Zoonotic Disease Risks Associated with Travel Trade & Movement of Animals

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Centers for Disease Control and Prevention
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- Enforce HHS statutory authority at ports of entry
- 20 Quarantine stations at major US ports
- Primary focus is human health
  - Quarantinable diseases
- Some regulations related to health risks animals may pose to humans
  - Animal importation from abroad
  - Interstate animal movement
The Global Movement of Animals

- Exhibition at zoos
- Education and research
- Scientific conservation programs
- Incidental/accidental importations
- Use as food and products
- Tourism and immigration
- Commercial pet trade
Emerging Zoonotic Diseases and Commercial Pet Trade

- Emergence of new infectious diseases from animals increasing
  - In the last century, 60% of newly identified infectious diseases in humans globally were zoonotic.¹

- Live Wild Animal Importation – 2009²
  - 289,843 mammals
  - 159,795 birds
  - 946,243 reptiles
  - 3.6 million amphibians
  - 157.4 million fish

*Does not include data for imported animals that were recorded by weight rather than number (fish, amphibians, mammals, and reptiles).

CDC Regulatory Authority for Importation of Animals and Animal Products

42 CFR 71 (Foreign Quarantine)

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- 71.32(b) – Persons, carriers, things
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**DOGS AND CATS**

A valid rabies vaccination certificate is required at a US port for admission of a dog unless the owner shows that dogs have been in a rabies-free country for 6 months before arrival.

Photo credit: http://www.fantomxp.com/wp_15 ~/ Cat_and_dog_friends.html
Global Distribution of Rabies Reservoirs

Map credit: Kevin Liske, Division of Global Migration and Quarantine
Public Health Concerns about Dogs Imported to the US from Rabies-Endemic Areas

- Puppies imported for commercial pet trade
  - Trend in importation of purebred puppies from abroad for sale to US buyers
  - Many too young to be vaccinated for rabies & come from rabies-endemic areas
  - 2004-2007 - 3 instances of dogs imported from Puerto Rico, Thailand & India positive for rabies

- Dogs imported as part of humanitarian rescue operations
  - Animal rescue organization efforts to find homes in the US for stray dogs from Iraq, Puerto Rico
  - June 2008 - dog imported from Iraq positive for rabies
    - Resulted in 16-state contact investigation to identify all animals in the shipment
Rabies in a Dog Imported from Iraq -- New Jersey, June 2008

Please note: An erratum has been published for this article. To view the erratum, please click here.

Rabies vaccination and stray dog control have led to successful control of canine rabies in the United States. The number of rabid dogs reported decreased from approximately 5,000 in 1950 to 79 in 2006, when the canine rabies virus variant associated with dog-to-dog rabies transmission was declared eliminated in the United States (1). On June 18, 2008, a mixed-breed dog, recently shipped from Iraq into the United States, was confirmed to have rabies by the Public Health and Environmental Laboratories of the New Jersey Department of Health and Senior Services. A total of 34 additional dogs in the shipment, “potentially” exposed to the dog, have also been distributed to 16 states. This...
Can a Country Really be Considered ‘Rabies-Free’?

- CDC publishes a list of countries that reported no indigenous cases of rabies in the previous year (formerly known as ‘rabies-free’ countries)
- Pups imported from rabies-endemic countries can still pose a risk to ‘rabies-free’ countries
  - reintroduction of terrestrial rabies in Greece and Taiwan
- Bat lyssaviruses also pose risk for reintroduction of terrestrial rabies
- CDC working on proposal to reduce the ‘rabies-free’ countries to those that have no lyssaviruses
Rabies in Wildlife: Travelers exposed to a Rabid Zebra, Kenya 2011

- Kenya is a popular destination for viewing African wildlife: over 1 million tourists a year!  

- Travelers in Kenya often have close encounters with animals

- 2011- orphaned zebra found and kept at safari lodge

- Later in the year discovered to have rabies

- > 200 travelers had contact with zebra

- Safari lodge & multi-country response to ensure traveler safety

1Kenya Ministry of Tourism: http://www.tourism.go.ke/ministry.nsf/pages/facts_figures
TURTLES, TORTOISES AND TERRAPINS

Persons may not import more than 6 turtles with shells <4 in long or viable eggs, except for scientific, educational or exhibition purposes.

Part 1: CDC’s Ban on Turtle Importation

- CDC prohibited importation of turtles with shells < 4 inches in length and viable turtle eggs
  - To prevent transmission of salmonellosis to young children
- Persons may import no more than six turtles with shells <4in long, or viable eggs, except for science, educational, or exhibition purposes
Part 2: FDA’s Turtle Regulations

- FDA prohibited sale and interstate distribution of viable turtle eggs and live turtles with a shell <4 in long

- In 1980, the ban was estimated to prevent 100,000 *Salmonella* infections annually in children <10 years old in the United States\(^2\)

- Exceptions
  - Sale for scientific, educational or exhibition purposes
  - Sale and distribution intended for export only, provided that the outside of the shipping package is labeled conspicuously “FOR EXPORT ONLY”

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\(^2\) Cohen M et al. Turtle Associated Salmonellosis in the US. *JAMA* Vol 243 No 12 1980
Part 3: Trends in Turtle Production, Sale & Distribution in the US & Abroad

- US produced nearly 9 million baby red-eared sliders each year from 1997-2003\(^1\)

- Millions of US turtles consumed in China annually
  - Nearly 32 million live turtles farmed and exported from the US from 2003-2005\(^2\)

- However, the domestic turtle Industry in China is rising

- Supply growing in US with nowhere to go

- Suppliers skirting FDA regulations
  - No monitoring of internet turtle sales
  - Still sold in flea markets by providers who treat “educational” as a loophole
  - Sell terrarium and give away turtle for “free”
  - Hard to prove suppliers are not selling for those purposes
  - All boxes in store could just be labeled “FOR EXPORT ONLY”

- U.S. turtle ownership rising dramatically over last 5 years\(^3\)

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\(^3\) https://www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics-US-pet-ownership.aspx
Eight Multistate Outbreaks of Human *Salmonella* Infections Linked to Small Turtles

Posted May 24, 2013 11:30 AM ET

**Highlights**

- [Read the Advice to Pet Owners >](#)
- [Read the Advice to Those Who Sell Turtles >](#)

A total of 391 persons infected with the outbreak strains of *Salmonella* have been reported from 40 states and the District of Columbia.

- 29% of ill persons have been hospitalized, and no deaths have been reported.
- 71% of ill persons are children 10 years of age or younger, and 33% of ill persons are children 1 year of age or younger.
- 45% of ill persons are of Hispanic ethnicity. Information about the association between reptiles and *Salmonella* is available in Spanish.

Results of the epidemiologic and environmental investigations indicate exposure to turtles or their environments (e.g., water from a turtle habitat) is the cause of these outbreaks.

- 70% of ill persons reported exposure to turtles prior to their illness.
- 89% of ill persons with turtle exposure specifically reported exposure to small turtles (shell length less than 4 inches).
- 30% of ill persons with small turtles reported purchasing the turtles from street vendors, and 13% reported purchasing small turtles from pet stores.

**At a Glance:**

- Case Count: 391
- States: 41
- Deaths: 0
- Hospitalizations: 63

**More Information:**

- Advice to Pet Owners
- Signs & Symptoms
- Key Resources

**Latest Case Count Map**
Persons may not import a nonhuman primate except for scientific, educational or exhibition purposes.

**REQUIREMENTS FOR IMPORTERS OF NONHUMAN PRIMATES**

Persons, carriers, things

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Nonhuman Primate (NHP) Infectious Disease Risks

- Tuberculosis
- Viral hemorrhagic fever
  - Ebola, Marburg
- Herpes B virus
- Hepatitis A and B viruses
- Monkeypox
- Simian immunodeficiency virus
- Simian foamy virus
- Yellow fever
- Meliodosis (*Burkholderia pseudomallei*)
CDC Nonhuman Primate Importation Program

Importers must—
- Register with CDC
- Certify use for scientific, educational purposes, or exhibition
- Isolate and quarantine for ≥31 days
- Implement disease control measures
- Report suspected zoonotic disease to CDC

Impact
- Improved detection and control of disease outbreaks to prevent transmission to human
- Reduction in nonhuman primate mortality from 15% to <1%
  - Improved quality of medical research studies
IMPORT REGULATIONS FOR INFECTIOUS BIOLOGICAL AGENTS, INFECTIOUS SUBSTANCES, AND VECTORS

Persons may not import any infectious biological agent, infectious substance, or vector without a permit and only for scientific, educational or exhibition purposes.

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Rapid Evolution of SARS Coronavirus, 2003

- Emergence of disease in 2003 in mainland China
- Rapid global spread through human travel & transport
  - >8,000 cases and >750 deaths
  - 26 countries
- Palm civet cat was initially identified as vector
  - Human interaction in marketplace, food
- Bats subsequently identified as the reservoir
Evidence for the Zoonotic Origins of MERS Coronavirus, 2012

- MERS is first known Lineage C beta coronavirus linked to human infection
- Closely related to viruses found in lesser bamboo and Japanese Pipistrelle bats
- *in vitro* studies – virus was able to replicate in bat, primate, civet cell lines
- Epidemiologic linkage of human MERS cases with animals & caretakers
- Serologic evidence of camel infection!


Other Zoonotic Risks from Bats: Marburg Virus in Travelers

In the News
Marburg Case in US Traveler to Uganda
This information is current as of today, February 10, 2009 at 17:55

Updated: January 30, 2009

CDC has recently determined that a US citizen who became ill in January has contracted Marburg hemorrhagic fever after a trip to Uganda. Marburg hemorrhagic fever is caused by Marburg virus. The traveler has since recovered. No evidence of other people has been identified in the United States at this time. There is no evidence of other people being infected.

During her trip to Uganda, the traveler visited "the python cave" in the Forest in western Uganda (at the southern edge of Queen Elizabeth National Park), a popular tourist destination, this cave contains large numbers of fruit bats that harbor Marburg virus.

In July 2008, a Dutch tourist visited this same cave and died from infection with Marburg virus after she returned home.

Travelers should be aware of the serious health risks associated with visiting African forests and caves, especially in areas inhabited by fruit bats. In Africa, the Marburg virus is transmitted from fruit bats to other species, such as monkeys, and then to people.
AFRICAN RODENTS AND OTHER ANIMALS THAT MAY CARRY THE MONKEYPOX VIRUS

Persons must not import or attempt to import any rodents, whether dead or alive, that were obtained, directly or indirectly, from Africa, or whose native habitat is Africa and any products derived from such rodents, any other animal, whether dead or alive.

Photo credit: www.nbcnews.com/id/44867689/ns/technology_and_science-science/t/african-rodents-invaded-brazil-million-years-ago/

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African Rodents and Other Animals That May Carry the Monkeypox Virus

- Restrictions followed a 2003 monkeypox outbreak in the US linked to importation of infected African rodents

- November 2003 Joint FDA-CDC Interim Final Rule
  - Banned interstate movement of African rodents and prairie dogs
  - Banned importation of African rodents

- September 2008
  - FDA portion of ban on interstate movement of prairie dogs lifted
  - CDC’s import restrictions still in place

Photo credit://docs.google.com/document/d/1nvSP5uh3VlCn8Xtl_D9NiRm87a258K0KFBovYkWJmSs/edit?hl=en_US
Rodent Shipment from Accra, Ghana

**TX 1**
50 Gambian rats (GR)
53 rope squirrels (RS)
2 brush-tailed porcupines (BTP)
47 sun squirrels (SS)
100 striped mice (SM)
~510 dormice (DM)

**TX 2**
GR

**TX 3**
RS, BTP, SS

**TX 4**
DM

**TX 5**
DM

**TX 6**
SS, SM, DM

**TX 7**
DM

**TX 8**
DM

**TX 9**
DM

**TX 10**
DM

**IL 1**
GR, DM

**IL 2**
DM

**MN**
DM

**WI**
DM

**IL**
Human cases: 8 confirmed, 4 probable/suspect
14 PDs traced
24 PDs traced

**IN**
Human cases: 2 confirmed
1 PD traced
11 PDs traced

**MO**
Human cases: 1 confirmed
1 PD traced

**KS**
Human cases: 1 confirmed

**MI**
No human cases

**SC**
No human cases

**Japan**
DM

June 2003 lab confirmation: diseased animals derived from shipment

200 prairie dogs (PDs) in existing inventory

**MMWR July 2003**
## Summary of Rodent Importation Trends, 1999-2011

- 2003 ban on African rodent importation to the US

<table>
<thead>
<tr>
<th></th>
<th>Europe</th>
<th>N. America</th>
<th>S. America</th>
<th>Asia</th>
<th>Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # Imports (1999-2011)</td>
<td>999,121</td>
<td>65,215</td>
<td>15,381</td>
<td>5,013</td>
<td>5,317</td>
</tr>
<tr>
<td>Total Imports in 1999</td>
<td>578</td>
<td>485</td>
<td>369</td>
<td>863</td>
<td>444</td>
</tr>
<tr>
<td>Total Imports in 2011</td>
<td>172,596</td>
<td>16602</td>
<td>1605</td>
<td>66</td>
<td>46</td>
</tr>
<tr>
<td>% Change (1999-2011)</td>
<td>29,800%</td>
<td>3,300%</td>
<td>300%</td>
<td>-92%</td>
<td>-90%</td>
</tr>
</tbody>
</table>

Trend during 1999-2011:
- Europe: ↑
- N. America: ↑
- S. America: ↗
- Asia: ↘
- Africa: ↘
Outbreak of Multidrug-Resistant *Salmonella* Typhimurium Associated with Rodents Purchased at Retail Pet Stores --- United States, December 2003--October 2004

During 2004, the Minnesota Department of Health (MDH) Public Health Laboratory notified CDC about the isolation of multidrug-resistant *Salmonella* enterica serotype Typhimurium from ill hamsters from a Minnesota pet distributor. This report describes two of the first identified human cases associated with this outbreak, summarizes the multistate investigation of human *S*. Typhimurium infections associated with exposure to rodents (e.g., hamsters, mice, and rats) purchased at pet stores, and highlights methods for reducing *Salmonella* transmission from pet rodents to their owners. This is the first documented salmonellosis outbreak associated with pet rodents. Findings demonstrate that the handling of pet rodents is a potential health risk, especially for children. Public health practitioners should consider pet rodents a potential source of salmonellosis.

**Case Reports**

**South Carolina.** During June 2004, a boy aged 4 years was hospitalized for 5 days with fever (105°F [40.6°C]), watery diarrhea, and abdominal cramping. A stool culture yielded *S*. Typhimurium. Nine days before the boy's illness, his family had purchased a hamster from a retail pet store supplied by an Arkansas distributor; the hamster was found dead 2 days after purchase.

**Minnesota.** During August 2004, a boy aged 5 years had diarrhea of 14 days' duration (initially bloody), abdominal cramps, vomiting, and fever (103°F [39.4°C]). A stool culture yielded *S*. Typhimurium. Four days before the boy became ill, his family had purchased a mouse from a retail pet store supplied by a Minnesota distributor. The mouse became lethargic and had diarrhea immediately after purchase. Even though the mouse was ill, the boy frequently handled and held the mouse. On one occasion when the boy held the mouse for a few seconds, he transmitted the infection to his mother.
Salmonella in Feeder Mice:
“Added to the Recall List: Millions of Frozen Mice”
International *Salmonella* Outbreaks 2008-2010

*Salmonella* traced to frozen mice sold over the internet to snake owners in US, UK and Canada$^{1,2}$

- US company
- Snakes infected from eating mice, but typically show no sign of illness
- Possible routes of transmission to humans
  - handling frozen or thawed mice
  - handling infected snakes
  - cleaning feces from enclosure
  - cross contamination in the kitchen
- Resulted in hundreds of human *Salmonella* infections
  - US - 34 cases in 17 states
  - UK - >500 cases

Multistate Outbreak of Human *Salmonella* I 4,[5],12:i:-Infections Associated with Frozen Rodents
http://www.cdc.gov/salmonella/frozenrodents/index.html
If any arriving carrier or article or thing on board the carrier is believed to be infected or contaminated with a communicable disease, it may be subject to detention, disinfection, disinfestation, fumigation, or other related measures.

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CDC Embargo on Civets

- Regulated under 42 CFR 71.32(b)
- Due to concerns about transmission of SARS coronavirus to humans
  - Although bat subsequently found to be the vector, concern about high viral load in civets keeps the embargo in place
- Prohibits the importation of civets (family: Viverridae)
  - Exceptions by permit for science, exhibition, or education

Credit: Smithsonian National Zoo
Haitian Goat-Hair Products

- 1973 – case of cutaneous anthrax associated with goatskin drum from Haiti
- CDC investigation in Haiti, resulted in import restrictions on untanned goat-hair products from Haiti
  - Advisory memorandum No. 107
Inhalation Anthrax Associated with Dried Animal Hides --- Pennsylvania and New York City, 2006

On February 21, 2006, the Pennsylvania Department of Health (PDAO) reported to CDC and the New York City (NYC) Department of Health and Mental Hygiene (DOHMH) a case of inhalation anthrax in a man who resided in New York City. This report summarizes the joint epidemiologic and environmental investigation conducted by local, state, and federal public health, animal health, and law enforcement authorities in Pennsylvania and NYC to determine the source of exposure and identify other persons who were potentially at risk.

On February 16, the patient had traveled from NYC to northern Pennsylvania for a performance with his dance troupe. He collapsed later that evening with rigors and was admitted to a local hospital, where he reported a 3-day history of shortness of breath, dry cough, and malaise. A chest radiograph revealed bilateral infiltrates and pleural effusions.

On February 17, the patient was transferred to a tertiary care center because of worsening respiratory status. All four blood culture bottles grew gram-positive rods. Isolates were sent to the PDAO laboratory and confirmed on February 21 as *Bacillus anthracis* by polymerase chain reaction and susceptibility to lysis by gamma phage. On February 22, CDC identified the isolate as *B. anthracis* genotype 1 by multiple-locus variable-number tandem repeat analysis (1). Isolates were susceptible to all antimicrobials tested. Preliminary anti-protective antigen (PA) antibody testing by enzyme-linked immunosorbent assay was below the lower limit of quantification of the assay (2), consistent with early infection. Anti-PA IgG was detectable in the patient’s plasma on February 22 and reached a four-fold elevation above the assay reactivity threshold by February 23, thus confirming seroconversion. As of March 14, the patient remained hospitalized in Pennsylvania.

The joint epidemiologic and environmental investigation sought to 1) determine the source of exposure, 2) identify other persons who were exposed and required...
International Travel & Trade in Animal Products: A Pathway for Hitchhiking Pathogens?

- In 2011: 327,000 nonresident passenger arrivals to the US from Africa
  - 86% increase since 2004

- Opportunities for pathogen introduction via animal products

- Other routes of entry
  - Cargo
  - Mail

- Limited inspection capabilities given scope of trade and travel

Top: [http://www.spiegel.de/fotostrecke/photo-gallery-designing-planes-for-the-future-fotostrecke-59458.html](http://www.spiegel.de/fotostrecke/photo-gallery-designing-planes-for-the-future-fotostrecke-59458.html)

1 Office of Travel & Tourism Industries, U.S. Department of Commerce
**Potential Health Risks from Bushmeat**

- **HIV** is most likely derived from chimpanzee-to-human transmission
  - Through hunting & butchering of bush meat
  - Adaptation to human host & human-human transmission

- **Ebola virus**
  - Detected in chimpanzees and duikers in Côte d’Ivoire
  - Associated with hunter contact with dead chimpanzees

- **Simian immunodeficiency virus (SIV)**
  - 131/788 samples from monkeys & meat SIV+
  - Cameroon¹

- **Simian T-lymphotropic virus (STLV), simian foamy virus (SFV)**

¹Peters et al EID Vol 8 No. 5, May 2002
Zoonotic Agents in Confiscated Bushmeat

- Pilot project with EcoHealth Alliance, Wildlife Conservation Society, and Columbia University to establish surveillance methodology for zoonotic pathogens in bushmeat confiscations

- Laboratory speciation and pathogen screening of bushmeat seized at US ports of entry

- 2012-2013: 96 shipments seized
  - Species identification
    - Cane rat, rodent, hoofstock, nonhuman primate, bat

- Pathogens screened for
  - *Leptospira* and anthrax, herpesviruses, filoviruses, orthopoxviruses, paramyxoviruses, coronaviruses, flaviviruses, simian retroviruses

- 7 shipments with positive results
  - Nonhuman primates - simian foamy virus
  - Rodents – herpesviruses, polyomavirus
  - Bats – coronavirus

State Authority to Limit the Pet Trade: Exotic Animal Swap Meet, Georgia
Sale and Transport of Reptiles Through Mail Shipping Services

- Sumatran Wagler's Viper: $69.00
- Sumatran Wagler's Viper: $69.00
- Banded Pit Viper: $59.00
- Sulawesi Wagler's Viper: $59.00
- Green Western Bush Viper: $49.00
- Red Tail Pit Viper: $59.00
- Eastern Cotton Mouth: $29.00
- Western Diamond Back: $29.00
- Indo Eyelash Viper: $79.00
- Cane Brake: $59.00
- Eastern Diamond Back: $69.00
- King Cobra: $275.00 & up
Challenges

- 4 US federal agencies are responsible for live animal importation
  - CDC, USDA, US FWS, DHS
- 2010 GAO report on live animal importation
  - Agencies need better collaboration to reduce the risk of animal-related diseases
- Gaps and loopholes in regulatory authority
  - Exemptions that allow importation of animals too young to be vaccinated for rabies
  - No laws to prevent exportation
- Varying state and local regulations
- Limited data regarding the number, type of animals in commercial pet trade
  - No testing requirements for animals in the commercial pet trade prior to shipment, or post-arrival
Reducing Zoonotic Risks Associated with Trade & Movement of Animals

- Broker interagency cooperation to assess and close regulatory gaps
- Use regulatory mechanisms and education to decrease supply and demand for animals in the commercial pet trade
- Encourage partnerships between wildlife and public health to promote conservation and protect animal and human health, especially in source countries
- Enhance surveillance of animals in commerce
  - Build the capacity of existing systems to identify and track imported animal species and quantity of shipments
  - Conduct risk assessments of high-risk animals, products, and vectors to better target control and prevention efforts
Preventing Transmission of Zoonotic Diseases Is a Shared Responsibility

- **International travelers**
  - Seek pre travel consultation from a travel medicine provider 4-6 weeks prior to travel
  - Use common sense: animal avoidance, prompt wound care & reporting of bites
  - Avoid temptation to adopt an animal while traveling
  - Assess availability of post-exposure prophylaxis in travel destination, purchase evacuation insurance

- **Veterinarians**
  - Ask about animal’s origin, recent history of travel
  - Know foreign diseases
  - Know reporting pathways

- **Physicians**
  - Know foreign diseases, get travel & animal contact history
  - Advise travelers of risks they may face at destinations
  - Know reporting pathways
  - Pre-exposure immunization of high-risk travelers
  - Follow CDC guidelines to assess risk of exposure & need for post-exposure prophylaxis
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- Bob Mullan
- Lipsa Panda
- Nicki Pesik
- Betsy Schroeder
- Sheryl Shapiro
Thank You!

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.