



# Rabies

Coming to Australia...or already here?

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**Rufino Tamayo** (1899-1991), *Mad Dog*, 1943, Mexican. Oil on canvas.





## Objectives

- Understand the fatal nature of rabies, its presentation, its epidemiology, the initial wound care and pre-and post-exposure treatment for rabies
- Understand that rabies should always be considered with any unknown encephalopathy





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## Rabies epidemic warning threat for Top End

PM By Hagar Cohen

Updated Wed Jan 4, 2012 11:05am AEDT

**Vets in the Top End warn an epidemic of rabies in Indonesia could have disastrous consequences if it reaches Australia, because of the large dog population in remote Indigenous communities.**

The disease is highly infectious, has been a killer in parts of the developing world for decades, and is spreading quickly across the Indonesian archipelago.

It arrived on the Indonesian holiday island of Bali four years ago and is now on an island 600 kilometres north of Darwin.

"They tracked it back to a fisherman who brought his dog on a boat, and that dog had been incubating rabies," said Janice Girardi, director of the Bali Animal Welfare Association.

Ms Girardi says eliminating rabies is tough because it is so contagious and the most effective way of preventing the disease is through vaccinating all dogs.

Her organisation has already vaccinated close to 300,000 canines across Bali.

"Extensive studies have come up with the R0 number, the infectious number, to be under two, so one rabid dog will infect one and a half other dogs," she said.

"You put an unvaccinated population of dogs, you will see how quickly it spreads because every dog is infecting one and a half other dogs.

"If you vaccinate above 70 per cent of those dogs, the disease will die out."

She says rabies has spread beyond Bali and Australia is not immune.

"You have very good quarantine controls, which is excellent," she said.

"But people are still brought in to Australia and still get through, so the chance of a dog coming in on those boats is likely.

"If it's undetected and you have a population of dogs that are not vaccinated then those dogs will get rabies and it will start spreading, as it did in Bali."



PHOTO: More than 300,000 dogs have been vaccinated across Bali. (Sukree Sukplang: Reuters)

RELATED STORY: [The battle to control rabies in Bali is being won](#)

MAP: Bali





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HEALTH AND SCIENCE

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A+ A- Print

## Health experts say Australia must brace for rabies arrival from Indonesia

ANDY DREWITT The Australian January 03, 2012 12:00AM

- Fixing a rabies epidemic
- Rabies vaccinations
- Rabies soundslide



**Fixing a rabies epidemic**  
A rabies epidemic in Bali has killed 130 people. Now 275,000 half-wild dogs are being vaccinated. Video: Andy Drewitt

**EXPERTS** battling a rabies epidemic in Bali are warning Australians to brace for the arrival of the disease.

Rabies is island-hopping towards Australia through the Indonesian archipelago and is about 600km north of Darwin on the island of Pulau Larat, where it killed 19 people in 2010.



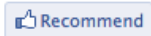



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## Rabies isn't coming to Australia... we think

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AAP  
January 06, 2012  
6:27AM

**THE Government says Australia is ready to fight an outbreak of rabies, but believes the risk of the deadly disease spreading from Indonesia to the Northern Territory is very low.**

Bali is now in the midst of a dog vaccination program following the deaths of a number of people in Indonesia from rabies after dog bites.

The virus, which is highly contagious and causes inflammation of the brain, is believed to have been introduced to Bali when a fisherman brought an infected dog to the island.

Australia is currently free of rabies, but experts fear the epidemic may somehow be carried to areas around the Top End, which are closest to Bali, and spread.

The Department of Agriculture, Fisheries and Forestry says measures to prevent that from occurring include biosecurity officers, who are based on all islands in the Torres Strait to ensure there is no movement of animals between Papua New Guinea and Northern Torres Strait islands.

### RELATED

[Helping save Bali from deadly disease](#)

[Rabies coming to Oz is 'unlikely'](#)

[Action urged to stop spread of rabies](#)

[Health experts warn of rabies arrival](#)

[Rabies on our doorstep](#)





7:05AM, TUE 29 MAY 2012 GRANDMOTHER DIES FROM RABIES

## Grandmother dies of rabies

- last updated Tue 29 May 2012

UK • Rabies • Darent Valley Hospital

Recommend

Tweet



*The hospital in Dartford reportedly failed to recognise the signs of rabies Photo: ITV News*

A woman being treated for rabies in London after being bitten by a dog in south Asia has died.

The woman, believed to be a grandmother in her fifties, was reportedly turned away twice by doctors at Darent Valley Hospital in Dartford, Kent, before she was finally diagnosed

She was being treated at London's Hospital for Tropical Diseases.

In a statement, University College London Hospitals NHS Foundation Trust said: "We regret to announce that a patient being treated for rabies by the Hospital for Tropical Diseases and colleagues at University College Hospital died over the weekend.

"The patient's family have kindly requested for the media to respect their privacy during this very difficult time and we will not be releasing any further details, nor will the family be making any statements."

Rabies is usually transferred through saliva from the bite of an infected animal, with dogs being the most common transmitter of rabies to humans.

More than 55,000 people are estimated to die from the disease every year, with most cases occurring in developing countries, particularly south and south-east Asia.





© DOUG SCOTT

**Rare: Naturalist David McRae (pictured) became the first person in Britain to die of the disease for 100 years after he was bitten on the hand by a rabid bat in 2002**





# Rabies

- Why should you learn about rabies?
  - ◆ It's the most uniformly fatal infectious disease in the world
  - ◆ It is endemic everywhere, except for a few exceptions (**WHO states that Antarctica is the only rabies free continent.**)
  - ◆ Any unknown encephalopathy that you transport is suspect
  - ◆ You, being on the front line, may make a difference in someone being **seen, treated and their life saved**





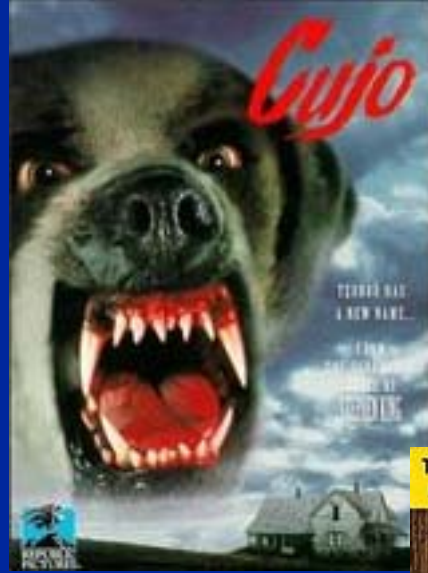


## Rabies History

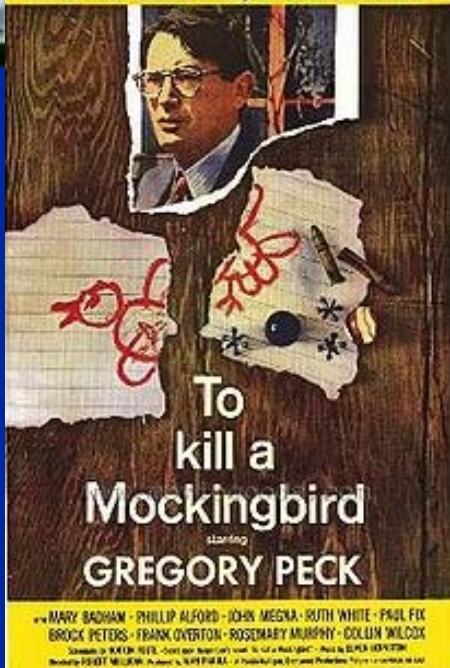
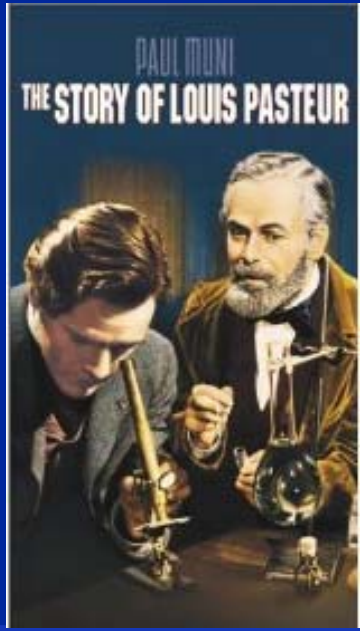
- One of oldest diseases recorded in human history
- Noted in Babylonian Code 4000 years ago
- Sanskrit: “rabhas” “to rage”
- Latin: “raverere” “to rave”
- No wonder: a rabid bite was literally the kiss of death; through most of human history there was nothing that could be done

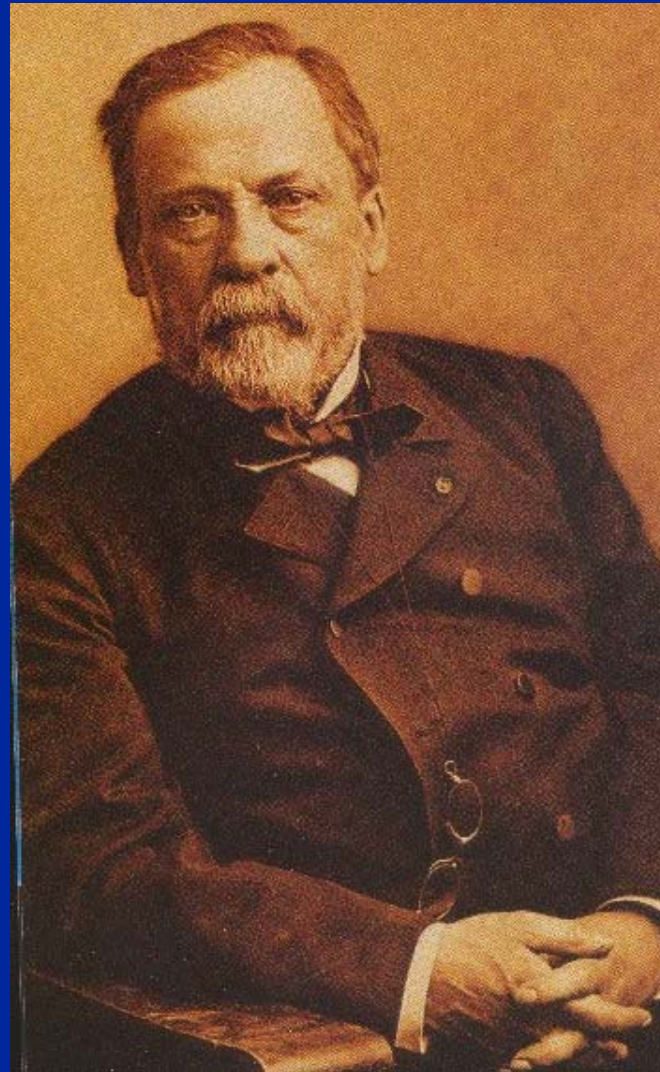


# Five Movies with Rabies Theme



The most beloved and widely read Pulitzer Prize Winner now comes vividly alive on the screen!





**Louis Pasteur 1822-1895**





## First Immunization

- Pasteur showed that the rabies agent, a virus, could be attenuated by serial intra-cerebral passage in the rabbit, a species other than its natural host. He immunized a young boy, Joseph Meister, who had been bitten by a rabid dog
- No prior use in animals!
- Imagine trying to get that through the IRB or your Ethics Committee!





## Turning Point in 19th Century

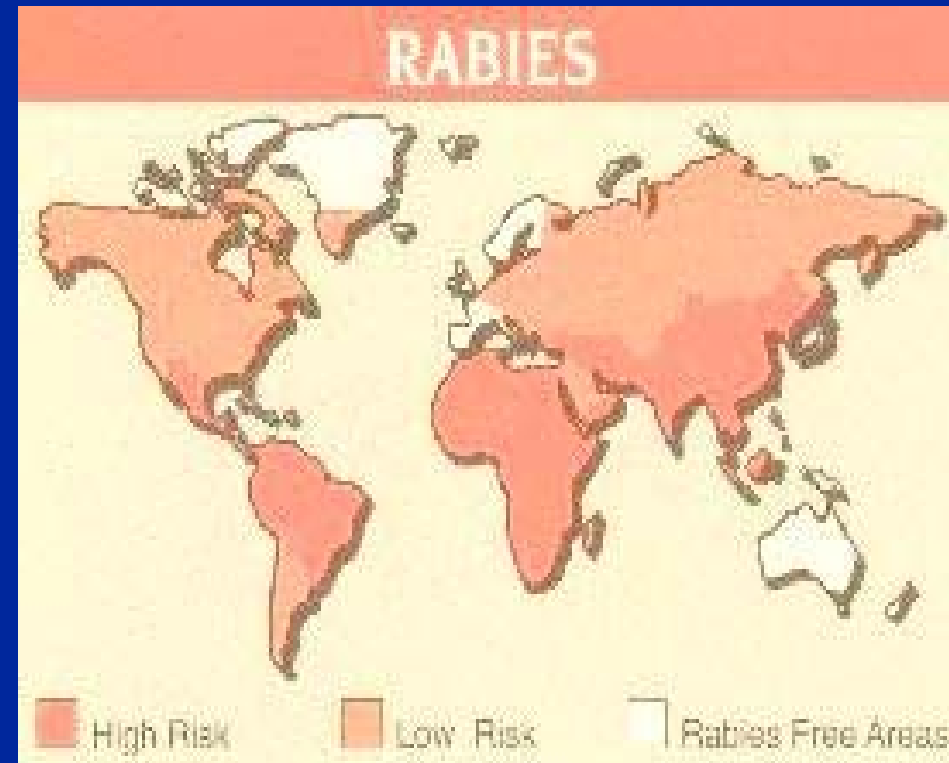
- Development of rabies vaccine in 1885 dramatically changed everything
- That which was fatal was now potentially survivable
- ...but WHO estimates 30,000 to 70,000 people still die yearly worldwide-- in third world countries a rabid bite is still the kiss of death (contrast with U.S that has had an average of 1-3 deaths per year in the last 20 years; one death in 2005)





## Areas of World Rabies Free

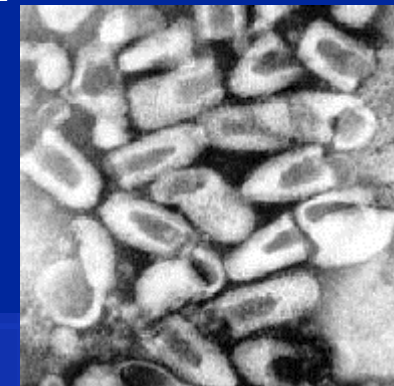
- Great Britain
- Ireland
- Sweden
- Hawaii
- New Zealand
- Japan
- Taiwan
- Iberia Peninsula





## The Virus(es)

- Caused by a number of strains of the family lyssavirus, genus Rhabdoviradae
- Single-stranded RNA bullet shaped virus
- Viruses in different areas and different animals have different epitopes (in glycoprotein and nucleoprotein) and differing nucleotide sequences





## The Virus(es)

- Travels from bite site along peripheral nerves to CNS
- Closer to CNS-- faster the syndrome occurs (e.g. a bite on the face leads to clinical rabies faster than a leg bite)

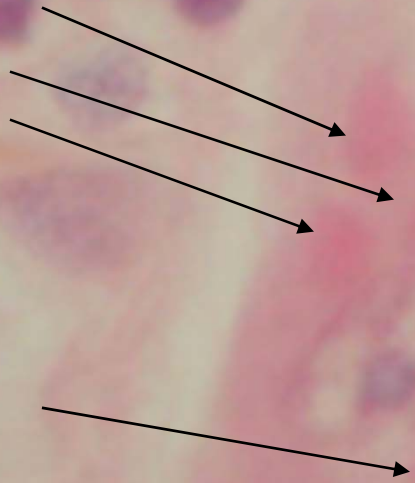


Killer: Rabies viruses showing their characteristic bullet shape. The disease has an extremely low survival rate once symptoms have developed





Negri bodies

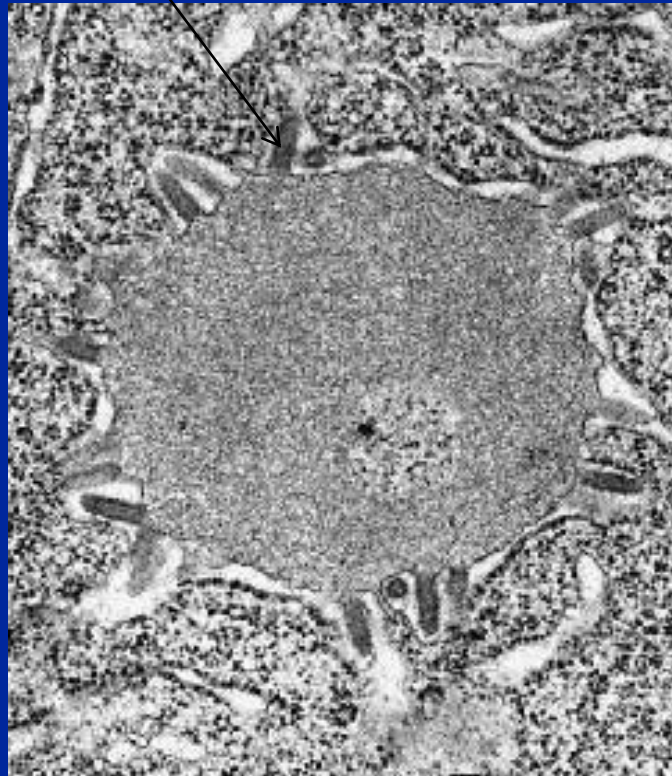


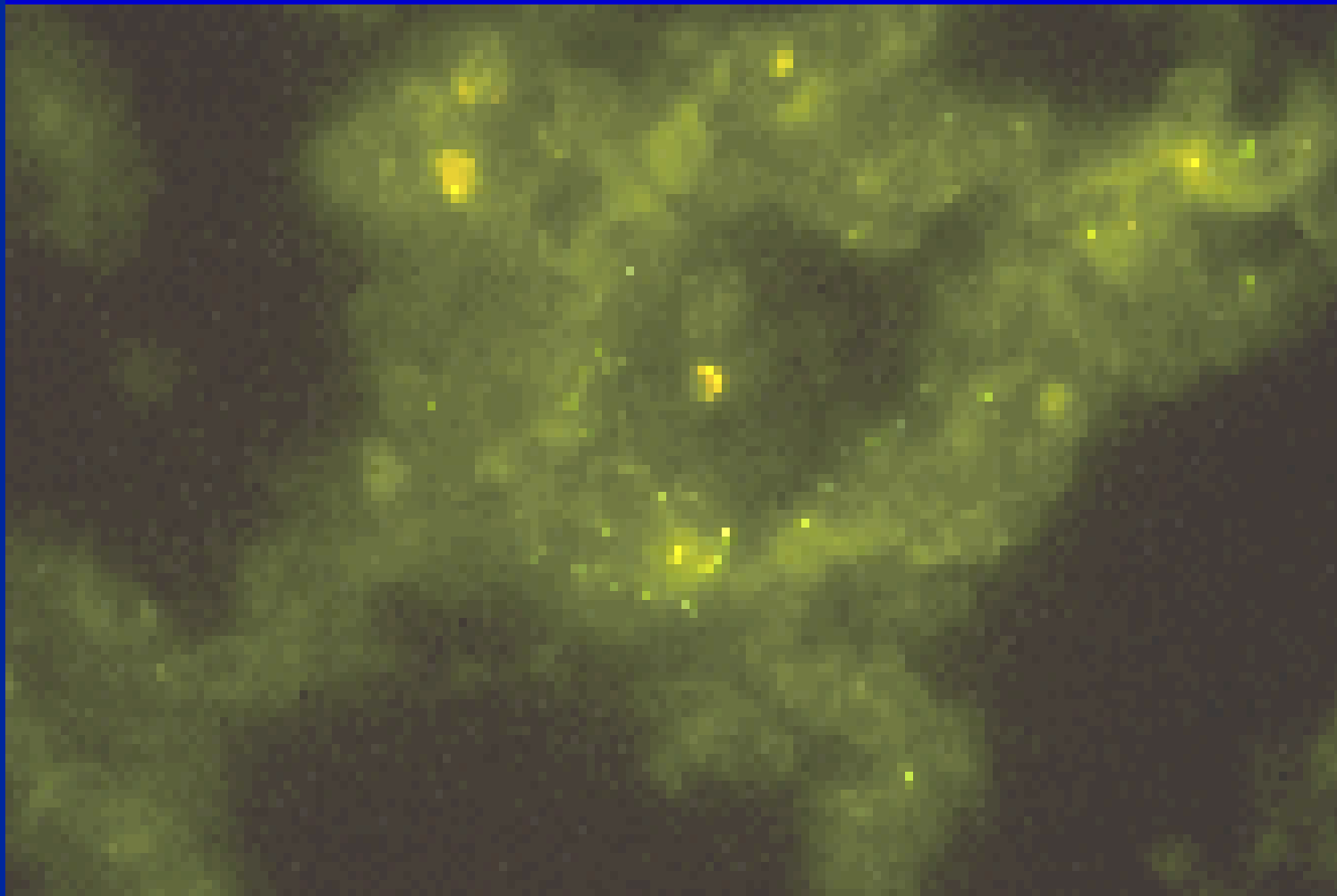


# Negri Bodies

The lesion in brain sections by light microscopy

Virus budding off Negri body





Immunofluorescence of virus particles confirms infection





## Clinical Illness

- Rabies presents with one of two clinical picture:
  - ◆ Encephalitic ("furious") rabies (80% to 85% of cases) has the classical presentation with hydrophobia, pharyngeal spasms, and hyperactivity leading to paralysis, coma, and death
  - ◆ Paralytic form is much less common.





# Clinical Illness

- Incubation: Ranges from 10 days to 1 year (average 20 to 60 days); *the woman who died in Australia in 1996 of ABL had a 27 month incubation!*
- Prodrome: Onset 2 to 10 days postexposure; lasts 1 day to 2 weeks.
- Characterized by nonspecific flu-like symptoms:
  - malaise, anorexia, irritability, low-grade fever, headache, nausea, vomiting
  - paresthesia, pain, or numbness may be present at bite site





## Clinical Illness

Acute neurologic syndrome  
occurs 2 to 7 days after prodrome

dysarthria,  
dysphagia,  
excessive salivation,  
diplopia,  
vertigo,  
nystagmus,  
restlessness,  
agitation  
polyneuritis,  
nuchal rigidity

visual or auditory  
hallucinations,  
manic behavior  
alternating with  
lethargy;  
hydrophobia  
secondary to  
painful contractions  
of pharyngeal  
muscles;  
hyperactive deep  
tendon reflexes  
positive Babinski  
signs





# Clinical Illness

- **Coma:**
  - 7 to 10 days after neurologic stage.
  - Hydrophobia,
  - Prolonged apnea,
  - Generalized flaccid paralysis which can evolve in an ascending fashion as in Guillain-Barre,
  - Seizures and coma with ultimate respiratory and vascular collapse.





## Clinical Illness

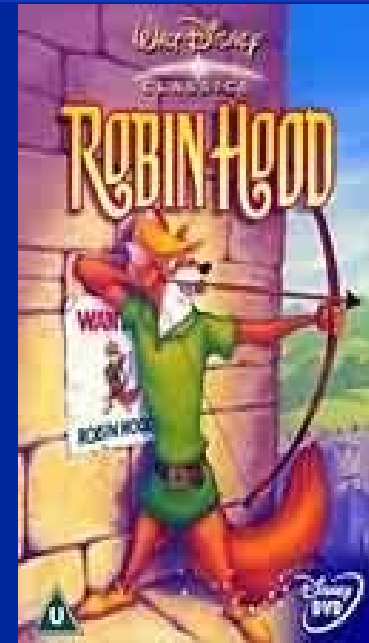
- **Death may follow 2 to 3 days after onset of paralysis symptoms**
- **May be prolonged by life-support**
- **Recovery rare**







Raccoons © Kevin Gillis, Art © Amanda Allan 2001





# Transmission

- **Bites of infected animals**
  - ◆ In undeveloped countries: 90% dogs
  - ◆ In developed countries: <5% dogs
  - ◆ Principal vectors:
    - ✦ Mongoose, antelope and jackal in Africa
    - ✦ Fox in Europe, Canada, Arctic and sub-arctic regions
    - ✦ Wolves in western Asia
    - ✦ Vampire bat in Latin America
  - ◆ In U.S: skunks, raccoons, cattle, horses, foxes, bats





<b>Date of Death</b>	<b>State of Residence</b>	<b>Exposure History*</b>	<b>Rabies Virus Variant†</b>
March 15, 1995	WA	Unknown#	Bat, Msp
September 21, 1995	CA	Unknown#	Bat, Tb
October 3, 1995	CT	Unknown#	Bat, Ln/Ps
November 9, 1995	CA	Unknown#	Bat, Ln/Ps
February 8, 1996	FL	Dog bite - Mexico	Dog, Mexico
August 20, 1996	NH	Dog bite - Nepal	Dog, SE Asia
October 15, 1996	KY	Unknown	Bat, Ln/Ps
December 19, 1996	MT	Unknown	Bat, Ln/Ps
January 5, 1997	MT	Unknown#	Bat, Ln/Ps
January 18, 1997	WA	Unknown#	Bat, Ef
October 17, 1997	TX	Unknown#	Bat, Ln/Ps
October 23, 1997	NJ	Unknown#	Bat, Ln/Ps
December 31, 1998	VA	Unknown	Bat, Ln/Ps
September 20, 2000	CA	Unknown#	Bat, Tb
October 9, 2000	NY	Dog bite - Ghana	Dog, Africa
October 10, 2000	GA	Unknown#	Bat, Tb
October 25, 2000	MN	Bat bite - MN	Bat, Ln/Ps
November 1, 2000	WI	Unknown#	Bat, Ln/Ps





February 4, 2001	CA	Unknown# - Philippines	Dog, Philippines
March 31, 2002	CA	Unknown#	Bat, Tb
August 31, 2002	TN	Unknown#	Bat, Ln/Ps
September 28, 2002	IA	Unknown#	Bat, Ln/Ps
March 10, 2003	VA	Unknown#	Raccoon, Eastern US
June 5, 2003	PR	Bite	Dog/Mongoose, Puerto Rico
September 14, 2003	CA	Bite	Bat, Ln/Ps
February 15, 2004	FL	Bite	Dog, Hati
May 3, 2004	AR	Bite (organ donor)	Bat, Tb
June 7, 2004	OK	Liver transplant recipient	Bat, Tb
June 9, 2004	TX	Kidney transplant	Rat, Tb





June 10, 2004	TX	Arterial transplant recipient	Bat, Tb
June 21, 2004	TX	Kidney transplant recipient	Bat, Tb
Survived, 2004	WI	Unknown#	Bat, Unknown
October 26, 2004	CA	Unknown#	Dog, El Salvador
September 27, 2005	MS	Unknown#	Bat, Unknown
May 12, 2006	TX	Unknown#	Bat, Tb
November 2, 2006	IN	Bite	Bat, Ln/Ps
December 14, 2006	CA	Bite	Dog, Philippines
October 20, 2007	MN	Bite	Bat, Unknown
March 18, 2008	CA	Bite-Mexico	Fox, Tb-related
November 30, 2008	MO	Bite	Bat, Ln/Ps
Survived, 2009	TX	Unknown#	Bat, Unknown
October 20, 2009	IN	Unknown#	Bat, Ps
November 11, 2009	MI	Unknown#	Bat, Ln/Ps
November 20, 2009	VA	Bite	Dog, India
August 21, 2010	LA	Bite	Bat, Mexico, Ds
January 10, 2011	WI	Unknown	Bat, Ps
Survived, 2011	CA	Unknown	Unknown
July 20, 2011	NJ	Bite	Dog, Haiti
August 31, 2011	NY	Bite	Dog, Afghanistan



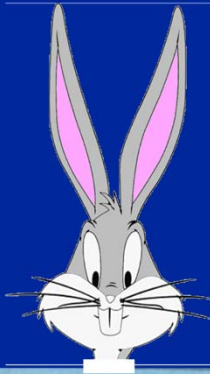


**What large group of mammals do not carry rabies (at least in the U.S.)?**

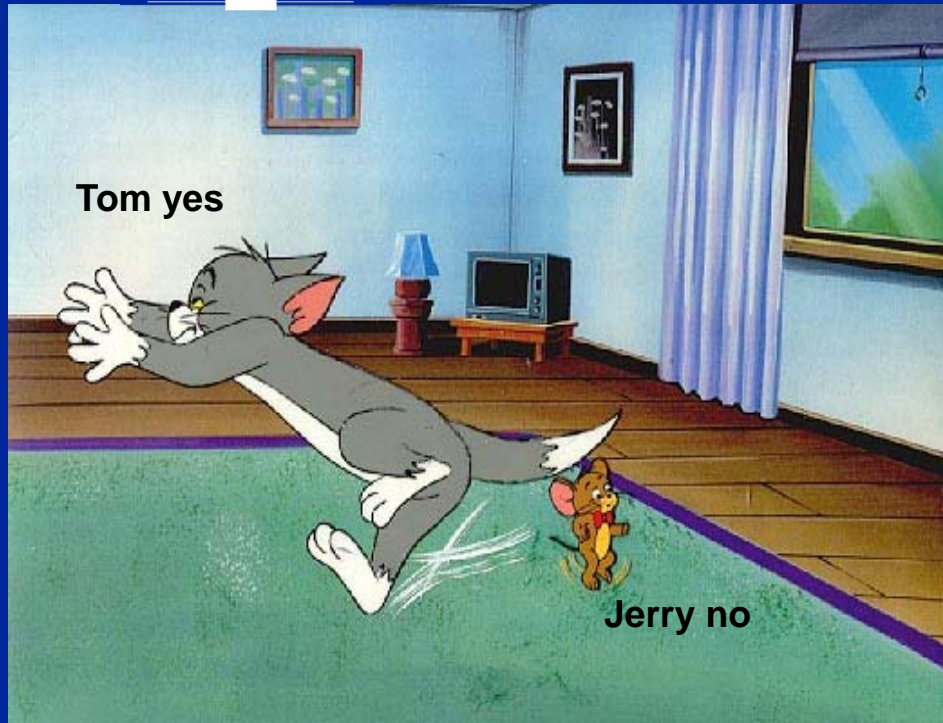




# Rodents and Lagomorphs



Bugs no



Tom yes

Jerry no



Rocky no

Bullwinkle yes





- The only rodent that is commonly rabid in the U.S. is the woodchuck
- Anecdotal reports of rabies transmitted by rats in Thailand and by bandicoots in Sri Lanka

Bandicoot







# Largest North American Rodent



Can carry and transmit rabies





# Largest rodent in the world

## Capybara





- Our opossums are very low risk, are resistant to rabies





# Rabies in Animals

## Scope of Problem

- In 2006, 6900 rabid animals submitted to CDC
- 7.6% of cases were in domestic animals  
(compared to 82% in 1950)
- Cats represented 318 (4.6%) of the CDC cases
- Of the 24 cases in the US since 2000, none associated with cats
- Last human rabies case in US from cat in 1975
- Dog and cat exposures can not be discounted

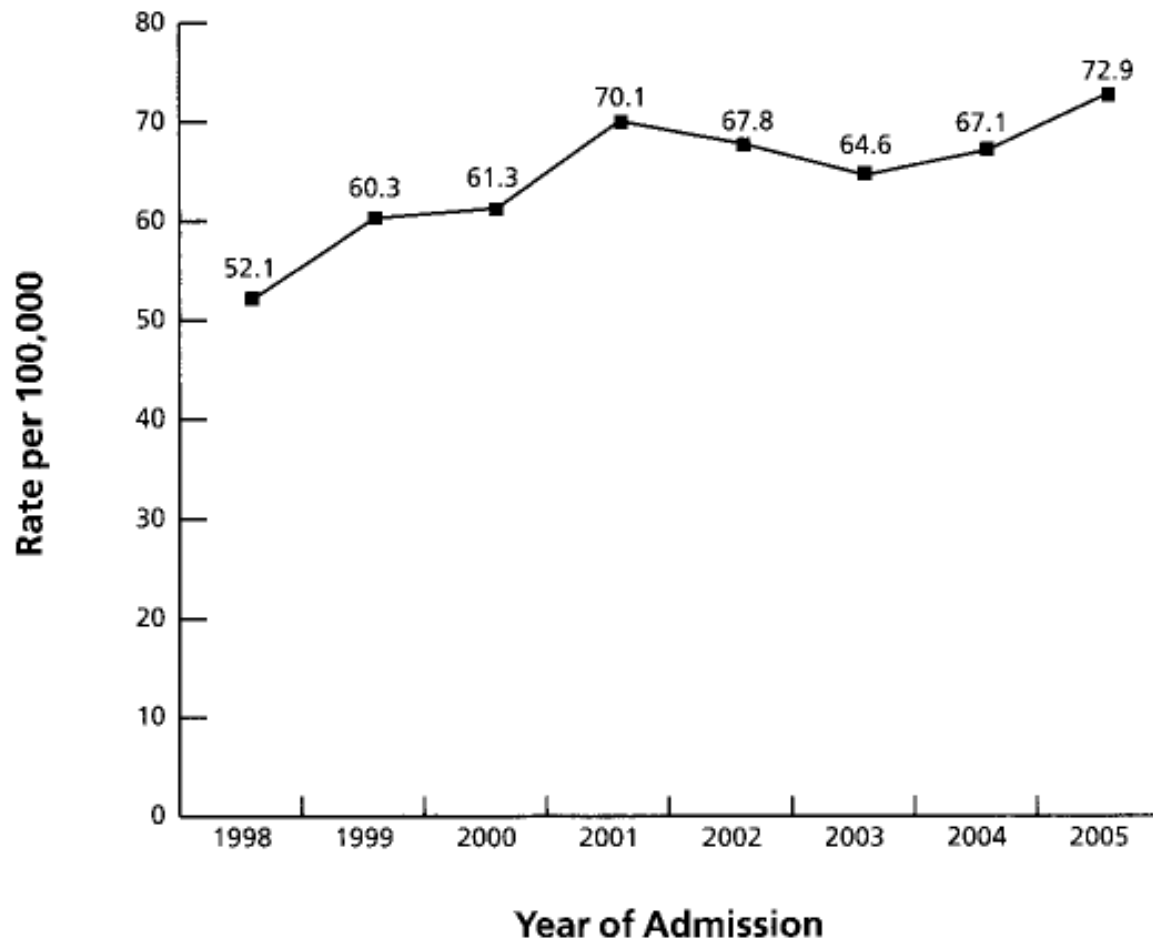






Figure 1

### Age-Adjusted Rates of Hospital-Treated Dog Bites by Year of Admission, 1998-2005, Minnesota (N=25,433)





## Rabies in MN

- 5 cases of human rabies in MN since 1917: 1917, 1964, **1975**, 2000, 2007
- All fatal, obviously
- The case in 1975 that I cared for as resident was diagnosed postmortem
- Last one in 2007, male in 40's exposed to **bat** in North Central MN in August, 2007, died October 20, 2007





## Rabies in MN

- Last case, 2007, the man felt a “needle prick” on his finger, but no blood drawn, so he did not seek medical attention
- Rabies diagnosed Oct 18, he died Oct 20, 2007







## Testing Animals

- **Controlled domestic (immunizations UTD): quarantine 10 days**
- **Uncontrolled domestic (immunizations unknown): start vaccine within 5 days**
- **Feral or wild:**
  - ◆ **Available- sacrifice and ? begin vaccine**
  - ◆ **Unavailable- begin vaccine and immunoglobulin**
- **Any vet can prepare an animal to send to state health department**





## Bats

- **Most common source of rabies in U.S.**
- **For many of the cases in which nucleotide analysis demonstrates that the rabies virus strain is of bat origin, no history of an actual bite by a bat can be obtained**
  - ◆ **bat bite is very tiny,**
  - ◆ **because the victim did not report a bite to anyone and can no longer give the history**
  - ◆ **because the virus is spread through aerosol transmission**





## Bats

- CDC recommendations include postexposure rabies prophylaxis for anyone who has contact with a bat even if there has not been a bite
- Any person who awakens from sleep and finds a bat in their room should be immunized, as should any one who is unreliable (child, inebriated)





## Rabies Immunization in the U.S.

- 25,000 to 40,000 get post-exposure prophylaxis each year in the U.S.
- Cost exceeds \$1000 per course
- CDC estimates of cost per life saved is:





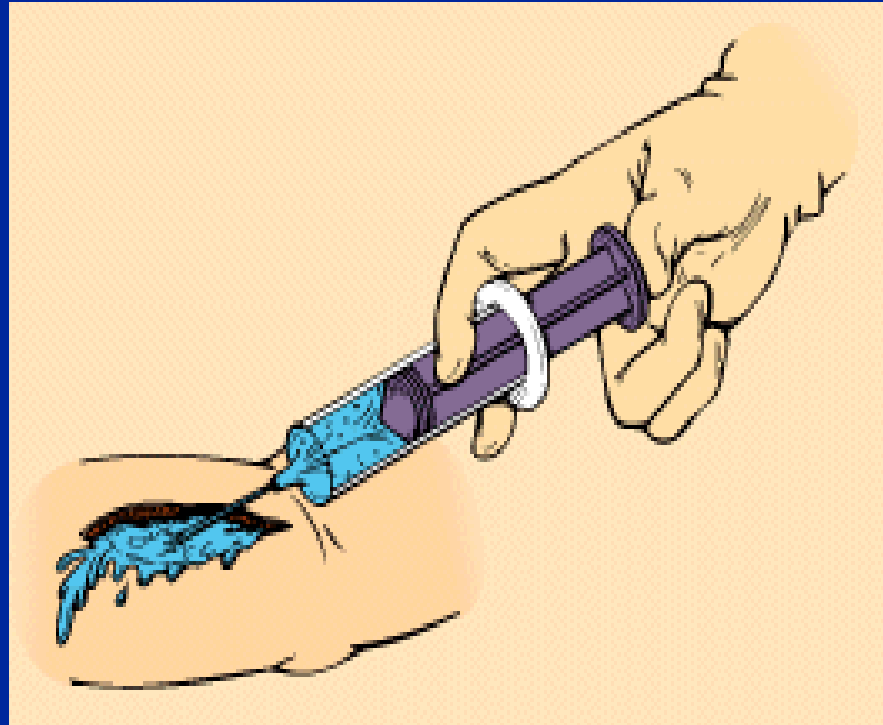
**TABLE 2. Cost-effectiveness ratios (cost/life saved) for rabies postexposure prophylaxis, by different scenarios of potential exposure\* — United States**

Contact scenario	Probability of rabies <sup>†</sup> Median (minimum–maximum)	Baseline cost scenario <sup>§</sup> Average cost effectiveness (most cost-effective–least cost-effective)
Animal tests positive for rabies	(0.01–0.7)	Cost Saving
Skunk bite <sup>¶</sup>	0.05 (0.01–0.1)	Cost Saving
Possible bat bite <sup>¶**</sup>	0.001 (0.000001–0.01)	\$2.9 million (Cost saving–\$8.4 billion)
Dog bite <sup>¶</sup>	0.00001 (0.00001–0.001)	\$403 million ((\$524,080–\$840 million)
Dog lick <sup>¶</sup>	0.000001 (0.000001–0.00001)	\$4 billion ((\$162 million–\$8.4 billion)
Cat bite <sup>¶</sup>	0.001 (0.00001–0.01)	\$2.9 million (Cost saving–\$840 million)
Cat lick <sup>¶</sup>	0.000001 (0.000001–0.00001)	\$4 billion ((\$15 million–\$8.4 billion)
Contact with rabid human in clinical setting <sup>**</sup>	0.000001 (0.000001–0.00001)	\$4 billion ((\$162 million–\$8.4 billion)





# Wound Treatment





- **Soap and water is effective to remove any virus that may remain in the area of the bite**
- **Rinse under clean water tap for ten minutes**





# Vaccines

Now 2 types of vaccines

- All preparations in U.S. produced in cell culture (Safer than infected animal brain preparations)
  - ◆ HDCV (Imovax) (only one FDA approved for PRE-EXP)
    - ◆ Human diploid cells
    - ◆ Risk of serum sickness 6% with boosters
  - ◆ PCEC (RabAvert)
    - ◆ Developed in chick embryo
    - ◆ New preparation with fewer side effects
    - ◆ Contraindicated in severe egg allergy







# Who should consider preexposure rabies prophylaxis?

State tissue laboratory technicians



Veterinarians; Animal Handlers



Travelers to remote Countries such as India, Nepal, Central America



Cave explorers, cleaning bat infested attic?





# How many doses of vaccine are needed for Pre-exposure Prophylaxis?





## How many doses of vaccine are needed for Pre-exposure Prophylaxis?

- 3 Intradermal
- Day 0, 7, 21
- Antibody testing to determine when boosters are needed (usually every two years)
- Two boosters needed if exposed to possible rabies (day 0, day 3) **No Immunoglobulin!!!**





**How many doses are needed for the rabies postexposure vaccine schedule?**

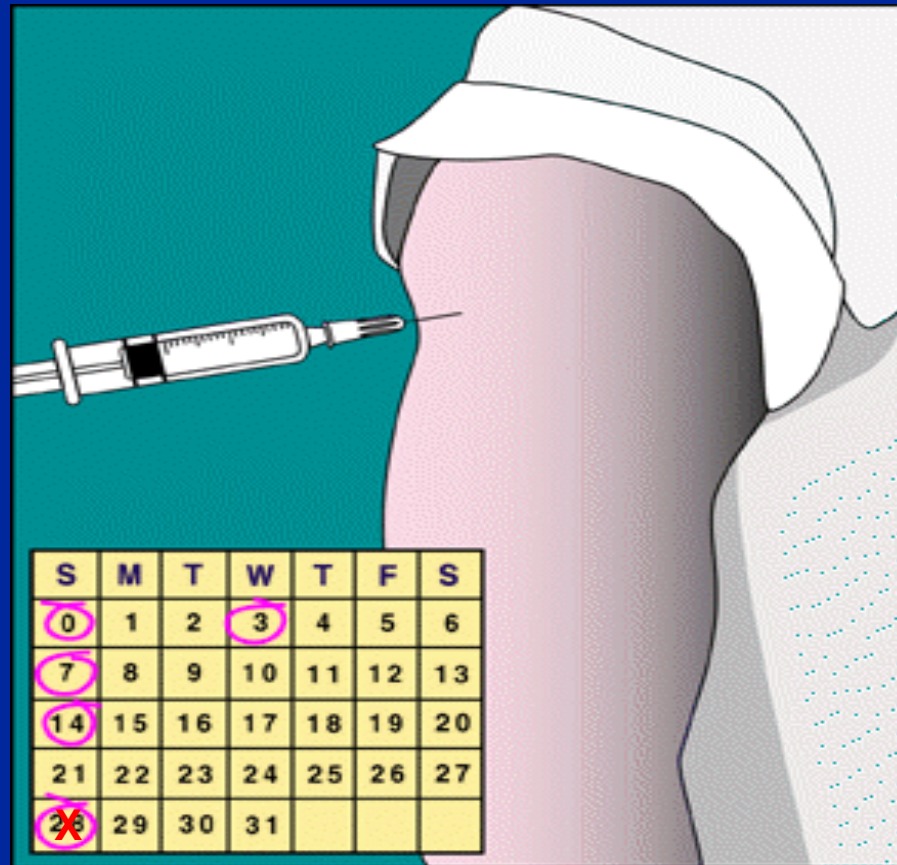




# How many doses are needed for the rabies postexposure vaccine schedule? NOW

~~5~~

4





**What is the dose in  
International Units per KG of  
Rabies Immunoglobulin (RIG)?**





# What is the dose in International Units per KG of Rabies Immunoglobulin (RIG)?

**20 IU/kg**

- **Passive Immunoprophylaxis:**
  - ◆ 1/2 dose should be infiltrated into wound areas, if feasible
  - ◆ remainder IM in an additional site
- **DO NOT use if previously immunized**





## How many doses are required of “old” neural preparation vaccine?

21

- Vaccine given subcutaneously in abdominal wall
- High rate of complications
- Semple or Neural Tissue Vaccine







## How many survivors of rabies disease are acknowledged by CDC?

67

- MMWR: December 24, 2004 / 53(50);1171-1173
  - ◆ Recovery of Wisconsin 15 year-old
  - ◆ Bitten by bat in September
  - ◆ One month later fatigue; tingling and numbness in hand
- 5 previous survivors all had some immunization prior to illness
- Only one survived neurologically intact





The NEW ENGLAND JOURNAL of MEDICINE

BRIEF REPORT

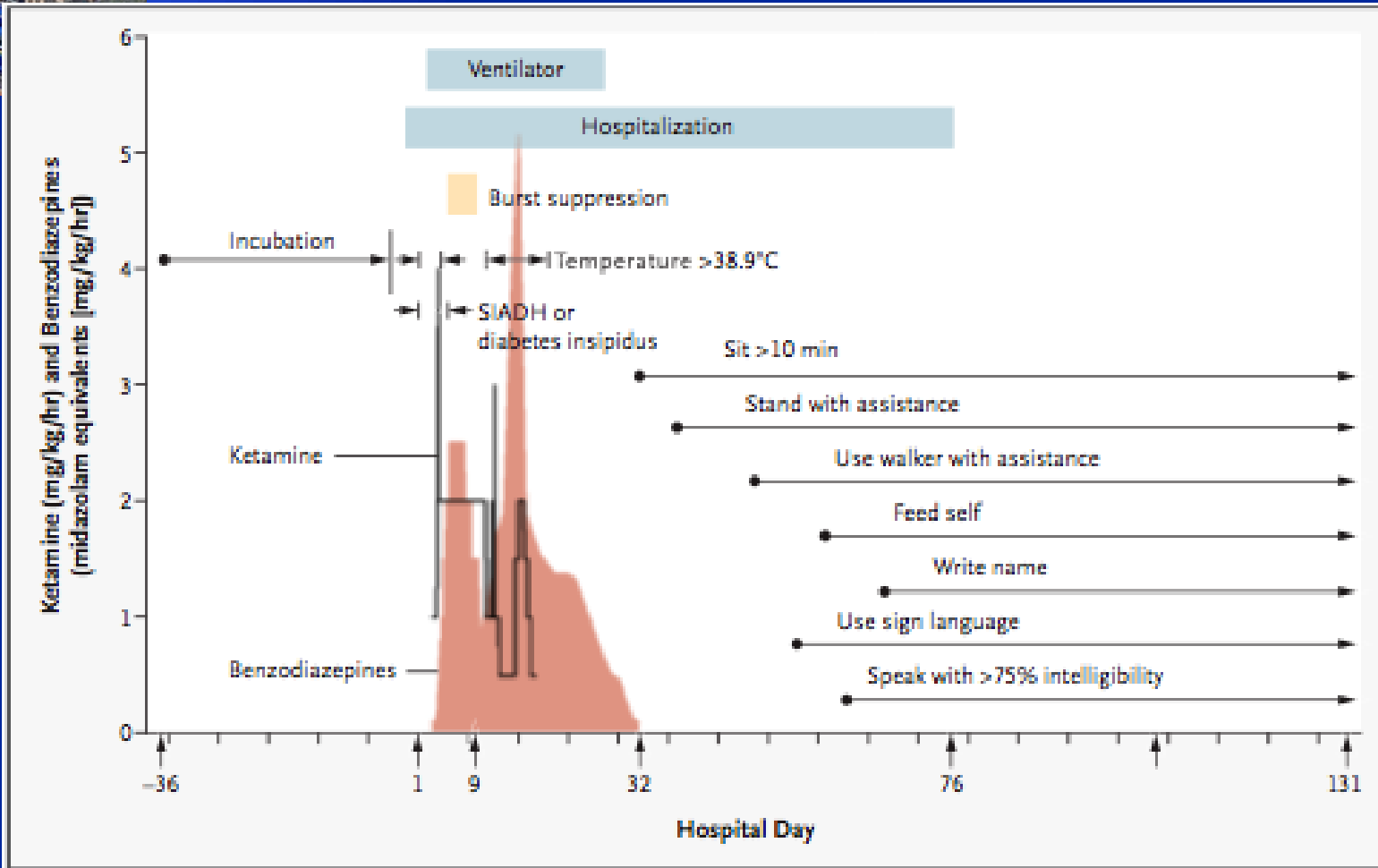
## Survival after Treatment of Rabies with Induction of Coma

Rodney E. Willoughby, Jr., M.D., Kelly S. Tieves, D.O.,  
George M. Hoffman, M.D., Nancy S. Ghanayem, M.D.,  
Catherine M. Amlie-Lefond, M.D., Michael J. Schwabe, M.D.,  
Michael J. Chusid, M.D., and Charles E. Rupprecht, V.M.D., Ph.D.

### SUMMARY

We report the survival of a 15-year-old girl in whom clinical rabies developed one month after she was bitten by a bat. Treatment included induction of coma while a native immune response matured; rabies vaccine was not administered. The patient was treated with ketamine, midazolam, ribavirin, and amantadine. Probable drug-related toxic effects included hemolysis, pancreatitis, acidosis, and hepatotoxicity. Lumbar puncture after eight days showed an increased level of rabies antibody, and sedation was tapered. Paresis and sensory denervation then resolved. The patient was removed from isolation after 31 days and discharged to her home after 76 days. At nearly five months after her initial hospitalization, she was alert and communicative, but with choreoathetosis, dysarthria, and an unsteady gait.





**Figure 2.** Timeline by Hospital Day from the Time of Inoculation with Rabies Virus until Two Months after Discharge from the Hospital.

The incubation period extends from the day on which the patient was bitten by a bat until her first symptoms appeared. Hospitalization includes both the referral and accepting hospitals. The therapeutic coma induced by ketamine and midazolam and the period of burst suppression are shown for reference. Disorders of temperature (more than 38.9°C) and the syndrome of inappropriate antidiuretic hormone (SIADH) or diabetes insipidus are indicated. The patient was transferred from intensive care on the 32nd hospital day. A selected list of rehabilitation milestones is shown.





# Kids Did It!

BY STEFAN LOVGREN

## “I’m a Miracle Survivor!”

Fond du Lac, Wisconsin

**J**eanna Giese wasn't thinking about rabies when she found a bat on the floor of her church. The 15-year-old animal lover just wanted to take the creature outside so it could fly home. But when Jeanna picked up the bat, it nipped her finger.

At home, Jeanna's mom cleaned the small wound with peroxide. "It was just a tiny scratch," says her mom, Ann. "So I didn't think it *could* cause rabies."

But a month later Jeanna felt tingling in her arm. Then at a volleyball game, she developed double vision and began to vomit. At the hospital, doctors were stumped. Then came the diagnosis: Jeanna had rabies.

People *do* survive rabies, a virus transmitted through the saliva of rabid animals. But they survive only if they receive a vaccine before symptoms occur. Jeanna was already showing signs of rabies, so doctors thought it was too late.

To save Jeanna's life, Dr. Rodney Willoughby tried something that had never been done before with a rabies victim—he put Jeanna into a deep sleep. He hoped this would protect her brain while her immune system fought off the virus.

It was touch-and-go for a while until Jeanna began to wake up. After almost three months in the hospital, Jeanna finally returned home. She's back in school, and her doctors predict that she'll be fine.

Jeanna has learned a valuable lesson to never handle wild animals. She knows how lucky she is, but she takes her remarkable recovery in stride. Even with her no-big-deal attitude, though, doctors couldn't help but give Jeanna a new nickname: the miracle patient.

HERE'S WHAT HAPPENED.



Little brown bat

THE BAT LOOKED LIKE THIS.



NOW SHE'S HEALTHY!



Jeanna, now 17, and her pet rabbit

Fond du Lac, WI



Only one or two people in the United States develop rabies each year, but thousands are exposed. Stay safe by *never* handling wild animals or petting neighborhood animals whose owners you don't know. Rabid animals are rare, but if you're bitten by any animal, seek medical attention immediately.

MICHAEL DURHAM (BAT); RICK WOOD (JEANNA); BEN SHANNON (ART)





## Newest Survivor Just Reported

CDC Home



Centers for Disease Control and Prevention

CDC 24/7: Saving Lives. Protecting People. Saving Money through Prevention.

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A-Z Index [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#) <#>

### Morbidity and Mortality Weekly Report (MMWR)

[MMWR](#)

Text size: [S](#) [M](#) [L](#) [XL](#)



## Recovery of a Patient from Clinical Rabies – California, 2011

*Weekly*

February 3, 2012 / 61(04);61-65

In May 2011, a girl aged 8 years from a rural county in California was brought to a local emergency department (ED) with a 1-week history of progressive sore throat, difficulty swallowing, and weakness. After she developed flaccid paralysis and encephalitis, rabies was diagnosed based on 1) detection of rabies virus-specific antibodies in serum and cerebrospinal fluid (CSF), 2) a compatible clinical syndrome in the patient, and 3) absence of a likely alternative diagnosis. The patient received advanced supportive care, including treatment with therapeutic coma. She was successfully extubated after 15 days and discharged from the hospital 37 days later to continue rehabilitation therapy as an outpatient. The public health investigation identified contact with free-roaming, unvaccinated cats at the patient's school as a possible source of infection. Several of these cats were collected from the school and remained healthy while under observation, but at least one was lost to follow-up. A total of 27 persons received rabies postexposure prophylaxis (PEP) for potential exposures to the patient's saliva. No further cases of rabies associated with this case have been identified. Rabies prevention efforts should highlight the importance of domestic animal vaccination, avoidance of wildlife and unvaccinated animals, and prompt PEP after an exposure.

### Case Report

On April 25, 2011, a girl aged 8 years visited her pediatrician with a complaint of a sore throat and vomiting when taking sotalol, a medication previously prescribed for her supraventricular tachycardia. Over the next few days, she developed swallowing difficulties and could drink only small amounts of liquids, but was able to carry on with daily activities. Three days after her initial visit, she was seen in a local ED for poor oral intake and was given intravenous fluids to treat dehydration. Two days later, she complained of abdominal pain without localization and neck and back pain, and was brought back to the ED, where she was evaluated and discharged home with a presumed viral illness. The next day, May 1, she returned for a third time to the ED with complaints of sore throat, generalized weakness, and abdominal pain suggestive of appendicitis. On physical examination, she was confused with a pulse of 108 beats per minute, blood pressure of 112/87 mmHg, and temperature of 96.7°F (35.9°C). Head and abdominal computed tomography (CT) were unremarkable. Chest CT was only remarkable for left lower lobe atelectasis. She choked while trying to drink oral radiographic contrast medium. Because of respiratory distress and acidosis shown by arterial blood gas analysis, she was intubated and placed on a ventilator. She was given intravenous fluids, ceftriaxone, and azithromycin and was transferred to a tertiary-care facility.





# Rabies Pearls

- Immunization always means vaccine and immunoglobulin, except if they have had vaccine previously
- Rodents and lagomorphs (rabbits, hares) do not carry rabies (except large rodents: woodchucks, beavers, capyberas)
- Bats are the biggest single source of human rabies in the USA
- Domestic animals in custody, vaccinated, not sick: can wait 10 days unless become ill





## Rabies Pearls

- **Domestic animals not in custody, chance of recovery: wait no more than 5 days**
- **Wild animals in possession: have vet send head to state, can wait until results**
- **Wild animals not in possession: begin immunization right away**





# Cases







## Case 1

- A 24 year-old medical student is planning a trek in Nepal.
- She plans to be away form Katmandu and other medical treatment centers.
- She is concerned about exposure to rabid dogs, which are endemic in the trek area.
- What precautions should she take if a dog bites her during her trek?





- A. She should carry a first aid kit, which includes Betadine, and 70% alcohol to clean contaminated wounds and only worry about rabies if the dog was acting strangely.**
- B. She should return immediately to Katmandu for proper treatment within a week of a bite.**
- C. She should carry rabies immune globulin and immunization vaccine with her to start if she gets bitten while on the trek.**
- D. She should be immunized with the rabies vaccine before going to an endemic area.**





## Case 2

- A 30 year-old woman living temporarily in an older rental home with three young cats; found one of the cats in her bedroom playing with a dead bat.
- A second bat was found in the bedroom closet.
- What treatment is indicated for this event?





- A. Since the bat is dead and she has not had any direct contact with bat no treatment is necessary for the woman or her cat.**
- B. Since she has been sleeping in a room where bats have been present she will need standard rabies immune globulin and immunization.**
- C. Since she has been sleeping in a room where bats have been present but has not had any direct contact with the bat she just needs the immunization series**
- D. Since the cat was playing with the dead bat the cat should be sacrificed and the brain examined for possible rabies.**





## Case 3

- A 5 year-old girl ran home and told her mother that a bad cat had bitten her hand when she tried to pet it.
- She does not know what color the cat is or where it lives. Her mother thinks there are some stray cats living in the area.
- She has two deep puncture wounds on her right thumb.
- What treatment is indicated for this event?





- A. The neighborhood should be searched for stray cats and any found should be sacrificed and sent to the state lab for analysis of brain tissue. Any prophylactic treatment of the girl should wait until these results are available.**
- B. The wound should be cleaned with soap and water and antibiotics started for bacterial infection. No rabies prophylaxis is needed since cats are unlikely to spread this viral disease.**
- C. The girl should be started on rabies immunization series but she does not need RIG since the wounds are too tiny to be injected with immunoglobulin.**
- D. The girl should have rabies immune globin at a dose of 20 IU /kg divided between injection into the wound sites and IM at a different site, as well as beginning the immunization series with rabies vaccine**





## Case 4

- At a family reunion a horse was bridled with a mouth bit and ridden by several children.
- The next day the horse was found dead.
- Veterinary and laboratory testing revealed that the horse was positive for rabies.
- What treatment is indicated for this event?





- A. Everyone who bridled the horse or petted the horse and was exposed to the horse's saliva should receive immune globulin and the immunization series**
- B. Everyone who attended the reunion and was in the vicinity of the horse should receive immune globulin and the immunization series**
- C. Everyone who touched or rode the horse should receive immune globulin and the immunization series**
- D. Only people who were bitten by the horse should receive immune globulin and the immunization series**







**That's all, Folks!**





## The “Streamlining”

- Manufacturing problems
- Surging demand; expected 8,000 to 10,000 per year for prophylaxis; actually 35,000 to 40,000 per year are exposed (mostly due to large numbers of exposures to rabid raccoons on East Coast)
- Evidence that promptness of administration is more important than length of dosing
- No evidence in the U.S. of problems with accidentally omitting 5<sup>th</sup> dose





## The “Streamlining”

- CDC says this could save \$12-\$17 million dollars per year
- Is this “off label” usage?
- Package insert still says 5 doses
- What does one do?





# CDC Advisors Suggest Streamlining Postexposure Prophylaxis for Rabies

## **Proposed Rabies Postexposure Prophylaxis Schedule**

For those who have not been previously vaccinated:

- Immediate, thorough cleaning of all wounds with soap and water and irrigation with a virucidal agent (if available)
- Administration of human rabies immunoglobulin
- Administration of human diploid cell vaccine or purified chick embryo vaccine on days 0, 3, 7, and 14

For those who have been previously vaccinated:

- Immediate, thorough cleaning of all wounds with soap and water and irrigation with a virucidal agent (if available)
- Human rabies immunoglobulin should not be administered
- Administration of human diploid cell vaccine or purified chick embryo vaccine on days 0 and 3

