Companion Animal Zoonoses

OEGO, 14 November 2012
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Outline
- Significance of zoonotic infections
- Which zoonotic microorganisms are relevant?
- Significant companion animal zoonoses
- Control of zoonoses

Can you answer these questions?
- Should dog and cat bite wounds in the human always be treated with antibiotics?
- Are cats allowed with immunosuppressed patients (HIV, splenectomy)?
- Is deworming of the dog/cat twice a year sufficient to prevent human toxocarosis?
- Should pregnant women prevent any contact with cats?
- Will a new SARS outbreak require stringent measures regarding cats?

Zoonotic infections
- **Definition**: any disease and infection that are naturally transmitted between vertebrate animals and humans (WHO)
- Approx. 61% of existing human pathogens are zoonotic
- Since 1979 more than 40 new human infectious diseases → 75% of these (emerging) diseases are zoonotic
- Global impact more significant than indicated

- Taylor and Latham, 2001

Global impact

Certain zoonotic outbreaks of the last decade (Clin Microbiol Inf Dis, 2011;17:323)
Reasons for emerging zoonoses

- Extensive population movements
  - tourism to "true nature" (rabies, leptospirosis)
  - business travel
  - military operations (Iraq, Afghanistan → leishmaniosis, Q-fever)
  - immigration (brucellosis, echinococcosis, tuberculosis)
- Exotic pets
- Tasting all sorts of raw delicacies (even in the field; bush meat)
- Global warming

Reasons for emerging zoonoses

Medical progress created a vast reservoir:

- Immunocompromised patients (YOPI’s)
  - Young
  - Old
  - Pregnant
  - Immune suppressed (cancer treatment, AIDS, splenectomy)
  - (students)

Mumps epidemic in Dutch students

Reasons for emerging zoonoses

Medical progress created a vast reservoir:

- Immunocompromised patients (YOPI’s)
  - YOPI’s can be found:
    - children playgrounds / petting zoos
    - children care centres
    - homes for the elderly
    - care farms

Reasons for emerging zoonoses

- In immunocompromised patients development of opportunistic infections which were previously harmless zoonotic agents:
  - e.g. cryptosporidiosis (unknown 40 yrs ago)
  - toxoplasmosis and listeriosis in AIDS patients

Small intestine infected with Cryptosporidium parvum (round pink dots)

Routes of transmission
Classification zoonoses based on routes of transmission

- Animal - Human
- Animal - Vector - Human
- Animal - Environment - Human
- Animal - Food - Human

Veterinary Public Health ~ One Health

Risk perception vs. the facts

Potential feline zoonotic agents

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Risk perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSE</td>
<td>++</td>
</tr>
<tr>
<td>Growth hormones</td>
<td>++</td>
</tr>
<tr>
<td>Salmonella</td>
<td>++</td>
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</tbody>
</table>

Risk perception vs. the facts

<table>
<thead>
<tr>
<th>Relativize</th>
<th>Risk perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harm</td>
<td>Risk analysis</td>
</tr>
<tr>
<td>BSE</td>
<td>++</td>
</tr>
<tr>
<td>Growth hormones</td>
<td>++</td>
</tr>
<tr>
<td>Salmonella</td>
<td>++</td>
</tr>
</tbody>
</table>

Risk perception vs. the facts

Potential feline zoonotic agents

- Bacteria
  - Bacillus anthracis
  - Bartonella henselae
  - Borrelia burgdorferi
  - Clostridium perfringens
  - Francisella tularensis
  - Helicobacter pylori
  - Mycobacterium tuberculosis
  - Salmonella spp.
- Rickettsiae & Chlamydial
  - Chlamydia psittaci
  - Coxiella burnetii
  - Rickettsia felis
- Parasites
  - Ancylostoma braziliense
  - Ancylostoma caninum
  - Dirofilaria immitis
  - Strongyloides stercoralis
  - Taenia solium
  - Toxocara canis
  - Toxoplasma gondii
- Protozoa
  - Cryptosporidium parvum
  - Entamoeba histolytica
  - Giardia spp.
  - Tritrichomonas freti
  - Trichomonas vaginalis
- Viruses
  - Feline calici virus
  - Feline infectious peritonitis virus
  - Feline parvovirus
  - Feline retroviruses

Risk perception vs. the facts

Potential feline zoonotic agents

- Proteozoa
- Cryptosporidium parvum
- Entamoeba histolytica
- Giardia spp.
- Tritrichomonas freti
- Trichomonas vaginalis
- Toxoplasma gondii
- Coccidioides
- Catarrhalis
- Avian influenza
- Coxiella
- Rabies

Risk perception vs. the facts

Potential feline zoonotic agents

- Bartonella henselae
- Clostridium perfringens
- Francisella tularensis
- Helicobacter pylori
- Mycobacterium tuberculosis
- Salmonella spp.
- Rickettsia felis
- Ancylostoma braziliense
- Ancylostoma caninum
- Dirofilaria immitis
- Strongyloides stercoralis
### Potential feline zoonotic agents

**Bacteria**
- Bacillus anthracis
- Bartonella sp.
- Bordetella bronchiseptica
- Brucella abortus
- Capnocytophaga canimorsus
- Corynebacterium diphtheriae
- Francisella tularensis
- Helicobacter sp.
- Mycoplasma felis
- Salmonella sp.
- Streptococcus g. A
- Yersinia enterocolitica
- Yersinia pestis

**Rickettsiae & Chlamydiae**
- Chlamydophila felis
- Coxiella burnetii
- Rickettsia felis

**Parasites**
- *Ancylostoma braziliense*
- *Ancylostoma tubaeforme*
- *Dirofilaria immitis*
- *Strongyloides stercoralis*
- *Toxocara cati*
- *Toxoplasma gondii*

**Protozoa**
- *Cryptosporidium parvum*
- *Entamoeba histolytica*
- *Giardia sp.*
- *Toxoplasma gondii*

**Fungi**
- *Dipylidium caninum*
- *Echinococcus multilocularis*
- *Sarcoptes scabiei*

**Viruses**
- *Avian influenza*
- *Cowpox*
- *Rabies*

### How to define risk?

- **Risk = Exposure x Hazard**
  - (chance of infection x seriousness of the outcome)

- **Risk = a number**
  - **Risk = a percentage**

### Simple risk analysis

- **Risk = Exposure x Hazard**
  - **Risk**
  - **Exposure**
  - **Hazard**
  - **DANGER**
  - **ELECTRICITY**
  - **Child protected socket outlet**

### Quantitative infection risk analysis

- Infections and infection risks are **never similar**. Every situation may be different and influenced by many (difficult measurable) factors.
- **Distinguish**: contamination – infection – disease
- Infection risk = multidimensional concept

### Analysis emerging zoonoses NL

1. **to provide a systematic approach to **signal** emerging zoonoses**
2. **to prioritize emerging zoonoses relevant for our country**
3. **to develop a blueprint for an early warning and surveillance system for emerging zoonoses**
Prioritising based on multicriteria analysis

1. Introduction
2. Transmission between animals
3. Economic damage in animal reservoir
4. Animal-human transmission
5. Transmission between humans
6. Animal-to-animal transmission
7. Morbidity
8. Mortality

Flow chart of the pathway from introduction of zoonotic pathogen to public health impact, represented by 7 criteria from which the risk to public health of emerging zoonoses was derived.

Havelaar et al, PLoS One 2010; 5: e13965

Significant companion animal zoonoses

Based on multi-criteria analysis & in terms of infection risk and/or health risk:
- toxoplasmosis
- bite wounds
- cat scratch disease (Bartonella henselae)
- Toxocara canis, T. cati, Echinococcus multilocularis
- Giardia intestinalis
- dermatophytosis
- zoonoses and hygiene of the owner

Toxoplasmosis
Toxoplasma gondii
Toxoplasmosis

Routes of transmission

1. Ingestion tissue cysts in meat, milk
2. Ingestion sporulated oocysts environment (incl. water)
3. Congenital infection
4. Transplantation/infusion

Prevalence Netherlands: 2/1000 newborns
- 390 babies /yr in NL (in 1987 → 107)
- Other European countries (similar screening method):
  - Ireland: 0.2/1000 (10x less)
  - Denmark: 0.2/1000 (10x less)
  - USA (Maine): 0.2/1000 (10x less)
  - Poland: 0.5/1000 (4x less)

2300 DALY’s/year
(Disability Adjusted Life Years)*

* Havelaar et al, Clin Inf Dis 2007; 44: 1467-74

Congenital toxoplasmosis

Disease burden – DALY’s

- Conceptually simple:
  - disease burden is a function of the number of affected persons, the duration of the adverse health effect and the severity of the effect
- DALY = YLL + YLD
  - mortality: years of life lost
    \[ YLL = \sum_{i} d \times n \]
  - morbidity: years lived with disability, weighted for severity of illness
    \[ YLD = \sum_{i} d \times n \times w \]

DALY toxoplasmosis NL

<table>
<thead>
<tr>
<th></th>
<th>Total number</th>
<th>Duration (years)</th>
<th>Disability weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth (after 24 weeks)</td>
<td>5</td>
<td>1.4</td>
<td>9.5</td>
</tr>
<tr>
<td>Chorioretinitis in 1st year of life</td>
<td>14</td>
<td>0.6</td>
<td>25</td>
</tr>
<tr>
<td>Intraocular calcification</td>
<td>1.4</td>
<td>5</td>
<td>20.2</td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>1.9</td>
<td>0.7</td>
<td>4.4</td>
</tr>
<tr>
<td>CNS abnormalities</td>
<td>2.7</td>
<td>0.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Death in 1st year of life</td>
<td>0.75</td>
<td>0.2</td>
<td>2</td>
</tr>
<tr>
<td>Chorioretinitis later in life</td>
<td>17</td>
<td>3</td>
<td>78</td>
</tr>
</tbody>
</table>

Disease burden toxoplasmosis vs. other zoonoses NL

Nr. 1 zoonosis when acquired chorioretinitis (95% cases) included!!
Toxoplasmosis

**risk factors**

**Age 20-79:**
- Owning a cat (1.4)
- Undercooked pork meat (1.4) (beef: not)

**Age <15 jaar (children):**
- Ingesting sand from sandpit (1.6)
- Eating unwashed vegetables (1.5)

(* Hofhuis et al. 2010)

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**Prevention**

**Target on pregnant women**
- don’t handle or eat undercooked meat
- hygiene: wear gloves when gardening or handling soil or sandpits
- wash all fruit and vegetables thoroughly
- have someone else empty the litter tray on a daily basis
- .......... removal of the cat not required!

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**Zoonoses and household hygiene**

**Pets sleeping on/in owners bed (%)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Dogs</th>
<th>Cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>21-33&lt;sup&gt;1&lt;/sup&gt;</td>
<td>60</td>
</tr>
<tr>
<td>UK</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>France</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>NL&lt;sup&gt;2&lt;/sup&gt;</td>
<td>45</td>
<td>62</td>
</tr>
</tbody>
</table>

<sup>1</sup> breeders vs. average dog owner
<sup>2</sup> 6% always sleeps in the bed with owner

(* Chomel and Sun. 2011)
Owners & pets sleeping together

• 56% of the owners sleeps with the dog next to them (USA)
• 62% small dogs – 41% medium sized – 32% large dogs
• 25% women – 16% men
• Cats: 62% slept with adults and 13% with children

Survey outline

• 60 clinical healthy cats & 152 clinical healthy dogs
• Questionnaires owner + sampling animals in vet clinics
  - divided all over the country
  - urban and rural

Prevalences zoonotic pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalences cat %</th>
<th>Prevalences dog %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giardia</td>
<td>13.6 (8/22)</td>
<td>15.2 (14/92)</td>
</tr>
<tr>
<td>Cryptosporidium</td>
<td>4.6 (1/22)</td>
<td>8.7 (8/92)</td>
</tr>
<tr>
<td>Toxocara canis</td>
<td>4.6 (1/22)</td>
<td>4.4 (4/92)</td>
</tr>
<tr>
<td>Salmonella</td>
<td>0</td>
<td>1.3 (2/152)</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MRSA</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* P< 0.05

Other zoonotic infections after close contact with pets

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Sleeping</th>
<th>Kissing</th>
<th>Licking</th>
<th>Zoonosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurella hammela</td>
<td>D x C</td>
<td>K</td>
<td></td>
<td>zoonotic plague</td>
</tr>
<tr>
<td>Pasteurella spp. C. canimorsus</td>
<td>D + C</td>
<td>D + C + K</td>
<td>D + C</td>
<td>meningitis, wound infections and abscesses, arthritis</td>
</tr>
<tr>
<td>Staph. intermedius</td>
<td>D</td>
<td>D</td>
<td></td>
<td>wound infections</td>
</tr>
<tr>
<td>MRSA</td>
<td>D</td>
<td></td>
<td></td>
<td>wound infections</td>
</tr>
<tr>
<td>Cheyletella spp.</td>
<td>D</td>
<td></td>
<td></td>
<td>dermatitis</td>
</tr>
</tbody>
</table>

D = Dog
C = Cat
R = Rabbit
K = Kitten

Licking faces by pets

Because of You... Jacob has his happy, healthy best friend back.
There is clear evidence that animals are the source of gastric infections with non-\textit{H. pylori} \textit{Helicobacter} species of the human. Although it is not clear how gastric NHPH is transmitted from animals to the human, this is most likely by direct contact. 

Granulomatous conjunctivitis

Fever, swollen lymph nodes

after direct inoculation or rubbing the eye following contact with a cat

Rates of acquisition of MRSA and \textit{C. difficile} 4.7 resp. 2.4 times higher among dogs that visited human health-care facilities, compared with dogs in other animal-assisted interventions.

Dogs that licked patients or accepted treats during visits were more positive for MRSA and \textit{C. difficile}.

The periodontal pathogens \textit{Porphyromonas gingivalis} and \textit{Tannerella forsythia} are highly prevalent in humans with periodontitis and have also been isolated from the oral cavity of cats.

Transmission to owners has been found and cats may therefore be a reservoir for these bacteria.
Licking wounds by dog or cat

- 73 yrs. old woman 3 months after knee replacement surgery
- Abscess with 20 ml pus
- Wound infection (P. multocida) after licking by her dog

Licking ear by pets

- A 67 yr old patient with right-side chronic purulent otitis media (perforated tympanic membrane)
- Developed meningitis due to Pasteurella multocida transmitted by a dog that frequently licked his ear.

Cats allowed on the sink

In our survey in the NL: 45%

Enterobacteria may be isolated from food-preparing areas

Significant exotic animal zoonoses (birds, reptiles)

Based on multi-criteria analysis & in terms of infection risk and/or health risk:
- Salmonellosis
- Psittacosis (Chlamydophila psittaci)
- Dermatophytosis

Reptiles & salmonellosis

- 50,000 clinical salmonellosis reported annually (NL)
- Young children, pregnant women, elderly and diseased
- Diarrhoea, abdominal cramps, dehydration, mortality
- Alimentary zoonosis: eggs, meat, raw milk

Salmonella & pets

- 15% to 20% of cases are attributable to pets
- Esp. reptiles (lizards, snakes, and turtles) → 90% infected
- Reptiles in 3% households (US) (1.7 M. and doubled since ‘91)
- Responsible for 7% human salmonellosis (75,000/yr)
Salmonella & pets

- FDA banned commercial distribution of turtles < 4 inch (1975)
- Result: 100,000 less salmonellosis in children per year
- Number of reptile-related Salmonella-serotypes in the human is raising proportional with the popularity of these animals
- All pet shops inform their clients about Salmonella-risks with sales of reptiles

Prevalences:
- Dog: 10-25%
- Cat: 1-13%
- Ferret, bird
- Dog chews, such as beef jerky, smoked hooves, pig ears, and pig snouts, may carry Salmonella

Answers of the questions

• Should dog and cat bite wounds in the human always be treated with antibiotics? 95% yes (next presentation)
• Are cats allowed with immunosuppressed patients (HIV, splenectomy)? only if bite and scratch wounds can be prevented
• Is deworming the dog/cat twice a year sufficient to prevent human toxocarosis? in general: no → tailor-made deworming
• Should pregnant women prevent any contact with cats? no
• Will a new SARS outbreak require stringent measures regarding cats?

SARS

SARS → Civet cat = Viverra (marter like animal commonly found in Southeast Asia)

Not related with Felidae

No role in SARS!
Control of zoonoses

- **Control: issue of veterinarians?**
  - identifying and eliminating diseases in animals
  - however: numerous zoonotic agents in wildlife
  - inadequate campaigns
  - poor infrastructure developing countries → **zoonotic reservoirs**
  - zoonoses are the diseases of the poor

- **Control: issue of politicians?**
  - BSE: an example how a peculiar and vaguely understood zoonotic agent affected global politics....

Control = education

**Role MD vs. DVM**

- Zoonoses seen: vets >> physicians
- C.A practitioners >> LA practitioners
- Communication between physicians and vets is largely absent
- Physicians indicated that vets should play an equal or greater role in advising patients about zoonotic diseases
- Perceived zoonotic pathogens of greatest concern for immunocompromised persons:

<table>
<thead>
<tr>
<th>Animals</th>
<th>Vets</th>
<th>Physicians</th>
</tr>
</thead>
<tbody>
<tr>
<td>reptiles</td>
<td>Salmonella</td>
<td>Toxoplasma</td>
</tr>
<tr>
<td>cats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Grant, S., Olson CW. Emerg Infect Dis 1999; 5: 159-63

Responsibility of vet (technician)

- Knowledge of infectious diseases of animals
- Knowledge about owner – animal bond
- Knowledge of zoonoses and zoonotic risks
- Responsible for important part of zoonosis control

Education of the owner is task of vet and veterinary technician!

Thanks for your attention!