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Riesgo de enfermedades zoonóticas y agroturismo. Una revisión

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Zoonotic Disease Risks and Agritourism in the Netherlands: A Review

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Abstract

Agritourism literally means tourism to the countryside and includes many activities that take place at farms open to the public. Agritourism is popular with farmers as a source of supplementary income, and with visitors from an idealistic perspective, involving a generally romantic image of nature and the country lifestyle. However, with agritourism many extra risk factors occur, such as direct contact with animals and manure, as well as the consumption of homemade farm products. Not much has been published about the link between agritourism and the risk of zoonotic diseases, although much material exists regarding zoonotic diseases. Therefore, this article describes the risks of zoonotic diseases in agritourism and offers an overview of publications and discussions among experts on this subject. Zoonotic diseases can be caused by different types of agents, such as bacteria, parasites, fungi and viruses, all of which possibly existing at farms open to the public. This emphasizes the importance of strict adherence to hygiene measures by workers and visitors on farms in The Netherlands. The four most important zoonotic diseases in agritourism today are *Escherichia coli*, *Salmonellosis*, *Campylobacteriosis* and the Q fever. In the past, measures were only taken after serious outbreaks of zoonotic diseases. Under the motto "prevention is better than cure", it would be wise to introduce preventative measures in agritourism before more serious cases occur, which is something that experts already predict. General hygiene measures, such as an information board and hand washing facilities, can be followed in order to prevent zoonotic diseases in agritourism. All general hygiene measures can be described in a code like the one that for children's farms in The Netherlands.

Keywords

Agritourism, Zoonotic Diseases, Higiene, Prevention.

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RISCO DAS DOENÇAS ZOONÓTICAS E AGRO-TURISMO NA HOLANDA. UMA REVISÃO

Resumo

Agro-turismo significa literalmente turismo em zonas agrícolas e inclui diversas atividades, organizadas em quintas abertas ao público. O Agro-turismo é popular entre os agricultores pois constitui uma fonte suplementar de lucros e com visitantes de uma perspectiva idílica, envolvendo geralmente um quadro romântico da Natureza e do estilo de vida rural. No entanto, com o Agro-turismo vêm também importantes fatores de risco como os "YOPI's" (young, old, pregnant and ill people), o contato direto com os animais e estrume e consumo de produtos agrícolas caseiros. Pouco tem sido publicado sobre a relação entre o Agro-turismo e o risco de doenças zoonóticas, apesar de existir muita informação sobre doenças zoonóticas. Assim, este artigo visa descrever o risco das doenças zoonóticas em Agro-turismo e oferecer um resumo das publicações e discussões existentes entre especialistas neste assunto. As doenças zoonóticas podem ser causadas por diferentes tipos de agentes tais como bactérias, parasitas, fungos e vírus, podendo qualquer um deles existir em quintas abertas ao público. Isto enfatiza a importância da aderência estrita a medidas de higiene pelos trabalhadores e visitantes das quintas na Holanda. As quatro doenças zoonóticas mais importantes na atualidade em Agro-turismo são *Escherichia coli*, *Salmonelose*, *Campilobacteriose* e *Febre Q*. No passado apenas eram tomadas medidas após a ocorrência de graves surtos de doenças zoonóticas. Perante o lema "mais vale prevenir que remediar" seria sensato introduzir medidas preventivas no Agro-turismo antes de ocorrerem casos mais sérios, algo já previsto pelos especialistas. Para prevenção de doenças zoonóticas em Agro-turismo, medidas de higiene gerais, tais como uma placa informativa e instalações para lavagem das mãos, deveriam ser instituídas. Todas as medidas de higiene geral podem ser descritas num código como o utilizado nas quintas para crianças.

Palavras chave

Agro-turismo, doenças zoonóticas, higiene, prevenção.

RIESGO DE ENFERMEDADES ZOONÓTICAS Y AGROTURISMO. UNA REVISIÓN

Resumen

Agroturismo literalmente significa turismo en el campo e incluye muchas actividades que tienen lugar en granjas abiertas al público. El agroturismo es popular entre los agricultores, pues representa una fuente de ingreso suplementaria y cuenta con visitantes

que tienen una perspectiva ideal que involucra una imagen romántica de la naturaleza y del estilo de vida de campo. Sin embargo, con el agroturismo vienen muchos factores de riesgo extra como los "YOPI's" (young, old, pregnant and ill people)", contacto directo con animales y sus excrementos, así como el consumo de productos de campo hechos a mano. Se ha publicado poco sobre la relación entre el agroturismo y el riesgo de enfermedades zoonóticas, aunque existe mucho material referente a las enfermedades zoonóticas. Este artículo describe, por tanto, los riesgos de enfermedades zoonóticas en el agroturismo y ofrece un resumen de publicaciones y discusiones entre los expertos en la materia. Las enfermedades zoonóticas pueden ser causadas por diferentes tipos de agentes, tales como bacterias, parásitos, hongos y virus, todos los cuales posiblemente existen en granjas abiertas al público. Esto enfatiza la importancia de adherirse estrictamente a medidas higiénicas para los trabajadores y los visitantes en granjas en Holanda. Las cuatro enfermedades zoonóticas más importantes hoy en día en el agroturismo son: *Escherichia coli*, *Salmonellosis*, *Campylobacteriosis* y *Q fever*. En el pasado, solo se tomaron medidas después de que ocurrieron serios brotes de enfermedades zoonóticas. Bajo el lema "prevenir es mejor que curar", sería inteligente introducir las medidas preventivas en el agroturismo antes de que más casos serios ocurran, algo que los expertos ya están prediciendo. Para la prevención de las zoonosis en el agroturismo, se pueden seguir medidas generales de higiene tales como tableros de información e instalaciones para el lavado de manos. Todas las medidas pueden ser descritas con códigos como aquellos utilizados para las granjas de niños.

Palabras clave

Agroturismo, enfermedades zoonóticas, higiene, prevención.

Introduction

There has been an increase in *agritourism*, or, in other words *tourism to the countryside* (Reitsemá & Pierik, 2009). The definition of agritourism is an activity, holiday or service at a farm open to the public, ranging from the provision of accommodation or camping, to the hiring of a covered wagon, bicycle or canoe. Furthermore, catering, petting animals, organized sports and games are covered by agritourism. Agritourism brings more visitors to farms, resulting in higher amounts of people having close contact with animals, bringing about an increased risk of zoonotic diseases. Any disease or infection that is naturally transmissible

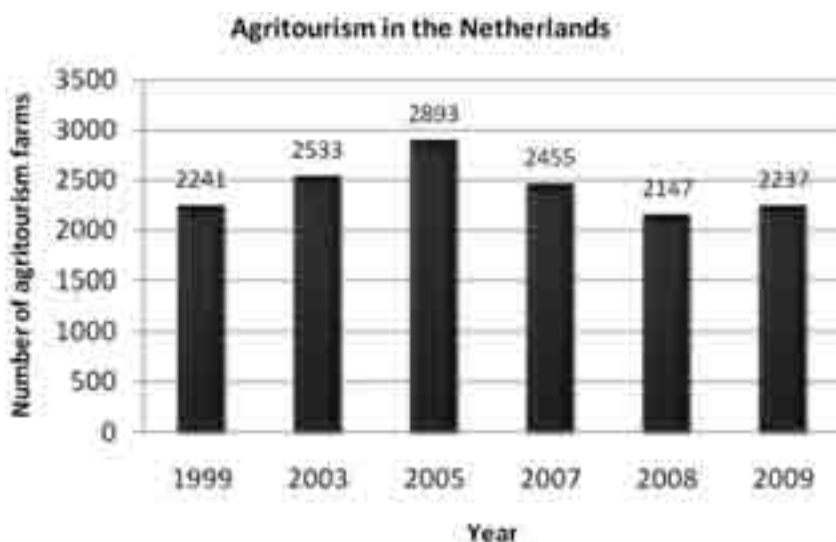
from vertebrate animals to humans and vice versa is classified as a zoonosis (Acha & Szyfres, 2003). Zoonotic diseases have been described for many centuries and have caused a variety of disease outbreaks among humans. They can be caused by different types of agents, such as bacteria, parasites, fungi and viruses. A wide variety of zoonoses have been scientifically investigated and described, reason why literature reviews of all kind of zoonoses are made. These literature reviews provide essential sources of information for zoonotic public health services, enabling multiple stakeholders to keep up with the rapidly increasing amount of primary research in the field (Waddell et al., 2009). Published work about agritourism itself is relatively scarce, which raises the question as to whether zoonotic diseases for this form of leisure need to be more thoroughly investigated and the material published in a comparable manner. A publication from the ‘The Food and Consumer Product Safety Authority’ (VWA) of the Netherlands shows that zoonoses are present at public farms (Heuvelink et al., 2007). However, there is a lack of reviews about zoonotic diseases in agritourism in the Netherlands or even Northern Europe. As a result, this article describes the risks of zoonotic diseases in agritourism and gives an overview of publications and current expert discussion on this issue.

Agritourism in Perspective

According to the Central Office of Statistics in the Netherlands, the definition of agritourism is *tourism, accommodation or leisure at a farm* (CBS, 2009). This means holiday tourism (camping, summer houses, group accommodation and Bed & Breakfast), receiving visitors at the farm (tours, museum, cafe and restaurant) and rental recreation, petting animals, education or recreational facilities. The Central Office of Statistics in the Netherlands sees other non-agricultural activities such as nature conservation, care provision and direct product sales as separate activities. Other agencies or countries view all non-agricultural activities at a farm as agritourism, including care farms and children’s farms. No two farms are alike, so agritourism enterprises are equally diverse, thus making it difficult to describe the “typical” agritourism business (Beus, 2008). Generally speaking, however, an agritourism enterprise is a business, conducted by a farm operator, for the enjoyment and education of the public, which thereby generates additional farm income. Agritourism is referred as “agriturismo” in Italy, “sleeping in the straw” in Switzerland, “farm stays” in New Zealand, and “farm holidays” in England, which concludes that agritourism is well established throughout Europe and in

many other countries (Beus, 2008). Extra income was the reason why farmers started these secondary activities, which provide more contact with people and also promote the agriculture sector. It can start with the making of a footpath on a farmer's land. The farmer will receive € 0.45 per meter for this path every year and perhaps more sponsors can be found for fences or other necessary materials. At the website (www.boerenlandpad.nl) of such an initiative, named the Walking Platform Foundation, there is no information about the risks of zoonoses for walkers in the pastures, where close contact with animals and their feces can be expected. A significant and popular business is Vekabo Nederland (VeKaBo Nederland, 2010). Here, over 1,600 different accommodations for recreation and camping in the countryside are available for visitors. Their website (<http://www.vekabo.nl/>) does not include any information about zoonoses, but there is a link to the Animal Health Service Deventer (GD), for more information. This is only one example of agritourism in the Netherlands, but searching the Internet you may find many possibilities and initiatives related to agritourism. At the moment 3 out of 100 farmers offer tourist activities (Heuvelink & Valkenburg, 2006). Farmers enjoy the work, but it is also time consuming and the income generated is relatively low (Siemes, 2004).

Figure 1. Number of farms with agritourism activities



Source: CBS (2009)

Figure 1 shows the total number of farms with agritourism in the Netherlands, according to the definition provided by the Central Office of Statistics in the Netherlands. Agritourism has increased by a total of 3.76 percent since 1999. The total number of farms in the Netherlands has decreased by 31.23 percent since 1999. From the latter, one can conclude that the 3.76 percent increase seen in agritourism is high. However, other supplementary activities such as nature preservation and care provision are also becoming increasingly popular among farmers and market gardeners.

This raises the question about the reasons for visitors to come to public farms, buy products and even bring their children. So what does bring people down to the farm? For some people Agritourism fulfills an idealized, often romanticized, perception of nature and social life at a farm. Many people today are busy and embrace the 18th century view of nature as pure and good in opposition to the moral decay and dehumanizing experiences of urban environments. "In the 1960s and 1970s, the countryside lost the physical but won the mental battle: the rural lifestyle is increasingly valued as a salve for people suffering the bruises of the urban lifestyle" (Koc, 2008). Therefore, people in the Netherlands want to visit farms in their leisure time and are willing to buy expensive products to give themselves a piece of the good country lifestyle. In contrast, another reason is the relatively low price of some direct farm products. This article provides an outline of the various sections of agritourism.

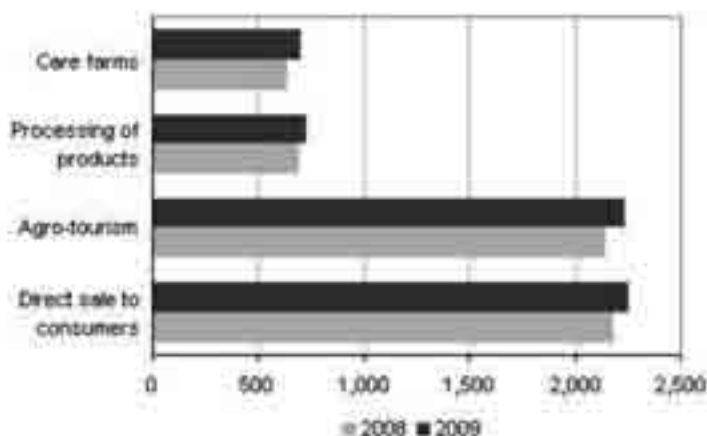
Care farms

A care farm is a farm where people with a care demand find valuable daily activities or work. These can be former alcohol and drug addicts, people with mental disabilities, the elderly and people in need of care. There are more than 700 care farms in the Netherlands. The number of care farms in 2009 has increased by 10 percent compared to 2008, as seen in Figure 2 (Reitsema & Pierik, 2009), and since 2003 the number of care farms has almost doubled.

Camp Sites

Farmers provide 45,000 camping locations, which correspond to 15% of the total camping sector (Heuvelink & Valkenburgh, 2006). A tourist in the Netherlands can choose among 2,250 farms to visit, which represents an increase of 4 percent compared to 2008.

Figure 2. Number of farms with diversified activities



Source: CBS

Home Sale Activities

Another option for farmers to supplement their incomes is direct selling and processing of agricultural products. In 2009 more than 2,250 farmers pursued home sale activities, which is 3% more than in 2008. Examples of these include cheese, jam, honey, flowers, potatoes, apples and flour. The number of farmers engaged in processing agricultural products has increased by 5 percent, up to 730.

Financial Results

Income from agritourism differs per farmer, but a farmer receives an income of between € 8,500 – 9,500 per year on average. Some incomes peak above € 50,000 per year. Tourists spend more than a quarter of a billion euro each year on agritourism (Siemes, 2004).

Zoonotic Diseases in Agritourism

Zoonotic diseases are infectious diseases of animals that can cause disease when transmitted to humans. *Zoonosis* and *zoonoses* are terms that encompass a variety of diseases, including toxoplasmosis and avian influenza, as well as a range of causative agents such as bacteria and viruses, to unconventional agents such as prions. “Zoonoses are not confined to a specific area but rather a global occurrence”

(Stirling et al., 2008). A comprehensive literature review identifies 868 species that cause zoonotic diseases; this represents 61% of the infectious organisms (Taylor et al., 2001). Zoonotic diseases, viruses and protozoa are twice more likely to be associated with emerging diseases compared with non-zoonotic diseases.

In the Netherlands different agencies are involved with zoonotic diseases. The Center for Infectious Disease Control from the National Institute of Public Health (RIVM) plays an important role in the prevention and control of infectious diseases. The RIVM receives its assignments from clients such as the Ministry of Health, Welfare and Sport (VWS), the Ministry of Agriculture, Nature and Public Health (LNV) and the EU.

In 2004 the RIVM published a zoonoses report that includes the following general outcome (Giessen et al., 2004). It is impossible to predict which zoonoses will emerge in the coming years. The emergence of zoonoses will often be the result of a complex mix of risk factors, in which the intensity of contact between animals and human beings seems to be crucial. Concerted action on a European level will be required in order to respond timely and effectively to zoonoses threatening public health in Europe. It is therefore concluded that zoonotic diseases are important and that prevention is necessary.

However, how many people in the Netherlands are infected with zoonotic diseases? This question is difficult to answer. The RIVM publishes diseases with the highest incidence.

In 2003 the incidence of infections from the lower respiratory and gastrointestinal tract was between 300,000 and 1,000,000 a year (Poos et al., 2009). There are a lot of factors responsible for zoonotic diseases, such as *Campylobacteriosis*, *Salmonellosis*, *E. coli* infections and the Q fever. How reliable are these numbers? People with mild symptoms will not seek medical help and these cases will not be reported. Only the cases (See Fig. 3) with significant symptoms, hospitalization or severe complications are reported. Therefore the agencies can only estimate the total zoonotic diseases in the Netherlands.

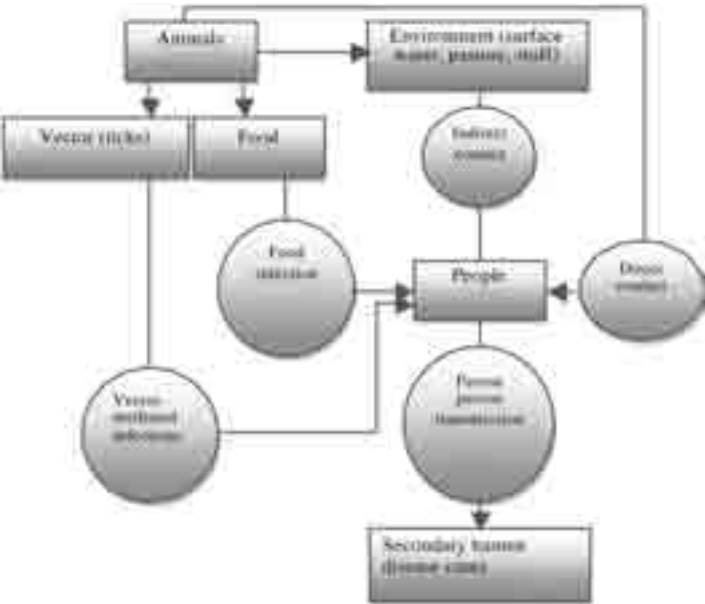
Different transmission routes by direct or indirect contact with animals can infect the visitors of agritourism, as seen in Figure 4. Zoonoses are not only acquired directly from animals, but also through environmental transmission. This means

that walking on a farm, swimming in a lake or a canal, can also cause zoonotic diseases. Consequently there are many possible transmission routes in agritourism. Many routes also means many possible zoonotic diseases.

Figure 3. The exact total number of zoonoses is unknown because of this pyramid structure. Only the cases in the top are reported



Figure 4. Different transmission routes of zoonoses



Extra risk factors for humans to get zoonoses are:

- Direct contact with infected animals
- Presence in an environment with contaminated manure
- Skin lesions
- Immunosuppression such as in Young, Old, Pregnant and Ill people (YOPI's)

All these factors may be found in agritourism. There are animals, there is manure, and many families with young children, pregnant mothers and grandparents who visit farms. An overview is presented in the appendix of all the potential zoonoses in agritourism in the Netherlands. These 32 zoonotic diseases do not contain possible unknown emerging diseases that can also be a risk for agritourism, although these tables do show the most important risks of zoonotic diseases from agritourism.

Risk Analysis

An article was published in 1995 about farm visits and zoonoses (Dawson, 1995). There were recent reports of outbreaks of gastrointestinal illness associated with public farms. The conclusion was that the risks of zoonotic diseases seem to be small but that the people at farms need to be alert to simple precautions in order to prevent infections. Much has changed since 1995, and as can be seen from previous sections of this paper, agritourism is at higher risk of zoonotic diseases. At the farms visitors have closer contact with animals, which is crucial for zoonotic diseases (Giessen et al., 2004). The question is, how much higher is that risk, and which zoonotic diseases need extra attention? The 32 zoonotic diseases described in the appendix are not equally important. The risk for a zoonosis can be estimated using the formula: risk = hazard x exposure x impact. Applying this risk analysis to the zoonotic diseases establishes the four with the highest risks for the veterinary public health in agritourism: *Escherichia coli* O157, Salmonellosis, Campylobacteriosis and at present also Q fever (Wijck, 2004). *E. coli*, *Salmonella* and *Campylobacter* are classic enteropathogens (Heuvelink & Valkenburgh, 2006) and most microbiological investigations on farms are related to these three zoonotic diseases. In 2001 a 'Code for hygiene at the children farms in the Netherlands' was published as a result of a 1.5 year old child, with a haemolytic-uraemic syndrome caused by infection with *E. coli* O157 (Heuvelink et al., 2002). This boy had visited a children's farm five days before he became ill.

Later investigation showed the presence of *E. Coli* at this farm, and the human and the animal isolates were indistinguishable by molecular sub typing. Results from this study and from other on-farm investigations highlighted the risk of acquiring severe zoonotic infections during visits to children's farms. The 'code for children farms' is a guideline for a structured hygiene system and an optimal business against all bacteria that can cause diseases in humans. The code helps to reduce the chances of visitors contracting a zoonotic disease, but next to the code there is also a role for visitors themselves, who need to follow the rules.

In 2002 the Food and Consumer Product Safety Authority (VWA) visited 132 children's farms to undertake an investigation about hygiene and hygiene facilities (Valkenburgh & Heuvelink, 2006). Hygiene was overall satisfactory, but certain points still needed to be improved. A microbiological investigation was carried out, revealing the presence of *E. coli*, *Salmonellosis* and *Campylobacteriosis* at 64.9 percent of children's farms (See Table 2). These results show that there is a real risk for zoonotic diseases at a children's farm. Unannounced visits were made in 2004 to 125 children's farms, and once again hygiene was generally good, but still not 100%, which is the goal of the code and an information board. The conclusion was that they are on the right track but that there needs to be a closer adherence to the code.

In 2003 the VWA visited 91 care farms and hygiene was good in 87% of these places (Heuvelink, & Valkenburgh, 2005). However, more than the half of these farms was positive for at least one of the three bacteria, as can be seen in Table 1.

Table 1. STEC 0157, Salmonellosis and Campylobacteriosis at child, care and camping farms in the Netherlands

Year	Farm	Number positives (%)			
		STEC 0157	Salmonellosis	Campylobacteriosis	Combinations
2002	Child farm	13 (10.2)	19 (14.5)	74 (56.5)	85 (64.9)
2003	Care farm	14 (15.4)	7 (7.7)	46 (50.5)	51 (56.0)
2004	Camping farm	10 (11.9)	2 (2.4)	30 (35.7)	38 (45.2)

Source: Heuvelink & Valkenburgh (2006)

In 2004, the VWA visited 84 camping farms. Hygiene was good in 92% of the cases, but the visits had been announced in advance. Forty-five point two percent (45.2 %) of the camping farms came out positive for one or more of the three bacteria. The report from this VWA project concluded the following:

The microbiological study confirms that there is a real risk of zoonoses when handling animals at a camping farm, care farm or children's farm. This underlines the importance of hygiene by farmers and all visitors. Information for farmers and recreationists about the chance of illness due to contact with (manure) animals plays an important role. The results ask for a general quality system for the camping farm based on the code for children farms possibly secured by a system of certification. The code for children farms is approximately 80% applicable for camping on farms. The VWA still recommend a specific hygiene code for the sectors in agritourism.

Relevant Zoonotic Diseases in the Agritourism

Salmonellosis

Salmonellosis is an infection caused by a bacterium called *Salmonella*. *Salmonella* germs have been known to cause illness for over 100 years. They were discovered by an American scientist named Salmon, after who they are named. It is one of the most common zoonoses and is found all around the world. Each year in the Netherlands there are an estimated 50,000 cases from *Salmonella*. Every year there are about 700-800 hospital visits and 52-64 deaths (Warris-Versteegen & Vlie, 2005). *Salmonella* live in the intestinal tracts of humans and other animals, including birds. *Salmonella* is usually transmitted to humans by eating contaminated food that usually looks and smells normal. This can be all foods of animal origin such as eggs, milk or poultry but also includes vegetables and other products affected by cross contamination. Another transmission route important for agritourism is through contact with animal feces, which occurs in 5 to 10% of all reported *Salmonella* cases. The *Salmonella enterica* bacterium may develop a carrier state in the host after primary challenge and such carriers typically excrete high levels of bacteria during recovery from enteric or systemic disease, often in the absence of clinical signs. In some cases, the carrier state may exist throughout the host's entire lifetime, so animals can be healthy carriers for a long time (Tomley & Shirley, 2009). Reptiles and birds, in particular, are often carriers

and show no clinical signs, as opposite to humans, who show different symptoms such as fever, diarrhea and abdominal cramps. These symptoms usually last from 4 to 7 days before recovery takes place. In 3 to 5% of the cases people develop complications, such as pneumonia, arthritis, sepsis and shock. The disease is mostly seen in YOPI's.

In order to prevent visitors of agritourism from contracting an infection with salmonellosis, the following guidelines should be observed: farmers who prepare food need to follow the general kitchen hygiene measures, including cooking poultry thoroughly and not serving any food with raw eggs or unpasteurized milk. Have a separate dirty and clean path for visitors in order to avoid contact with manure. It is important that visitors wash their hands with soap after handling animals or coming into contact with feces, especially before eating. Therefore, good washing facilities are necessary at convenient places. People tend to take more care at these facilities if information is given about the reason. Children should be warned not to put their hands in their mouth touching animals, or their environment, before washing them.

Campylobacteriosis

Campylobacteriosis, is an infectious disease caused by bacteria of the genus *Campylobacter*. The total estimated number of people with campylobacter infection in the Netherlands is of 80,000 a year (Havelaar et al., 2005), 18,000 of which visit a general practitioner. There are also 600 hospital admissions and 30 patients die, mainly elderly. The cost due to this disease is estimated at 21 million euro's per year. The most cases are seen during the summer and by children (<5 years) and young adults (18-29 years). Nevertheless, it can be concluded that direct contact with infected animals and consumption of unheated foods (vegetables, fruit, raw fish and unpasteurized milk) are the most significant transmission routes. *Campylobacter* is a normal gut habitant amongst different animals. Adult animals are usually healthy carriers, but young animals can get diarrhea, sometimes with fever. There are people who show no symptoms but most people infected with Campylobacteriosis become ill. The symptoms are diarrhea (bloody), cramping, abdominal pain and fever, for around one week. Some people develop sepsis when *Campylobacter* spreads to the bloodstream. The incubation period is usually 3 days but can be take from one to seven days. Sometimes *Campylobacter* infection even

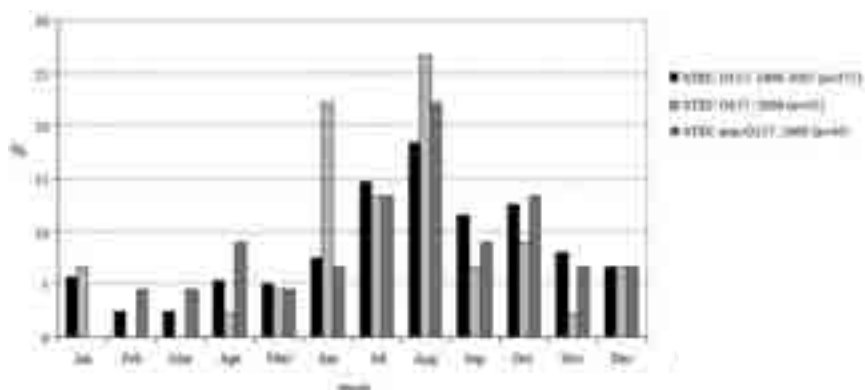
results in long-term consequences such as arthritis and Guillain-Barré syndrome, both diseases involving the immune system.

The transmission routes from *Campylobacteriosis* and *Salmonellosis* are similar, so the prevention measures adopted for *Salmonellosis* are often also effective in limiting *Campylobacteriosis*.

Escherichia coli 0157

Escherichia coli is a group of bacteria. Most strains of *E. coli* are harmless and it is one of the main inhabitants of the intestinal tract of most mammalian species, including humans, and birds. However, *E. coli* can cause diarrhea and other illnesses because of the 'Shiga toxin producing' (STEC), which is also called Verocytotoxin *E. coli* (VTEC) or enterohemorrhagic *E. coli* (EHEC). The disease is also called the 'hamburger disease' because of transmission by eating improperly heated burgers. The most commonly identified STEC is *E. coli* O157:H7 and, when referring to infections, they are usually talking about this one. However, non-O157 zoonotic strains are increasing and were probably underestimated, as they had been less well characterized and are more difficult to detect in samples than O157:H7 (Fairbrother & Nadeau, 2006). In the Netherlands the intensive surveillance was extended with STEC non-O157 in 2007. The results of this surveillance are presented in the RIVM bulletin from February 2010 (Friesema et al. 2010). Forty-five (45) cases were diagnosed with STEC 0157 in 2008 and 45 with non-O157 STEC. Forty-seven percent (47%) of these cases were hospitalized (32-54% in previous years) and 11% developed the haemolyticuraemic syndrome (HUS) (8-21% in previous years). Fourteen percent (14%) of the STEC non-O157 cases were hospitalized and none developed HUS. Eighty-six percent (86%) of the non-O157 cases who were younger than 10 had contact with animals or their manure. Based upon laboratories using PCR, it was estimated that the actual number of STEC non-O157 infections in the Netherlands is about 3.5 times higher than the reported number. Figure 5 shows clearly that most cases are reported during the summer months (this was also described earlier for the *Campylobacteriosis* bacteria). Probable explanations are barbecues, the climate and more farm, animal and holiday visits. Agritourism mainly takes place during the summer months.

Figure 5. Percentage of patients per month for STEC O157 (1999–2007 and 2008) and STEC non-O157 (2008), exclusive the STEC O157-patients from the explosions in 2005 and 2007



Source: infectieziekten bulletin RIVM february 2010

Ruminants and especially cattle are the most important reservoirs of zoonotic *E. coli*. STEC that cause human illness generally do not make animals sick, cattle are healthy carriers. The bacteria are transmitted to humans through the ingestion of contaminated foods or water, or through direct contact with the infected animals or their environment. Risk factors that have been identified for infection of animals with O157 include age, weaning, movement of the animals, season, feed composition, and the ability of the bacteria to persist in the environment. Humans have different symptoms of STEC infections but often include severe stomach cramps, diarrhea (often bloody), vomiting and fever (usually not very high). Most people recover within a week but patients diagnosed with STEC infection have a 5-10% chance of developing a potentially life-threatening complication known as the hemolytic uremic syndrome (HUS). Most people who develop HUS recover within a few weeks, but some suffer permanent damage or die. The incubation period is usually 3-4 days after exposure but can also be after 1 or up to 10 days.

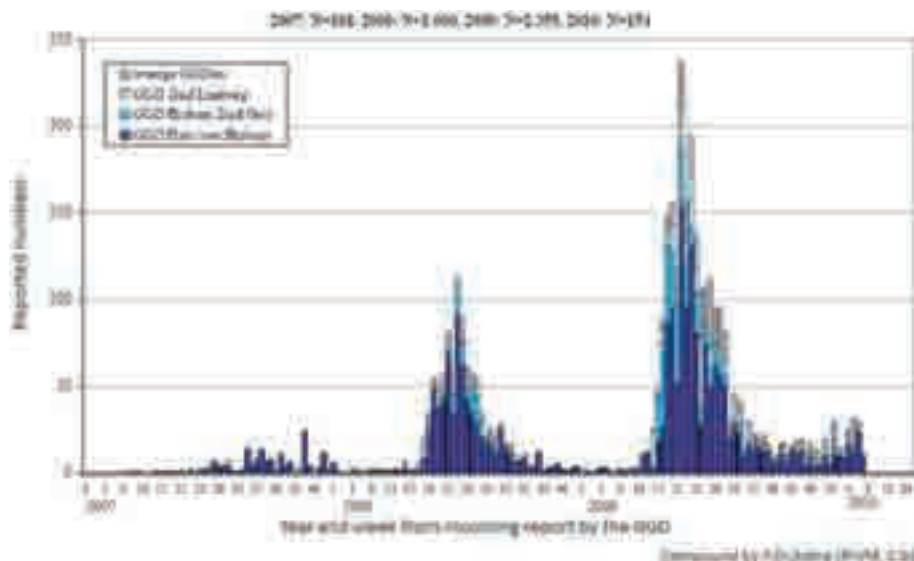
The same prevention measures described for earlier Salmonellosis are effective for these bacteria but there are also other prevention options. Cattle are the most important reservoir of these zoonoses, so children under the age of 5 years old should be extra cautious around cattle because they are more sensitive. When visitors at the farm come into contact with cattle, it is important that they are free from *E. coli* O157:H7. Farmers can test the cattle before buying for O157:H7 and

if they have it, remove it from the public farm. Unfortunately, diagnosing cattle is not an easy task because *E. coli* O157 is shed sporadically, and more tests become necessary after several days or even weeks. Additionally, diagnostic tests for *E. coli* O157 of cattle feces can be quite expensive and time consuming (Callaway et al, 2004). Another possible strategy is probacterials; probiotics are defined as commensal bacteria used to reduce pathogenic bacteria. Probiotics in general have not always been widely used because of the lack of real results. Due to increased concerns about antimicrobial resistance it is expected that the use of probiotics will increase in the future (Zhao et al, 2003). Refreshing is important in order to avoid decreasing opportunities for pathogens to multiply in food and water.

Q fever

The Q fever is a zoonotic disease caused by the *Coxiella burnetti* bacterium. The cause of the disease was unknown until 1937 which explains the name: Q stands for query. Cases of *C. burnetti* are found worldwide and have been in the Netherlands for many years. The *C. burnetti* bacterium has a high resistance against physical and chemical influences, including disinfectant. Until 2007 there were annually 10 to 20 cases reported (Roest et al., 2009) and Q fever was seen as an occupational disease for veterinarians, farmers and slaughterhouse staff. An investigation by Richardus in 1987 showed that 87% of veterinarians were positive for *C. burnetti* (Houwers & Richardus, 1987). During this investigation from 1968 to 1983 there had been no increase in the percentage of infected people. Q fever has been endemic in The Netherlands for a long time (Richardus et al., 1987). In 2007 there was a difference, where 191 cases of Q fever were reported, especially from the Nord-Brabant Province, around Herpen Village. The disease is reported in the newspapers as a mysterious epidemic, whereby 80 residents in Brabant are infected, during the months of May and June. About three months later the RIVM confirmed that it is indeed Q fever. The RIVM started an investigation into residents on Wednesday, September 12th (Roes, 2010). In the years from 2007 and until this moment, March 2010, there have been more and more reported cases of Q fever, as seen in Figure 6. At the end of 2008 there were 906 confirmed cases, making it the biggest documented epidemic of Q fever in the world (Roest, 2009).

Figure 6. Number of patients reported with Q fever within the week of the receiving notification by the Public Health Service (GGD), period 1.1.2007 to 17.2.2010



There are also comments about the numbers from Figure 5. During a presentation at the University of Veterinary Medicine in January 2010, F. Knapen, Professor of Veterinary Public Health at Utrecht, stated that ever since the reported cases in 2007 everyone was alerted to the disease Q fever. The cases from 2007 are probably related to the increasing size of dairy goat farms. Patients before 2007 with the same clinical signs were not reported or investigated for Q fever, whereas now they are. The question is whether the numbers from 2008 and 2009 went up because of the increasing bacteria or due to the increasingly alerted people. The authorities took measures for the Q fever outbreak such as a cull of animals at infected commercial goat farms. No culling took place at children's farms, which were obliged to vaccinate the animals.

The most important reservoirs from Q fever are goats, sheep and cows, but the bacteria can be found in the whole environment and many animals, including insects. Infected animals are usually healthy carriers. Since 2005 it has been observed that dairy goat and sheep farms in the Netherlands have abortions due to a *Coxiella burnetii* infection. During an abortion or birth the infected placenta

and the amniotic can infect the environment. The bacteria can also infect the environment through the urine and feces of infected animals. The most people affected in the Netherlands are infected by inhalation of contaminated fine dust particles from infected goat farms. About 60% of the infected humans show no clinical signs of illness. A thirty (30%) of people have fever, headaches, general malaise, confusion, sore throat, chills, sweats, non-productive cough, nausea, vomiting, diarrhea, abdominal pain, and/or chest pain. If the disease goes untreated it can become chronic but usually it passes. Complications, such as pneumonia, hepatitis and endocarditis can occur in 10% of all infected animals. Chance of death is less than 1 percent even without treatment. Treatment with antibiotics is usually effective. The incubation period of the disease is usually from two to three weeks, depending on the number of organisms that initially infect the patient.

Q fever has not yet been investigated with regards to the agritourism environment. However, and as previously described, the bacteria can be everywhere in this environment and an epidemic is present in the Netherlands. The impact of Q fever is high and Q fever reports occur in many newspapers. The RIVM has reported an outbreak of 2,293 human cases in 2009, including 6 deaths. Still, the disease was considered important in the past and is described in 2001 as a disease in the top five from attention asked infections at the children farm.

C.Burnotti can be mineralized in order to prevent infections from the Q fever, but the bacteria cannot be totally removed. Prevention measures for farmers of agritourism are vaccination, separation of animals that give birth and appropriate disposal of placenta, birth products, fetal membranes, and aborted fetuses. If goats abort it is wise to keep the animals 'far' away from visitors.

Discussion

Many risks of zoonotic diseases have been described and a lot of reviews from experts can be found. The diagnostic methods are improving and our knowledge of zoonotic diseases is increasing. Compared to the decreasing number of farmers in the Netherlands, the percentage of farmers involved with agritourism is increasing. Humans are often in close proximity to animals during the holidays, or other activities which seem to be harmless, but which do carry the risk of disease. Agritourism involves many extra risk factors, including YOPI's, direct contact with animals and manure, as well as consumption of farm products. Therefore,

zoonotic diseases become an increased risk and a reaction is inevitable. The Food and Consumer Product Safety Authority (Heuvelink et al., 2007) carried out microbiological investigations confirming that zoonotic diseases are often present. This emphasizes the importance of strict adherence to hygiene measures by both workers and visitors on farms in The Netherlands. Bacteria such as *E. Coli*, Campylobacteriosis and Salmonellosis are found to be present at public farms and are three of the highest risk zoonotic diseases in agritourism. At the farms not only bacteria but also viral, endoparasitic, fungal and arthropod zoonotic diseases, constitute a risk to health. The tables in the Appendix included in this paper are all possible zoonotic diseases in agritourism as described in Northern Europe. Q fever is the fourth high risk zoonotic disease in agritourism, a bacterium that has always been present in the Netherlands and that will remain there. Today there are still many consequences brought by Q fever. In 2005/2006 the Animal Health Service Deventer (GD) released a warning about the *C. burnetti* bacterium, but there were other priorities and no research funds available at the time. Measures have been taken due to the serious cases of Q fever in the last three years and its heightened impact. Some people, even experts like Mr.F.Knapen (professor of Veterinary Public Health in Utrecht), see some measures as a reaction to 'hysteria'. Political decisions have been made which could have been avoided otherwise. Another example is that of children's farms, as described in the 'code for children farms' instigated after a serious case of *E. coli* O157. The conclusion drawn is that measures are only taken after the occurrence of serious cases with serious consequences.

Not all people see hygiene protocols such as the "code of children farms" for prevention of zoonotic diseases as necessary. The hygiene hypothesis, for example, goes against it. "This hypothesis suggests that in the modern world, children's immune systems have a lack of external signals in their environment, which can cause a 'cytokine dysbalance', resulting in allergies" (Steenenbergh et al., 2002). In 2006 the PARSIFAL (Prevention of Allergy - Risk factors for Sensitization In children related to Farming and Anthroposophic Lifestyle) showed that the prevalence of atopic disease was up to 50% lower among farm children (Schram-Bijkerk, 2006). The protective factors from farm life were consumption of unpasteurized milk, pregnant mother working at the farm and the higher dust and microbial agent levels. However, a reaction to the hypothesis is that there has been no study of the natural selection of these farmers. One reason for the low prevalence is that only strong farmers survived. Could it also be that more and

more children now suffer from asthma or is the increased diagnosis a result of more and improved research into this disease? Epidemiological studies suggest the relationship between allergic diseases and infections in childhood, but there are also several well-conducted studies that do not support this relationship. A paper published in 2009 states that the term hygiene hypothesis is misleading and that a better term would be ‘microbial deprivation hypothesis’ (Bjorksten, 2009). In this article epidemiological, clinical and animal studies are taken together, which suggest that broad exposure to a wealth of commensal, non-pathogenic microorganisms early in life are associated with protection. “This has little relationship with ‘hygiene’ in the usual meaning of the word”, notes the article.

In 2007 the European Commission introduced a new strategy for animal health in the European Union. Under the motto “*prevention is better than cure*” the union wants to promote prevention, science, innovation, research etcetera (EU, 2007). No serious cases have yet been found in agritourism but there are no measures for prevention. With the current knowledge of all existing zoonotic diseases, and possible emerging zoonotic diseases which can occur in agritourism, it would be wise to further investigate prevention. The code for children’s farms can be taken as a guideline for the hygiene measures in agritourism and would cover it for about 80 percent. However, experts advised in 2006 that a code specifically for agritourism is required (Heuvelink & Valkenburgh, 2008). Reasons for this are the differences between children’s farms and farms in agritourism, notably the duration of stay, the number of animals and the form of contact with animals. The code for agritourism hygiene needs to be detailed and applicable to all public farmers. The code would include such general hygiene measures as a visitor information board with a warning and explanation about zoonotic diseases. Other prevention measures would be good hand washing facilities, keeping animals separated from eating and drinking areas, good hygiene practices regarding manure (for example rapid removal) and keeping animals that have given birth separately. Information for the farmer and visitor plays a very important role. When the reasons for the hygiene measures and the risk of zoonotic diseases are better understood, people and farmers will be more inclined to follow the hygiene measures.

References

- Acha, P. & Szyfres, B. *Zoonosis y enfermedades transmisibles comunes al hombre y a los animales*. Washington: Organización Panamericana de la Salud, 2003. Impreso.
- Beus, C. E. *Agritourism: Cultivating Tourists on the Farm*. Washington: State University Extension, 2008: 1-32. Report number: eb2020. Impreso.
- Bjorksten, B. "The hygiene hypothesis: do we still believe in it?". *Nestle Nutr Workshop Ser Pediatr Program* 64 (2009): 11-8. Impreso.
- Callaway, T. R. et al. "What are we doing about *Escherichia coli* O157: H7 in cattle?" *Journal of Animal Science* 82 (2004): 93-99. Impreso.
- Centraal Bureau voor de Statistiek. Landbouw; bedrijven met verbreding, naar hoofdbedrijfstype en regio. Statline, 12-3-2010 (CBS, 2009).
- Dawson, A.; Griffin, R.; Fleetwood, A. & Barrett, N. J. "Farm visits and zoonoses". *Communicable Disease Report CDR Review* 5 (1995): R81-6. Impreso.
- European Centre for Disease Prevention and Control, European Food Safety Agency, European Medicines Agency. *Joint scientific report of ECDC, EFSA and EMEA on meticillin resistant *Staphylococcus aureus* (MRSA) in livestock, companion animals and foods*. Report Number: EFSA-Q-2009-00612, (2009): 1-10.
- Europese Commissie. "Nieuwe strategie voor diergezondheid voor de Europese Unie (2007-2013): Voorkomen is beter dan genezen". Report number: 13292/07 (2007).
- Fairbrother, J. M. & Nadeau, E. "Escherichia coli: on-farm contamination of animals". *Revue Scientifique et Technique* 25 (2006): 555-569. Impreso.
- Friesema, I. H. M. et al. "Intensieve surveillance van Shiga-toxineproducerende *Escherichia coli* (STEC) in Nederland, 2008". *Infectieziekten bulletin* 21 (2010): 12-18. Impreso.
- Giessen, J. W. B. V. D.; Isken, I. D. & Tiemersma, E. W. *Zoonoses in Europe: a risk to public health*. Report number: 330200002/2004, (2004): 112.
- Havelaar, A. H. et al. *Kosten en baten van *Campylobacter* bestrijding in Nederland*. Report Number: 250911008, (2005): 2-51.
- Heuvelink, A. E. & Valkenburgh, S. M. *Kampeerboerderijen. Hygiëne en zoönoseverwekkers*. Report number: OT 04L001-6A. (2006).
- Heuvelink, A. E. & Valkenburgh, S. M. *Zorgboerderijen: Hygiëne en zoönoseverwekkers*. Report number: OT03L001 (2005).
- Heuvelink, A. E. et al. "Escherichia coli O157 infection associated with a petting zoo". *Epidemiology and Infection* 129 (2002): 295-302. Impreso.

Heuvelink, A. E. et al. "Public farms: hygiene and zoonotic agents". *Epidemiology and Infection* 135 (2007): 1174-1183. Impreso.

Houwers, D. J. & Richardus, J. H. "Infections with *Coxiella burnetii* in man and animals in The Netherlands". *Zentralblatt für Bakteriologie, Mikrobiologie und Hygiene, Series A* 267 (1987): 30-36. Impreso.

Koc, E. "The New Agritourism: Hosting Community & Tourists on Your farm". *Annals of Tourism Research* 35.4 (2008). Impreso.

Pedro, N. & Szyfres, B. *Zoonoses and Communicable Diseases Common to Man and Animals*. Washington, DC: Pan American Health Organization, 2003. Impreso.

Poos, M. J. J. C. & Gommer, A. M. *Ziekten en aandoeningen: Welke ziekten hebben de hoogste incidentie? Volksgezondheid Toekomst Verkenning, Nationaal Kompas Volksgezondheid*, 2009. Impreso.

Reitsema, M. & Pierik, C. *Meer landbouwbedrijven met inkomsten uit verbredingsactiviteiten*. Webmagazine (2009). Impreso.

Richardus, J. H. et al. "Q fever in the Netherlands: a sero-epidemiological survey among human population groups from 1968 to 1983". *Epidemiol Infect* 98 (1987): 211-219. Impreso.

Roes, J. Start onderzoek Q-koorts Herpen. *Brabants Dagblad* (2010).

Roest, H. J. et al. "Q-koorts in 2008 in Nederland en de verwachting voor 2009". *Tijdschrift voor diergeneeskunde* 134.7 (2009): 300-303. Impreso.

Schram-Bijkerk, H. E. "De hygiënehypothese-zijn allergie en astma de keerzijde van de infectieziektebestrijding?" *Infectieziekten Bulletin* (2006). Impreso.

Siemes, H. "Toeristen komen graag". *Boerderij* (junio 2004): 4-7. Impreso.

Steenenbergh, P. A.; Loveren, H. V. & Amsterdam, J. G. C. V. "De hygiëne-hypothese: zin of onzin". *Ned Tijdschr Allergie* (2002): 56-62. Impreso.

Stirling, J. et al. "Zoonoses associated with petting farms and open zoos". *Vector-Borne and Zoonotic Diseases* 8.1 (2008): 85-92. Impreso.

Taylor, L. H. Latham, S. M. & Woolhouse, M. E. "Risk factors for human disease emergence". *Philosophical Transactions of the Royal Society B: Biological Sciences* 356 (2001): 983-989. Impreso.

Taylor, M. A. Coop, R. L. & Wall, R. L. *Veterinary Parasitology*. Philadelphia: Blackwell Publishing, 2007. Impreso.

Tomley, F. M. & Shirley, M. W. "Livestock infectious diseases and zoonoses". *Philosophical Transactions of the Royal Society B: Biological Sciences* 364 (2009): 2637-2642. Impreso.

Valkenburgh, S. M. & Heuvelink, A. E. “Kinderboerderijen in Nederland, hygiëne en zoönoseverwekkers”. *Tijdschrift van diergeneeskunde* 131 (2006): 224-227. Impreso.

VeKaBo Nederland. *Kamperen op het platteland ver kabo 2010*. (2010).

Waddell, L. et al. “The Methodological Soundness of Literature Reviews Addressing Three Potential Zoonotic Public Health Issues”. *Zoonoses and Public Health* 56.9-10 (2009): 477-89. Impreso.

Warris-Versteegen, A. A. & Vlie, J. A. V. “De naoorlogse geschiedenis van salmonellose anders dan (para) tyfus in Nederland”. *Infectieziekten bulletin* 16.5 (2005): 176-179. Impreso.

Wijck, F. V. “Zoönosen als gezondheidsrisico. Kennisindeling tussen artsen en dierenartsen”. *Landbouwhuisdieren* (2004): 59-69. Impreso.

Zhao, T. et al. “Pathogenicity of enterohemorrhagic *Escherichia coli* in neonatal calves and evaluation of fecal shedding by treatment with probiotic *Escherichia coli*”. *Journal of Food Protection* 66 (2003): 924-30. Impreso.

Appendix

Table 2. Bacterial zoonotic diseases in Nord Europe

I. Zoonotic Diseases

Bacteria	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Anthrax	<i>Bacillus anthracis</i>	Cattle, sheep, goats, horses, wild herbivore	Food, inhalation or contact	Ulcerative skin lesions, pneumonia, sepsis, dead	Difficulties in breathing, sudden death	Extremely rare	Yes (group C)
Borreliosis (Lyme disease)	<i>Borrelia burgdorferi</i>	Rodents; deer, cattle, sheep, dog, cat, horse	Tick bite	Red spot at bite wound, general malaise, fever to sepsis (heart, arthritis, neurologic)	Dog fever and recurrent lameness; cat general malaise, horse lameness and behavioral changes	Prevalence is increasing, 17,000 patients in 2005	No
Botulism	<i>Clostridium botulinum</i>	Domestic and wild animals	Foodborne; occasionally wound contaminant	Vision problems, difficulty to swallow, talk, paralysis	limp tongue, swallowing problems and paralysis	Common presence, but rarely disease	No
Brucellosis (Bang's disease)	<i>Brucella</i>	Cattle, sheep, goat, pig, dog	Food, inhalation or contact	Fever, often sub acute and undulant to sepsis	Abortion, lameness, mastitis	Not present since August 1999; import disease	Yes (group C)
Campylobacteriosis	<i>Campylobacter jejuni</i>	Cattle, swine, poultry, dog, cat, wild bird	Mainly food borne (milk), contact with infected animals, water borne, or occupational	Diarrhea, enteritis, arthritis, sepsis	Young animal diarrhea, sometimes with fever.	Approximately 100,000 cases of enteritis and diarrhea per year. A few dozen mortality cases	No

Bacteria	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Cat scratch disease	<i>Bartonella henselae</i>	Cat	Scratches, bites, licking wounds	Lymphadenopathy to sepsis, skin lesions, fever, mortality (rare)	Cats are asymptomatic carriers of the bacteria	At least 300 to 1000 clinical cases per year	No
Erysipeloid	<i>Erysipelothrix rhusiopathiae</i>	All animals	Occupational, recreational exposure. Usually by skin contact	Skin itching and swelling, lymphadenopathy, light fever, arthritis	Acutely ill, high fever, decreased appetite, typical brick-shaped skin patches, sepsis, breathing difficulties, diarrhea, acute mortality	Non-vaccinated pigs may be diseased. Human cases esp. in meat (butcher, slaughterhouse) and fish industry	No
Hamburger disease	<i>Escherichia coli</i> O157	Cattle and sheep	Ingestion of undercooked beef, or water contaminated with bovine feces	Diarrhea, enteritis, hemolytic uremic syndrome	Cattle healthy carriers	At slaughter 10% cattle and 4% sheep infected	Yes (group B2)
Leptospirosis	<i>Leptospira</i> spp.	Rodents, dog, pig, cattle, wild animals	Occupational and recreational exposure: water- and food borne, contact with infected urine	Fever, rash, pneumonia, meningitis, hepatic and renal failure	Vomiting, diarrhea, nervous symptoms, haematuria	30 human cases per year. Approximately one third acquired during holidays	No
Listeriosis	<i>Listeria monocytogenes</i>	Mammals, birds	Undercooked milk, cheese, mud, water, vegetables	Enteritis, meningitis, sepsis, fetal infection	Meningitis, abortion, sepsis. Esp. goats and sheep mortality from 30 percent	80 human cases per year	Yes (group C)

(Cont.)

Bacteria	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
MRSA	<i>Methicillin-Resistant Staphylococcus aureus</i>	Humans and animals. Including dog, cat, horse, poultry, cattle and pig	Direct contact, airborne or through indirect contact by environment	Skin infections; cellulites, boils, abscesses. If spread; fever, low blood pressure, headaches, shortness of breath. Mortality rate 4%–23%	No symptoms. Sometimes red, crusty lesions.	Annually in the hospitals of the Netherlands approximately 1500 infected people. Estimated 40% is from the MRSA livestock type.	Yes (group C)
Psittacosis	<i>Chlamydia psittaci</i>	Wild and domesticated birds	Exposure to aerosol	Pneumonia, sepsis	No clinical signs or less active, loss of appetite, dehydration, eye and nasal mucosa inflammation, acute mortality	Thirty human cases per year	Yes (group C)
Q fever	<i>Coxiella burnetii</i>	sheep, cattle, goat, cat, dog, rodents, other mammals birds, ticks	Mainly airborne; placenta contact, animal excreta; occasionally tick bites, and milk	No signs, fever, pneumonia, hepatitis, endocarditis	Usually symptom free or abortion	Q fever outbreaks since 2006; more than 2000 patients, mortality of 6	Yes (group C)

Bacteria	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Salmonellosis	<i>Salmonella</i>	Almost all domestic and wild animals, birds and reptiles	Food borne (meat, eggs), contact with infected animals (reptiles)	Fever, diarrhea, abdominal cramps, 3 to 5% of the cases have complications, such as pneumonia, arthritis, sepsis and shock	Usually symptom free. Sometimes diarrhea, abortion, fever and complications	Most common zoonosis worldwide. 50,000 reported cases per year	No
Tuberculosis	<i>Mycobacterium bovis</i>	Cattle, occasionally sheep and other ruminants	Undercooked milk, inhalation	Lethargy, emaciation, fever, hemoptysis, back pain, chronic intermittent diarrhea	Lymphadenopathy in the throat, coughing, snoring, bloat	Not present since small outbreak in 1999	Yes (group B1)

Source: eCDC, 2009, Koc, 2008, Hewelink, A, 2002, Havelaar, 2005, Callaway, 2004

Table 3. Fungal zoonotic diseases in the Netherlands

Fungi	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Dermatophytosis (ringworm)	<i>Microsporum</i> spp., <i>Trichophyton</i> spp., <i>Epidermophyton</i> spp.	Dog, cat, cattle, horse rodents, rabbit, other animals	Direct contact with infected animals or materials	Skin and hair lesions, typical red ringworm spots are red, round and grow	Ringworm spots, red, round, hair loss, crusts	Common zoonosis	No

Source: Wijck, F, 2004

Table 4. Endoparasitic Diseases in Nord Europe

Endoparasites	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Ascariidose	<i>Ascaris suum</i>	Pig, wild boar, rarely sheep, cattle	Ingestion eggs (contact with infected soil)	Usually no signs. Sometimes liver problems, coughing and asthmatic symptoms	Usually no signs, some growth disturbances and coughing	Apr. 4% pig livers with 'white spots' at slaughterhouse	No
Cryptosporidiosis	<i>Cryptosporidium</i>	Cattle, human	water borne (surface)	Abdominal cramps, (watery) diarrhea, enteritis	Young animals: heavy, yellow or green watery diarrhea, weight loss	Apr. 2.000 cases of gastrointestinal complaints per one million inhabitants	No
Echinococcosis	<i>Echinococcus granulosus</i> , <i>Echinococcus multilocularis</i>	Dog, fox, sheep, cattle, swine, rodent, deer, moose	Ingestion of tapeworm eggs	Cause space-occupying lesions of organs, e.g. lung, liver, kidney, rarely CNS	No signs or vague complaints	The number of infected foxes is increasing. E. granulosus is very rare	No
Fascioliasis	<i>Fasciola hepatica</i>	Cattle, sheep, other large ruminants	Ingestion of contaminated greens, e.g. watercress	Fever, abdominal pain, weight loss and jaundice	Chronic weight loss, anemia, edema and diarrhea. Young animals: acute mortality	In moist areas present	No

Endoparasites	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Leishmaniasis	<i>Leishmania donovani</i> and other species	Wild canid, dog	Bite of infected phlebotomine sandflies	Ulcers, fever, hepatosplenomegaly, pancytopenia	Weight loss, hair loss around the eyes, burgeoning of the nails, fever, hepatosplenomegaly and pancytopenia.	Not present in the Netherlands. Import disease	No
Swimmer's itch	<i>Schistosoma cercariae</i> , <i>Trichobilharzia</i>	Birds, mammals	Penetration of the intact skin by cercariae from infected snails in fresh and saltwater	Self-limiting urticaria	Usually no signs, sometime growth disturbances and diarrhea	Areas with fowls. After swimming in surface water	No
Taeniasis	<i>Taenia saginata</i> , <i>Taenia solium</i>	Cattle, swine	Ingestion of undercooked meat containing larvae	Proglottides shedded in feces, eye inflammation, meningitis	Usually no clinical signs.	<i>T. saginata</i> present; <i>T. solium</i> not present	No
Toxocarosis	<i>Toxocara canis</i> , <i>Toxocara cati</i>	Dog, cat	Ingestion of embryonated eggs from environment (soil).	Nausea, abdominal pain, coughing, fever, ocular larva migrans, epileptic seizures	Adult animals usually no signs. Young animals diarrhea, distended belly, coughing, pneumonia, dead	19 percent of the Dutch population has positive <i>Toxocara</i> serology. Infective eggs in sandpits and parcs	No

(Cont.)

Endoparasites	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Toxoplasmosis	<i>Toxoplasma gondii</i>	Cats are final host. All other animals can be infected	Ingestion of embryonated oocysts from feces (soil gardening), undercooked meat or milk	No signs, fever, lymphadenopathy, brain abscess, infection of fetus with severe damage central nervous system	Usually no symptoms; kittens sometimes eye inflammation and fever	Appr. 40 percent positive Toxoplasma serology	No
Trichinosis (Trichinellosis)	<i>Trichinella spiralis</i>	Swine, rodent, bear, horse, wild carnivores, marine mammals	Ingestion of pork and flesh of wild animals containing viable cysts	Gastroenteritis followed by fever, severe myalgia, facial swelling; CNS or myocardial involvement may follow	Pigs asymptomatic	Since 1926 is the Dutch pig population free from <i>Trichinella spiralis</i> . Wild animals may have trichinellosis.	No

Source: Taylor et al., 2007

Table 5. Arthropod Zoonotic Diseases in Nord Europe

Arthropods	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Acariasis	Mites of <i>Sarcoptes Cheyletiella, Demanyssus, Ornithonyssus</i> spp.	Domestic animals	Contact with infected individuals animals, or materials	Itchy skin lesions (self-limiting)	Itching, red bumps, bald spots and a dusty coat	Common disease for persons in close contact with animals	No

Source: Taylor et al., 2007

Table 6. Viral Zoonotic Diseases in Nord Europe

Viruses	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Avian influenza (bird fever)	<i>Virus H5N1</i>	(Wild) Birds, pigs, cat	Close contact with infected animals or their feces	Mild flu symptoms, mild eye inflammation, coughing, high fever, pneumonia, dead	Sudden death without clinical signs, respiratory problems, diarrhea, anorexia	Not present	Yes (group B1)
Central European tick borne encephalitis	<i>Flavivirus</i>	Rodent, hedgehogs, bird, goat, sheep, cattle	Tick bites or ingestion of infected undercooked milk or cheese	Biphasic illness with fever, encephalitis, paralysis, neuropsychiatric symptoms	Usually no signs	Not present in the Netherlands. Present in Germany, Austria, Sweden, Finland, Norway, Croatia, Slovenia and Hungary	No

(cont.)

Viruses	Name causative organism	Principal animals involved	Contamination source & route of transmission to the human	Clinical manifestation in the human	Clinical manifestation in the animal	Distribution and frequency in the Netherlands	Reportable human disease
Contagious ecthyma	<i>Orf virus (parapox)</i>	Sheep, goat, wild ungulates	Contact with infected animals or material	Papule(s) that umbilicate and ulcerate, usually on hands and arms; dissemination rare	Bumps, pimples, blisters, crusty spot around mouth, eyelids and around the external genitalia. Eat problems	Each sheep or goat	No
Hantaviral diseases	<i>Bunya viruses</i>	Rodents	Aerosols from rodent excretions and secretions	More or less severe renal disease	No sickness	Increasing (27 cases in 2007)	Yes (group C)
Rabies and rabies-related infections	<i>Lyssaviruses Rabies virus Duvenhage virus Mokola virus Ibadan shrew virus</i>	Wild and domestic canids, mustelidae, viverridae, vampire and insectivorous bats	Bites of diseased animals; aerosols in closed environments	Paresthesia or pain at bite site, fever, myalgia, mood changes, progress to hyperventilation, general paresthesia, paresis, seizures, hydrophobia; mortality > 99%	aggressive behavior, isolate from herd, paralysis, high mortality	Since vaccination in 1992 is the Not present in domestic and wild animals. Only bats carrying the virus	Yes (group B1)

Source: Wijck, 2004; Tomley, F. M. & Shirley, 2009