per cent of outbreaks, followed by mixed food (15.6%), fish and fish products (9.2%). In terms of setting, outbreaks were most often (39.7% of cases) traced back to contamination in the domestic kitchen and 23.9% to a restaurant, cafe, pub, bar or hotel. How this relates to the number of food preparation events and therefore to risk is not revealed.[9]

It is often taken for granted that food poisoning and Infectious Intestinal Disease (IID) incidents generally increased during the twentieth century. This was a period of intensification of agriculture, a significant spatial extension and increasing complexity of the food system, and also a shift in lifestyles where

5. EFSA 2014. There were 328 deaths in 2012.
6. For instance in fish products and soft cheese.
7. EFSA 2014.
8. Ibid.
9. Ibid.

consumers relied less on their preparation skills and more on technologies of chilled or frozen storage and rapid heating. The data seem to bear this trend out, with increased reporting of food poisoning incidents, especially from the 1970s onwards. One does have to bear in mind, however, that data was incomplete. In England and Wales the first time *campylobacter* was linked to IID was as recently as 1972 and there was no official surveillance until 1982, when *salmonella* was also reported separately for the first time. Within just a few decades zoonotic food poisoning has risen to be a major burden of ill health. According to research funded by the UK's Food Standards Agency, the country has 17 million IID incidents a year, costing £1.5 to £2.0 billion a year in health resources and lost production.

The EFSA report referred to above has a series of maps of the incidence of zoonoses in Europe.[10] In a sense they are counter intuitive because they show high rates of human salmonellosis, campylobacteriosis and listeriosis in Scandinavian countries, which are known to be more scrupulous in their attention to food safety than the European average. Muller illustrates this by showing that Denmark has the highest annual self reporting rate in Europe at 1.4 incidents per person.[11] This does not mean that Denmark has the highest rate of IID; more likely it is due to heightened cultural awareness and an efficient recording system. Indeed this raises the issue of the 'burden of illness pyramid' that affects all morbidity statistics. A recent study in England found that only one in 17 IID incidents ever comes to the notice of a medical practitioner and only one in 147 is recorded in the national database.[12]

Zoonotic food scares

More informative about consumers' perceptions of ill health from food than self reported food poisoning is the recent history of zoonotic food scares. The classic example is outbreak of Bovine Spongiform Encephalopathy (BSE) that afflicted the UK for 20 years from 1986. BSE is a prion disease affecting the neurological system that can jump the species barrier, appearing as scrapie in sheep and New Variant Creutzfeldt Jacob Disease in humans. At the time of writing (December 2014) there have so far been 177 human deaths in the UK and the slaughter of 184,000 infected cattle at a cost of £5.0 billion in veterinary interventions and economic disruption. Under an intense media glare, beef consumption dropped by dropped 11 per cent in 1996 across the EU and there was also a dip in countries where there was neither a local problem of BSE nor much in the way of beef imports from Britain. It became a global food scare of truly astonishing proportions.

One interesting feature of the public response to BSE was the difference in reactions between countries. In the UK there was a 40 per cent reported drop in the consumption of beef in the first month after the official announcement in 1996 of a link between BSE and vCJD, but this was a brief pause and the purchase of better quality cuts actually increased thereafter. The negative reaction was greater in Germany in 2000 when BSE was found in 25 indigenous cattle, and the fear spread to other European countries that had previously felt safe. It seems that consistently across a wide range of food safety issues worries are higher in southern and eastern Europe than in Scandinavia, the UK and the Netherlands. This is paralleled by low levels of trust in the citizens of the southern and eastern countries in the ability of their governments to deal with food scares by comparison with relatively high levels of satisfaction with policy making in the north.[13] Trust and perceived risk are closely intertwined and the differences between the north and the south of Europe have deep socio cultural roots that are historical.

Bovine tuberculosis

Our final example of a zoonosis is less headline grabbing than food poisoning or food scares but over a long period it has been amongst the most serious for

10. EFSA, 2014.
11. Muller, 2012.
12. Tam, 2012.
13. Mullet et al., 2005; Kjaernes et al., 2007; Kjaernes, 2010.

mortality. This is bovine tuberculosis (bTB), which between 1850 and 1960 is estimated to have been responsible for at least 0.5 million and probably 0.8 million deaths in the UK.[14] We know about the airborne version of TB (*M. tuberculosis*) and the mortality of 7 million in the same period but less has been written about the foodborne bacterium, *M. bovis*. This spreads readily in raw milk and therefore remains a public health hazard in those countries in the Global South where pasteurization has yet to be adopted as a precautionary measure. In Europe bTB remains a theoretical risk, with 125 cases in 2012, but this is small by comparison with the other zoonoses.[15]

There are no reliable published morbidity or mortality data for bTB in humans in the nineteenth and early twentieth centuries. It was possible to distinguish between the human mycobacterium, *M. tuberculosis*, and the bovine mycobacterium, *M. bovis*, by bacteriological laboratory analysis but this was time consuming and expensive and was never adopted as a matter of routine. Instead we have to use the vital statistics for tuberculosis to make an estimate on the following lines.

For the British Isles we have the *Annual Reports* of the Registrars General of England and Wales (from 1838), Scotland (from 1855), Ireland (1864-1921), Northern Ireland (from 1922), and the Republic of Ireland (from 1922). These record tuberculosis deaths attributed to the disease at various bodily sites, usually by age and by sex. The detail varies through time but in broad terms we can recover data in seven categories: respiratory; central nervous system; abdominal; bones and joints; genito urinary; skin; and cervical and other sites. Not all of the tuberculosis at these sites was caused by *M. bovis*, however. We know this because of the extensive experimental bacteriology undertaken by researchers such as Stanley Griffith and others in the first half of the twentieth century. Their conclusion for the UK was that *M bovis* can be credited with only 2.1% of deaths from respiratory tuberculosis in England and Wales, but 26.7% for the central nervous system, 64.7% for abdominal TB, 15.0% for bones and joints, 18.8% for genito urinary TB, 48.5% of the skin disease, and 56.8% of cervical and other cases of TB.[16]

Bringing these two datasets together we can now estimate mortality for the whole period. A simple calculation suggests over 800,000 bTB deaths in the British Isles in the period 1850-1960. There are several warnings that need to be attached to this figure, however. One is that the registration of the cause of death was not compulsory until 1874, with inevitable consequences for data quality, especially where a physician did not attend the person who died. The most important doubt though is that clinical diagnoses in the Victorian period were often vague and inconsistent, notably where more than one cause might plausibly have been attributed to the symptoms. The most often quoted example was infantile tuberculosis, which was frequently certified as tabes mesenterica but shared symptoms with marasmus.

Like BSE, bTB was a problem principally of the British livestock industry. Other countries with high rates of the cattle disease, such as Germany, habitually boiled their milk and therefore the transmission to humans was limited. The domestic heating of milk was less common in the UK and Scandinavia and the risk therefore remained as long as the milk supply was unpasteurized.

In the UK the milk supply of London was the first to be protected by heat treatment, although candidly this was a cynical ploy by the milk trade to increase the shelf life of their product rather than protect the public. 95% of the capital's milk was heat treated by 1932 but it took another 30 years for the rest of the country to be protected to the same degree. Pasteurization of milk has never been made compulsory in England and Wales and the slow pace of change was due to a reluctance by successive governments in the twentieth century to engage with food safety as a political issue. There were three reasons for this. First, in the 1920s and 1930s the peak of zoonotic TB meant that 40% of dairy cows were infected, and the poten-

14. Atkins, 2000a.

15. EFSA, 2014.

16. Atkins, 2016.

tial expense of compensation for farmers was off putting. When area based eradication did at last happen in the 1950s it cost in today's values about £2.65 billion to slaughter 110,000 animals. Second, no government was willing to take on the National Farmers' Union, a lobby group of legendary negotiating strength that had fellow travellers in the Ministry of Agriculture. Third, the heat treatment of milk was stridently and vigorously opposed by a number of different groups, to a degree that in retrospect is difficult to comprehend.[17]

Denmark has always taken the issue of foodborne zoonoses more seriously and for more than 100 years it has been well organized in its public health interventions. N.J. Fjord in the 1870s was among the first anywhere to apply Pasteur's ideas to the heating of milk and for the next 30 years it was Danish and German machinery that was at the forefront of pasteurization technology.[18] The so called Danish Heater was the first to be applied on a large scale to drinking milk, in New York in the 1890s, and it was the Danes who first made pasteurization compulsory, in a law passed in 1898, for the portion of their milk production that was used for feeding pigs and making butter. The rationale was that eliminating disease from foodstuffs was vital for the Danish economy, which at that time was dependent upon agricultural exports. Pasteurization therefore minimized the risk of reputational damage. Denmark was also home to Bernhard Bang (1848-1932), one of the world's most distinguished veterinarians and the originator of an influential method of monitoring and voluntary control of bTB in cattle. Although Bang's approach was eventually abandoned, the Danes were relentless in their desire to rid their country of bTB, which they eventually did in 1951.[19] By contrast there has been a recrudescence in British herds to the extent that 30-40,000 infected are still being slaughtered annually at a cost of £150 million pounds.

17. Atkins, 2000b.

18. Frederiksen, 1919; Westhoff, 1978.

19. Francis, 1958.

Conclusion

In conclusion it is fair to point to a British exceptionalism with regard to diseases which can pass from animals to humans. While all European countries have their challenges, particularly on the food poisoning front, it is the UK, both historically and in the modern era, that has suffered the largest scale, most dramatic and most costly outbreaks of zoonotic foodborne disease. BSE and bTB are indicative of the country's serious political and administrative failings, not to mention the Foot and Mouth Disease outbreak in 2001, which was a further vast though non-zoonotic embarrassment. We can suggest that the intensive nature of British livestock agriculture puts its farm animals at greater risk than experienced in other European countries but this is clutching at straws. The most obvious conclusion is that the successive crises of zoonotic foodborne are somehow a marker of a polity maladjusted to the veterinary public health needs of its farmers and other actors in the food supply chain, along with the consumers of the food produced.

Ulrich Beck and the other Risk Society theorists suggest that such food scares define a new phase in history.[20] They acknowledge that there have been many concerns expressed about food quality and food safety in the past but here we have something altogether different. The 'dread risks' represented by BSE are on a scale of catastrophe that is said to be beyond anything previously witnessed. Their impact has been global, crossing international borders, with the authorities seemingly powerless in the face of this aspect of globalization. As a result, the authority of science and of the political process has been undermined, to the extent that in many countries there has been a serious loss of credibility in official public health messages.

Foodborne zoonoses are not just a historical curiosity then. They have been in the past and remain a source of significant public health risk, and the regular emergence of novel zoonoses is a concern for the

20. Beck, 1992.

future. Ebola, a zoonosis originating in fruit bats devastated the west African countries of Liberia, Sierra Leone and Guinea caused worldwide anxiety in 2014. It is not a foodborne epidemic but it is conceivable that the future may see the emergence of new threats mediated by food and drink. Past successes in controlling zoonoses must therefore not be allowed to breed future complacency.

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