Rural Environment and Zoonoses: An update

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School of Veterinary Medicine,
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**ZOONOSES and the RISK of DISEASE EMERGENCE**


<table>
<thead>
<tr>
<th>Infectious Organisms</th>
<th>Human Pathogens (N=1415)</th>
<th>Zoonoses (N=868)</th>
<th>Emerging Pathogens (N=175)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses/Prions</td>
<td>217 (15%)</td>
<td>165 (19%)</td>
<td>77 (44%)</td>
</tr>
<tr>
<td>Bacteria/Rickettsia</td>
<td>538 (38%)</td>
<td>269 (31%)</td>
<td>52 (30%)</td>
</tr>
<tr>
<td>Fungi</td>
<td>307 (22%)</td>
<td>113 (13%)</td>
<td>16 (9%)</td>
</tr>
<tr>
<td>Helminths</td>
<td>287 (20%)</td>
<td>278 (32%)</td>
<td>10 (6%)</td>
</tr>
<tr>
<td>Protozoa</td>
<td>66 (5%)</td>
<td>43 (5%)</td>
<td>19 (11%)</td>
</tr>
</tbody>
</table>

* 61% of the human pathogens are zoonotic and 12% are emerging pathogens. 75% (132/175) of the emerging pathogens are zoonotic. Overall, zoonotic pathogens are twice as likely to be associated with emerging diseases than non-zoonotic ones.

All but one of classified category A biological agents for bioterrorism and most of category B are zoonoses.
Emerging Infections: Economic Development and Land Use

Epidemics of Emerging Diseases, 1996–2003

- Cholera
- E. coli O157
- Multidrug-resistant Salmonella
- BSE
- nvCJD
- Cholera 0139
- Legionellosis
- Typhoid
- Malaria
- Dengue hemorrhagic fever
- Echinococcosis
- West Nile fever
- Yellow fever
- Lassa fever
- Yellow fever
- Rift Valley fever
- O’nyong-nyong fever
- Monkeypox
- Hendra virus
- Influenza A (H5N1)
- E. coli O157
- Venezuelan equine encephalitis
- Hantavirus pulmonary syndrome
- Lyme borreliosis
- Cryptosporidiosis

Image 1: Agricultural land with silos and a pond.

Image 2: A map highlighting various diseases with arrows pointing to different locations.
Emerging Infectious Diseases:
Major resources are lost

USA, Periodically:  
E. coli O157  
Meat recall/destruction
USA, 2001:  
Anthrax  
US$ 250 million?
Peru, 1991:  
Cholera  
US$ 770 million

U.K., 1990-98:  
BSE  
US$ 9 billion

India, 1994:  
Plague  
US$ 2 billion

Tanzania, 1998:  
Cholera  
US$ 36 million

Malaysia, 1999:  
Nipah Virus  
Swine slaughtering  
US$ 540 million

China, 2003:  
SARS  
US$ 25 billion

Hong Kong, 1997:  
Influenza A (H5N1)  
Poultry slaughtering  
US$ 22 million

Reasons for emergence or re-emergence of zoonoses

Human population increase leading to an increased number of contacts between humans and infected animals.
In 1983 avian influenza (H5N2) appeared in Pennsylvania, killing 17 million chickens, and costing more than $60M (Source: F. A. Murphy, UCD)

SARS PANDEMIC, Spring 2003:
Spread of a new Infectious agent through international flights.

« Infectious Diseases will continue to emerge... »

More than 30 new infectious diseases caused millions of deaths since the mid 1970's. As for SARS, epidemiological surveillance is critical (Ebola, Africa; Avian Flu A/H7N7, Netherlands, etc.)
Spread of a new Infectious agent through international flights.

In 2000, 27 million Americans travelled abroad, 9% visited a National Park, 5% camped or hiked, 5% visited sites of ecological interest, and 2% (540,000) traveled to Africa.

Incidence of Rickettsial Spotted fever was 14 cases per million for travelers to Africa. By comparison, incidence of Rocky Mountain Spotted Fever in the USA is only 2 cases/million population.

A Global Threat

Leptospirosis outbreak among 312 participants, Eco Challenge 2000 *, Malaysia

- Canada: 4  - UK: 9
- USA: 10  - France: 4
- Brazil: 1
- Uruguay: 1
- Australia: 4

* Expedition race, multi-sport event, 20 August - 3 September 2000, Sabah, Malaysian Borneo
H5N1- Influenza outbreak Hong Kong 1997-1998

One million chickens were destroyed
Imports from mainland China were stopped
Shortage of poultry occurred in HK

Coronavirus
### SARS and live animal markets

#### Prevalence of IgG antibody to SARS associated Coronavirus in animal traders and persons in 3 control groups, Guangdong Province, China, 2003.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. tested</th>
<th>No. positive (%)</th>
<th>Chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal traders</td>
<td>508</td>
<td>66 (13.0)</td>
<td>26.1</td>
</tr>
<tr>
<td>Hospital workers</td>
<td>137</td>
<td>4 (2.9)</td>
<td></td>
</tr>
<tr>
<td>Guangdong CDC</td>
<td>63</td>
<td>1 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Healthy adults at clinic</td>
<td>84</td>
<td>1 (1.2)</td>
<td></td>
</tr>
</tbody>
</table>


#### Prevalence of IgG antibody to SARS associated Coronavirus in selected animal traders, by primary animal traded, Guangdong Province, China, 2003.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. tested</th>
<th>No. Pos. (%)</th>
<th>RR (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masked palm civet</td>
<td>22</td>
<td>16 (72.7)</td>
<td>7.9 (5.0-12.6)</td>
</tr>
<tr>
<td>Wild boar</td>
<td>28</td>
<td>16 (57.1)</td>
<td>6.2 (3.8-10.3)</td>
</tr>
<tr>
<td>Muntjac deer</td>
<td>16</td>
<td>9 (56.3)</td>
<td>6.1 (3.4-10.9)</td>
</tr>
<tr>
<td>Hare</td>
<td>13</td>
<td>6 (46.2)</td>
<td>5.0 (2.5-10.2)</td>
</tr>
<tr>
<td>Pheasant</td>
<td>9</td>
<td>3 (33.3)</td>
<td>4.9 (0.7-24.8)</td>
</tr>
<tr>
<td>Cat</td>
<td>43</td>
<td>8 (18.6)</td>
<td>2.0 (1.0-4.2)</td>
</tr>
<tr>
<td>Other fowl</td>
<td>25</td>
<td>3 (12.0)</td>
<td>1.3 (0.2-5.0)</td>
</tr>
<tr>
<td>Snake</td>
<td>250</td>
<td>23 (9.2)</td>
<td>Ref. group</td>
</tr>
</tbody>
</table>


Ivory Coast
1994 (1)

Gabon
1994 (49/59%), 1996 (31/68%), 1996 (60/75%), 2001-02 (60/83%)

Zaire/Rep. Congo
1976 (318/88%), 1977 (1), 1995 (316/81%), 2002-03 (143/89.5%)

Sudan
1976 (284/53%), 1979 (34/65%)

South Africa, 1996 (2/50%)

Uganda, 2000-2001 (425/53%)

Suspected Ebola Cases, by exposure date, Gabon 1996

- **Direct exposure to chimpanzee**
  - Week 1: 24-30 Jan.
  - Week 2: 31-7 Feb.
  - Week 3: 8-14 Feb.
  - Week 4: 15-21 Feb.
Increased International Trade of Agricultural Products.

Source: WTO, 2000

International trade of agricultural products multiplied by 5 since 1950

nVCJD and Mad Cow disease (BSE)

- nVCJD newly discovered in the UK in 1995, by Dec 2003: 145 cases in UK, 6 in France, a few in some other countries (1 per country, including one in Canada and one in the USA…).
- Fatal progressive neurodegenerative disease
- Age - 13 and 52 years of age
- BSE and nVCJD are caused by the same agent
- BSE epidemic in cattle was caused by BSE-contaminated MBM and source of exposure for humans is food
- No test to detect agent in food or living asymptomatic animals
- To control nVCJD, control the BSE epidemic
BSE and nvCJD: Potential Exposure through International Trade in the early 1990s

- Live cattle
- Cattle feed and Beef meat for human consumption
- Blood and derivated blood products
- Pharmaceutical and Cosmetic products
- Meat and Bones
- Human and Bovine Products used in Biology


Source: more likely infected imported livestock or windborne infected mosquitoes

2002: Febrile illness in two workers
At a commercial turkey breeder farm (Farm A) in Wisconsin

High prevalence of antibodies among farm A workers and turkeys

Possible non-mosquito transmission?


West Nile Virus infection among Turkey Breeder Farm workers, Wisconsin, 2002

Source MMWR, 2003;52(42):1017-1019.

<table>
<thead>
<tr>
<th>Exposure Group</th>
<th>No. tested</th>
<th>No. WNV IgM +</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm A workers</td>
<td>19</td>
<td>8</td>
<td>(42)</td>
</tr>
<tr>
<td>Farm A workers exclusively</td>
<td>11</td>
<td>6</td>
<td>(55)</td>
</tr>
<tr>
<td>Farm A workers and other</td>
<td>8</td>
<td>2</td>
<td>(25)</td>
</tr>
<tr>
<td>breeder-farm workers</td>
<td>38</td>
<td>2</td>
<td>( 5)</td>
</tr>
<tr>
<td>Other breeder-farm workers</td>
<td>13</td>
<td>0</td>
<td>( 0)</td>
</tr>
<tr>
<td>Non-breeder farm workers</td>
<td>14</td>
<td>0</td>
<td>( 0)</td>
</tr>
<tr>
<td>Turkey meat processing Plant</td>
<td>22</td>
<td>0</td>
<td>( 0)</td>
</tr>
<tr>
<td>workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm A residents*</td>
<td>14</td>
<td>0</td>
<td>( 0)</td>
</tr>
<tr>
<td>(Do not work with turkeys)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

West Nile Virus in farmed Alligators, Idaho

• The ranch obtained hatchling (approx. 1 month old) alligators from a farm in Florida. Since Idaho was a "WNV-free" state, these animals were likely infected in Florida prior to shipment.

• Clinical signs include swimming in circles, head tilt, muscle tremors, and anorexia as evidenced by lack of ingesta and digesta on necropsy. Mortality near 40 percent.
• 8 animals were tested at LSU from this ranch. All 8 were positive for WNV via RT-PCR and virus culture.

Promed20031114.2825

West Nile Virus in farmed Alligators, Idaho

“The zoonotic potential appears to be real, since we suspect that alligators can get high viremia and shed the virus in the feces. The human population at risk as are those alligator ranchers/ farmers and their workers.”

Promed20031114.2825
Deforestation, urbanization, increased pig production….

Most patients were pig farmers.

Clinically undetected Nipah infection was noted in 10 (6%) of 166 community-farm controls (persons from farms without reported encephalitis patients) and 20 (11%) of 178 case-farm controls (persons from farms with encephalitis patients).

Nipah virus, Malaysia, 1998

Cases were more likely than community-farm controls to report increased numbers of sick/dying pigs on the farm (59% vs. 24%, P=.001) and were more likely than case-farm controls to perform activities requiring direct contact with pigs (86% vs. 50%, P=.005). Only 8% of case patients reported no contact with pigs.

Emerging Zoonoses: Why Now?

- Better tools for diagnosis of fastidious organisms: The Molecular Microbiology Revolution: Hantavirus, Bartonella, etc…
- Epidemiological studies, outbreak investigation
- Surveillance systems: Hantavirus, influenza, leptospirosis, Hendra and Nipah viruses.
- Wildlife studies have revealed new pathogens; new studies done on interaction between wildlife reservoir and domestic animals/humans
- Increased interest in vector borne diseases i.e., tick-borne infections: Ehrlichioses, Lyme, etc.

Disease or Inapparent infection (or infestation)

**contact**
(direct or indirect)
with animals or their products and contaminated environment

**ingestion** of food products from infected animals

Professional Zoonoses
(also recreational or accidental)

Food-Borne Zoonoses

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

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Professional ZOONOSES

- Rabies
- Tuberculosis
- Brucellosis
- Q Fever
- Chlamydioidis
- Leptospirosis
- Anthrax
- Erysipeloïd
- Streptococciosis (*S. suis*)
- Poxviruses (orf…)
- Influenza (?)
- & salmonellose, campylobactérioïse …
Food-Borne ZOONOSES (FBZ)

Bovine Spongiform Encephalopathy
nvCJD (about 150 human cases)

Salmonellosis
Listeriosis
Campylobacteriosis
E. coli O157:H7 Infection

High level of infection carriage in animals ↓ FBZ

tuberculosis, brucellosis, Q fever,

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

ZOONOTIC DISEASES IN FARMERS:

United Kingdom, 1992-1999

Source: Coleman, Acta Tropica, 2000;76:71-75.

600 farmers enrolled from 3 areas: Herefordshire, Lancashire and Norfolk (200 for each region).

Serosurvey for
- Bornavirus, Hantavirus, Orthopoxvirus and parapoxvirus;
- Bartonella spp., Borrelia burgdorferi, Brucella spp.,
- Chlamydia spp., Coxiella burnetii, Helicobacter pylori,
- Leptospira interrogans
- Echinococcus granulosus, Neospora caninum,
- Toxoplasma gondii

Fecal samples for Salmonella spp., Shigella spp., Campylobacter spp., and E. coli O157:H7
Results

Ringworm and Orf (4%) rather common and associated with exposure to cattle and sheep (24% said to have had orf).

*Chlamydia psittaci*: 80% prevalence (most significant risk: attendance at lambing).

*Coxiella burnetii* (Q fever): 27%; 4 times more common than in controls (ambulance men). Exposure to cattle especially at calving was greatest risk factor amongst positive farmers.

No seropositive for Brucella and very low prevalence <0.5% for *Borrelia burgdorferi* and surprisingly for *Leptospira interrogans* (<0.2%).

Hantavirus: 4.7% (1991) and 4.8% seroconverted during the first year, Orthopoxvirus and parapoxvirus;

*Bartonella* henselae: 3% spp.,
*Helicobacter pylori*: 30%.
**ZOONOTIC DISEASES IN FARMERS:**  
**Northern Ireland**  

Seroprevalence for:  
Percent

- *Brucella abortus* 0.7
- *Leptospira interrogans* serovars 8.1
- *Borrelia burgdorferi* 14.3
- *Toxoplasma gondii* 73.5
- *Coxiella burnetii* 28.0
- *Chlamydia psittaci* 11.1
- Hantavirus 1.2

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**ZOONOTIC DISEASES IN FARMERS:**  
**Surveillance Network: FRANCE**  

- In France, about 250 professional diseases recognized by the Law. Among farmers, priority was brucellosis (1980s through 1990s). More recently, BSE, Chlamydiosis, leptospirosis and tick borne diseases.

- Institut de Veille Sanitaire (French CDC): Priorities for non-foodborne zoonoses (expert committee, July 2000):
  - Major priority: brucellosis, Echinococcosis, Influenza, Leptospirosis, Lyme disease, Mycobacteriosis, Rabies (bat), Toxoplasmosis, West Nile Virus, Psittacosis
  - Important: Anthrax, Tick borne encephalitis, HFRS, Q fever, visceral leishmaniasis, Pasteurellosis, Toxocariasis, Tularemia, *Streptococcus suis* infection.
AVIAN CHLAMYDIOSIS

(Chlamydophila psittaci)

Enzootic in
many duck (France),
turkey (USA, France,
U.K.), poultry farms...

Often subclinical infection
revealed
By human disease
farmers, veterinarians,
Slaughterhouse workers
(respiratory route)

Source: Pr. J. P. Ganiere, School of
Vet. Med., Nantes, France

CHLAMYDIOSIS IN FARMERS/PLANT WORKERS:

UNITED STATES

Source: Eidson, JAVMA, 2002;221:1710-1712.

Turkey farmers:

• Outbreak in Minnesota: many cases in processing
  plants, rendering plants, farm and further process
  plant. 186 suspect cases, 122 confirmed cases,
  serologically.

• North Carolina: 60 suspected cases, 40 confirmed.
  High rate of air sacculitis in birds (25% versus normal
  of 1-3%).
France: Human Tuberculosis caused by *M. bovis*

**In the past**
- **Common (1-5%)**
  - inoculation
  - inhalation
  - ingestion (raw milk)

**Extra-pulmonary tuberculosis**
- 0.33/100,000 persons > 75 yrs
- 0.02/100,000 persons < 15 yrs

**Now**
- **Elderly people**
  - 0.07 case for 100,000 inhabitants in 1995
- **Mainly human TB, pulmonary**
  - Pasteurized milk

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

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**Epidemiology of *Mycobacterium bovis* Disease In San Diego County, 1994-2000.**


- Between 1994 and 2000, 1,931 evaluable cases of culture-positive TB were identified; 129 (6.7%) were infected with *M. bovis* and 1,802 were infected with *M. tuberculosis*.

- More than 90% of *M. bovis* cases occurred in Hispanic persons. About 25% of patients were children, and the main site of disease was extra-pulmonary in 53% of patients (cervical and mesenteric nodes, the peritoneum, and the GI tract) ; 23% had concurrent HIV infection.

- Compared to patients with *M. tuberculosis*, patients with *M. bovis* were more likely to be Hispanic, aged 0-14 years, have extra-pulmonary disease, or have HIV co-infection in a multivariate model. They were less likely to be born in countries outside of the US or Mexico.
Bovine Tuberculosis Screening:
Becoming more difficult because of low prevalence: In more than 60% of cases: identified at slaughterhouse

Tuberculination  Bovine TB: pulmonary lesions

Herd destruction
Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

BOVINE TUBERCULOSIS: FRANCE
Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

<table>
<thead>
<tr>
<th>Year</th>
<th>Yearly prevalence of herd infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1954</td>
<td>20-25% Begining of control</td>
</tr>
<tr>
<td>1965</td>
<td>10% Mandatory prophylaxis</td>
</tr>
<tr>
<td>2000</td>
<td>0.06% (174 herds) Eradication in near future?</td>
</tr>
</tbody>
</table>
Brucella abortus \hspace{1cm} Brucella melitensis \hspace{1cm} Brucella suis (biovar 2)

**placentite et avortement**

Uterine Content during pregnancy: main source of contamination

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

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**Brucellosis Prevalence in human populations**


<table>
<thead>
<tr>
<th>Country</th>
<th>Prevalence per 100,000 persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.03</td>
</tr>
<tr>
<td>France</td>
<td>0.15</td>
</tr>
<tr>
<td>Italy</td>
<td>3</td>
</tr>
<tr>
<td>Spain</td>
<td>4</td>
</tr>
<tr>
<td>Portugal</td>
<td>10</td>
</tr>
<tr>
<td>Greece</td>
<td>20</td>
</tr>
<tr>
<td>Iran</td>
<td>30</td>
</tr>
</tbody>
</table>

(90% *B. melitensis* in 1997) (Sicily: 20)
**Human Brucellosis**

- Brucella infected Animal
  - Milk
  - Uterine Content during pregnancy, Genital secretions, urine
- Ingestion
- Consumers (raw milk, cheese made out of raw milk)

**Professional infection:**
- Farmers
- Veterinarians
- Slaughterhouse workers, ...

**France:**
- 1960s: 1-2 cases/100,000 persons (500-1,000 cases)
- 1997: 0.15/100,000 p. (93 cases)

**BOVINE BRUCELLOSIS: FRANCE**

<table>
<thead>
<tr>
<th>Year</th>
<th>Yearly prevalence of herd infection</th>
<th>Yearly prevalence of herd infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>50%</td>
<td>Begining of control</td>
</tr>
<tr>
<td>1975</td>
<td>15%</td>
<td>Mandatory prophylaxis</td>
</tr>
</tbody>
</table>

 Mandatory vaccination discontinued

- 2000 0.02% (75 herds)

Eradication in near future?
**Caprine Brucellosis**
(Mandatory prophylaxis since 1977)
Prevalence: 0.05%
(13 flocks)

**Ovine Brucellosis**
(Mandatory prophylaxis since 1991)
Prevalence: 0.13%
(106 flocks)

10% of infected flocks
90% of infected flocks

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

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**Swine Brucellosis**
Caused by *Brucella suis* 2
About 30 infected swine herds since 1993 in France

Source of infection: *Brucella* infection Of wild boar populations

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France
20% to 40% of sheep flocks infected in South-East of France

Q FEVER
Coxiella burnetii
(inapparent infections, abortion, metritis)

- Infectious fomites
- Infectious dust
- Aborted animals
- Infected tissues
- Milk
- Inhalation
- Direct contact
- Ingestion
- (tick bite)

Farmers, veterinarians, Slaughterhouse workers, inhabitants of rural areas
Consumers (raw milk)

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

Q fever prevalence studies in human populations: U.K. and Northern Ireland

England & Wales:
1117 cases reported between 1984 and 1994 (1/3 from southwestern region).
Mean age 45 yrs; 74% of cases were males,
47% respiratory symptoms,
7% heart disease and 5% with hepatitis.
Seroprevalence: 27% (600 persons tested)

Northern Ireland farmers:
Seroprevalence: 28% (N=?)
Q fever prevalence studies in human populations: FRANCE


**Estimates:** 600 acute and 60 chronic Q fever cases/year
(reported: 100 acute and 32 chronic cases)

**Seroprevalence:** 4-5% in southern France

Out of 100 human cases,
- 40 live in rural areas
- 23 ate unpasteurized goat cheese
- 35 had contact with newborn or pregnant animals


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Q fever prevalence studies in human populations: FRANCE


Serosurvey of 168 goat breeders and 40 Vet/Med staff (Central France)

71% had antibodies for *C. burnetii* phase II
- goat farmers: 78% abs Phase II, 33% abs Phase I
- field Vets: 3/12 (25%) had Phases I & II abs
- Vet/Med lab staff: 0/28 (0%)
Q fever prevalence studies in human populations: GERMANY


• The average annual Q fever incidence nationwide from 1979 to 1989 was 0.8 per million, and from 1990 to 1999, 1.4 per million.

• The mean annual incidence from 1979 to 1999 ranged from:
  • a minimum of 0.1 per million in several northern states to
  • 3.1 per million in Baden-Wurttemberg, in the South.

Q fever prevalence studies in human populations: GERMANY


• 40 documented outbreaks were identified since 1947; in 24 of these sheep were implicated as the source of transmission.

• The seasonality of community outbreaks has shifted from predominantly winter- spring to spring-summer, possibly because of changes in sheep husbandry.

• The location of recent outbreaks suggests that urbanization of rural areas may be contributing to the increase in Q fever.
Q fever prevalence studies in human populations: U.S.A.

- For 1948-1986, 1,396 human cases were reported from almost every state, but mainly from California (67%).

- Occupational exposures (research facilities, farm environments, slaughterhouses) commonly reported, sheep most frequently implicated as a possible source of infection.

- Livestock handlers had a significantly higher prevalence of antibodies to *C. burnetii* than did persons with no known risk.

Q fever prevalence studies in human populations: U.S.A.

Animal studies showed wide variation in seroprevalence, with goats having a significantly higher average seroprevalence (41.6%) than sheep (16.5%) or cattle (3.4%).
Orf & Milkers’ Nodule (Pseudocowpox)

POX-VIRUSES

Ecthyma
Pseudo-cowpox
Bovine Papular
Stomatitis

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France

ANTHRAX

(Bacillus anthracis)

Animal: source from soil contamination

In humans:
Mainly anthrax by inoculation
(rarely inhalation or ingestion)

(spleen)
Several outbreaks every year

Importance of vaccination
In exposed herds
And incineration
Of infected cadavers

Source: Pr. J. P. Ganiere, ENV, Nantes, France
Ovine Chlamydioidosis
(enzootic abortion)
Caused by *Chlamydophila abortus*

Infection widely spread
In sheep flocks
Important cause
Of abortion
(vaccination possible)

contact with infected ewes
During lambing
Incriminated in rare cases of abortion

Swine streptococcal infection
(*Streptococcus suis* 2)
septicemia, meningitis, pneumonia, endocarditis

Frequent carriage
(tonsils, mucosa)

Wound Contamination
farmers,
Slaughterhouse workers,
butchers, ..

meningitis and septicemia

Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France
**Swine streptococcal infection**  
*Streptococcus suis 2*

Human infection by streptococci was first reported in 1968, when three cases of meningitis with concurrent septicaemia were diagnosed in Denmark (Perch et al., *J. Clin. Microbiol.* 17, 993-996. 1983). Subsequently, a significant number of cases have also been reported from Holland, France, England, Wales, Hong Kong, Canada and New Zealand (Robertson and Blackmore, *Epidemiol. Infect.* 103, 157-164. 1989; Tambyah et al., *Clin. Infect. Dis.* 15, 1165-1173. 1997).

The disease in humans appears to be an occupational hazard, as most cases have occurred in pig breeders or abattoir workers. Minor skin cuts, infected wounds and abrasions have been reported as the portal of entry of the organism for humans.

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**Erysipelotrichosis**  
*Erysipelothrix rhusiopathiae*

*ROSENBACH ‘S ERYSIPELOID*

*Source: Pr. J. P. Ganiere, School of Vet. Med., Nantes, France*
Conclusions

• Rural Zoonoses need to be better investigated.

• New emerging zoonoses will appear related to international trade, new type of farming (ostriches, alligators…).

• Urban/rural encroachment and wildlife interaction are of concern for on farm zoonoses.