

Quarantined

An inspector has placed this area under quarantine for a disease of stock pursuant to sections 14(1) and 14(1A) of the *Stock Act 1915*. A person must not remove from or introduce to the quarantined area, stock, without the written authority of the chief executive (the Director-General, DPI&F).

Maximum penalty: 1,000 penalty units or 1 year's imprisonment.



Hendra virus..
..disease ecology perspectives

Hume Field
Queensland Primary Industries & Fisheries
Dept Employment, Economic Development & Innovation.

background..

- no evidence of infection in horses prior to 1994.
- now 11 known spillover events.
- flying foxes identified as the natural host.
- low infectivity, but high case fatality rate.
- human cases attributed to close contact with infected horses.

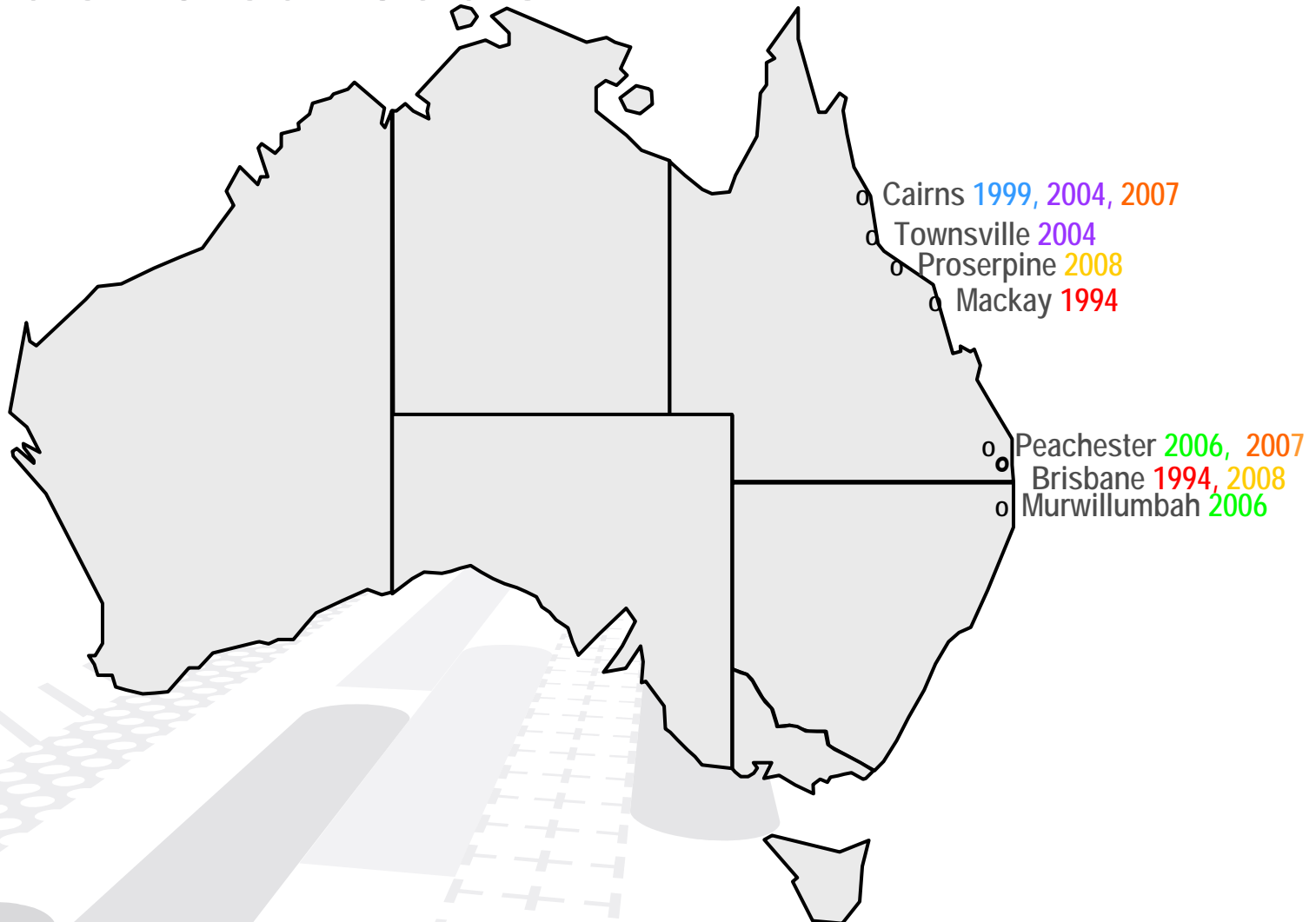


Kim Halpin, 1996 (then UQ/DPI&F)

known spillovers..

Mackay	2 horses & one human	August 1994
Brisbane (Hendra)	20 horses & two humans	September 1994
Cairns (Trinity Beach)	1 horse	January 1999
Cairns (Gordonvale)	1 horse & one human	October 2004
Townsville	1 horse	December 2004
Peachester	1 horse	June 2006
Murwillimbah	1 horse	October 2006
Peachester	1 horse	June 2007
Cairns (Clifton Beach)	1 horse	July 2007
Brisbane (Redlands)	5 horses* & two humans	June 2008
Proserpine	3 horses*	July 2008

spatial distribution..



known spillovers..

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CAUTION DO NOT ENTER

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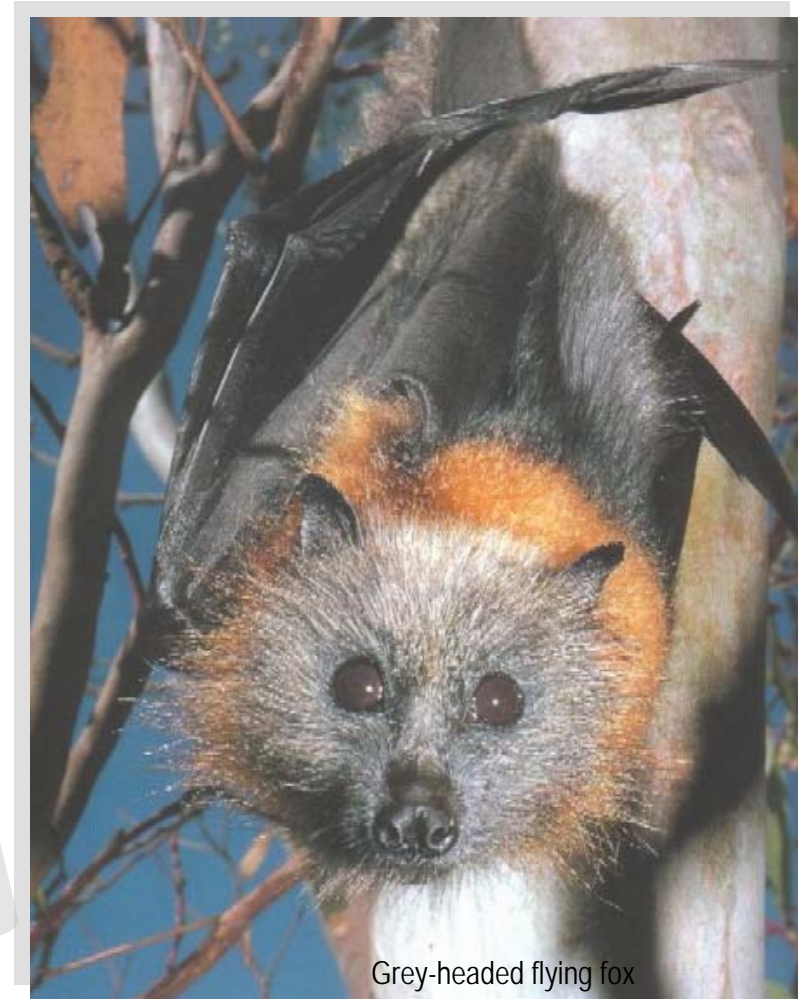
CAUTION DO NOT ENTER





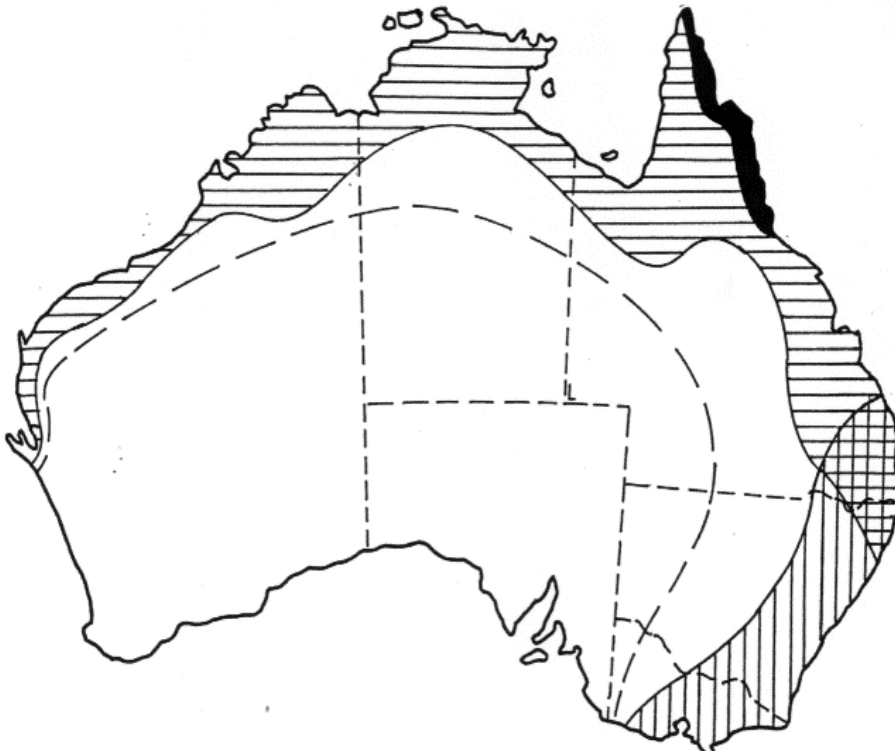
natural reservoir..

- flying foxes identified as the natural host in 1996.
- wide geographic range.
- wide species range.
- no attributed clinical disease in flying foxes.
- antibodies in archived samples.



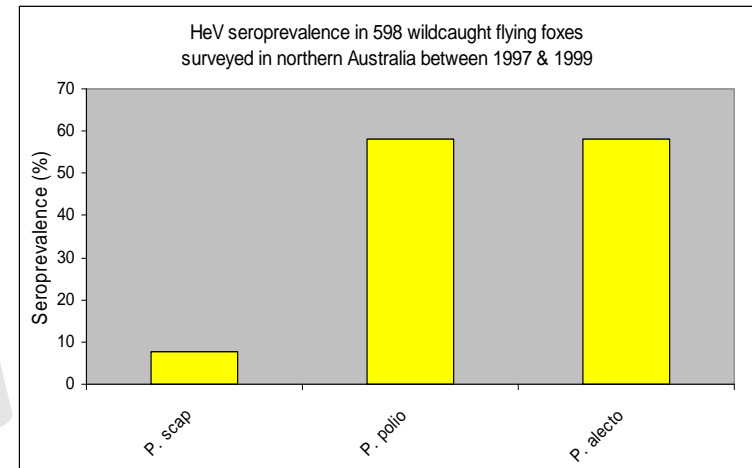
Grey-headed flying fox

flying fox distribution..

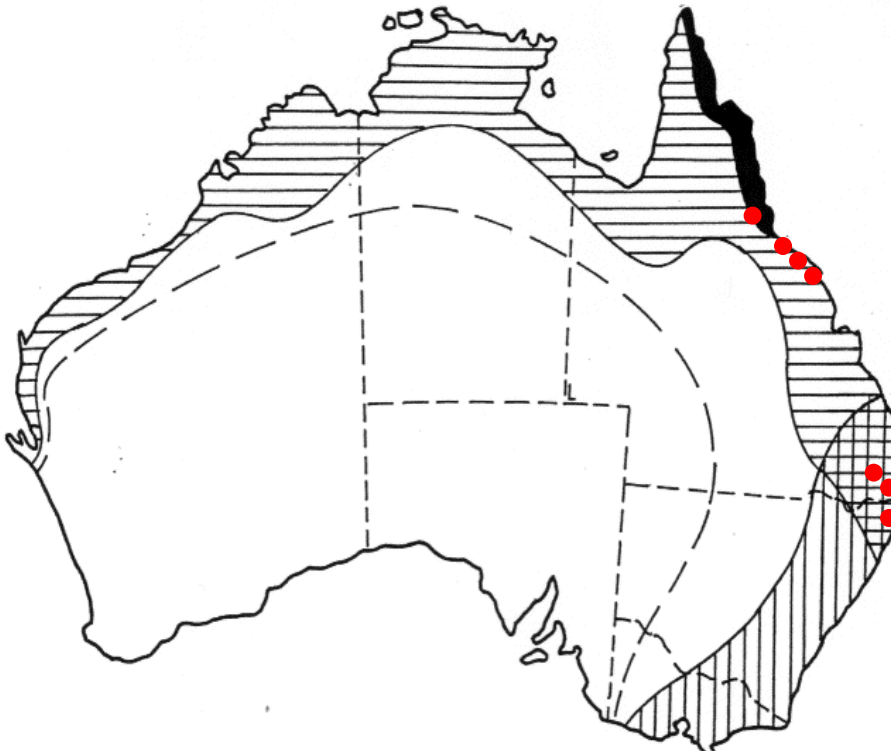


Key:
 Horizontal hatching *P. alecto*
 Vertical hatching *P. poliocephalus*
 Solid black *P. conspicillatus*
 Broken line *P. scapulatus* (southern inland limit)

Adapted from Hall and Richards (2000).



flying fox distribution..



- *P. alecto* 11/11
- *P. scap* 11/11
- *P. polio* 5/11
- *P. consp* 3/11

Key:

Horizontal hatching *P. alecto*
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Adapted from Hall and Richards (2000).

modeling infection dynamics..

- long-term virus persistence requires a mix of
 - 'smoldering' epidemics (requiring large populations) and
 - 'explosive' local epidemics (requiring many spatially discrete sub-populations)
- only two species, *P. alecto* and *P. scapulatus*, meet these requirements.



Raina Plowright, 2002

infection dynamics in bats..

- neutralizing antibody prevalence associated with

- age $p=0.0028$
- season $p=0.0025$



Andrew Breed, 2005 (then UQ/AB-CRC/BQ)

infection dynamics in bats..

VECTOR-BORNE AND ZOO NOTIC DISEASES

Volume 00, Number 00, 2009

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DOI: 10.1089/vbz.2008.0105

A Longitudinal Study of the Prevalence of Nipah Virus in *Pteropus lylei* Bats in Thailand: Evidence for Seasonal Preference in Disease Transmission

Supaporn Wacharapluesadee,¹ Kalyanee Boongird,² Sawai Wanghongsa,² Nitipon Ratanasetyuth,¹
Pornpun Supavonwong,¹ Detchat Saengsen,² G.N. Gongal,³ and Thiravat Hemachudha¹

infection dynamics in bats..

PROCEEDINGS
OF
THE ROYAL
SOCIETY

B



Proc. R. Soc. B
doi:10.1098/rspb.2007.1260
Published online

Reproduction and nutritional stress are risk factors for Hendra virus infection in little red flying foxes (*Pteropus scapulatus*)

Raina K. Plowright^{1,*}, Hume E. Field², Craig Smith², Anja Divljan³,
Carol Palmer⁴, Gary Tabor⁵, Peter Daszak⁶ and Janet E. Foley¹

- UC Davis
- US NSF funding



Raina Plowright, 2002

putative drivers for spillover..

- ecological changes ->urbanization and isolation.
 - increased contact within colonies.
 - decreased contact between colonies.
 - changed infection/immune dynamics.
 - increased outbreak intensity after viral re-introduction.

modes of transmission..

routes of excretion from flying foxes:

- urine
- saliva
- foetal fluids/tissues

modes of transmission..



Microbes and Infection 4 (2002) 145–151

Microbes and
Infection

www.elsevier.com/locate/micinf

Original article

Isolation of Nipah virus from Malaysian Island flying-foxes

Kaw Bing Chua ^{a,*}, Chong Lek Koh ^b, Poh Sim Hooi ^a, Kong Fatt Wee ^a, Jenn Hui Khong ^a,
Beng Hooi Chua ^a, Yee Peng Chan ^b, Mou Eng Lim ^c, Sai Kit Lam ^a

modes of transmission..

plausible modes of bat-horse transmission:

- ingestion of partially eaten fruit
- ingestion of 'spats'
- ingestion of urine-contaminated pasture/feed
- licking/sniffing foetal tissues

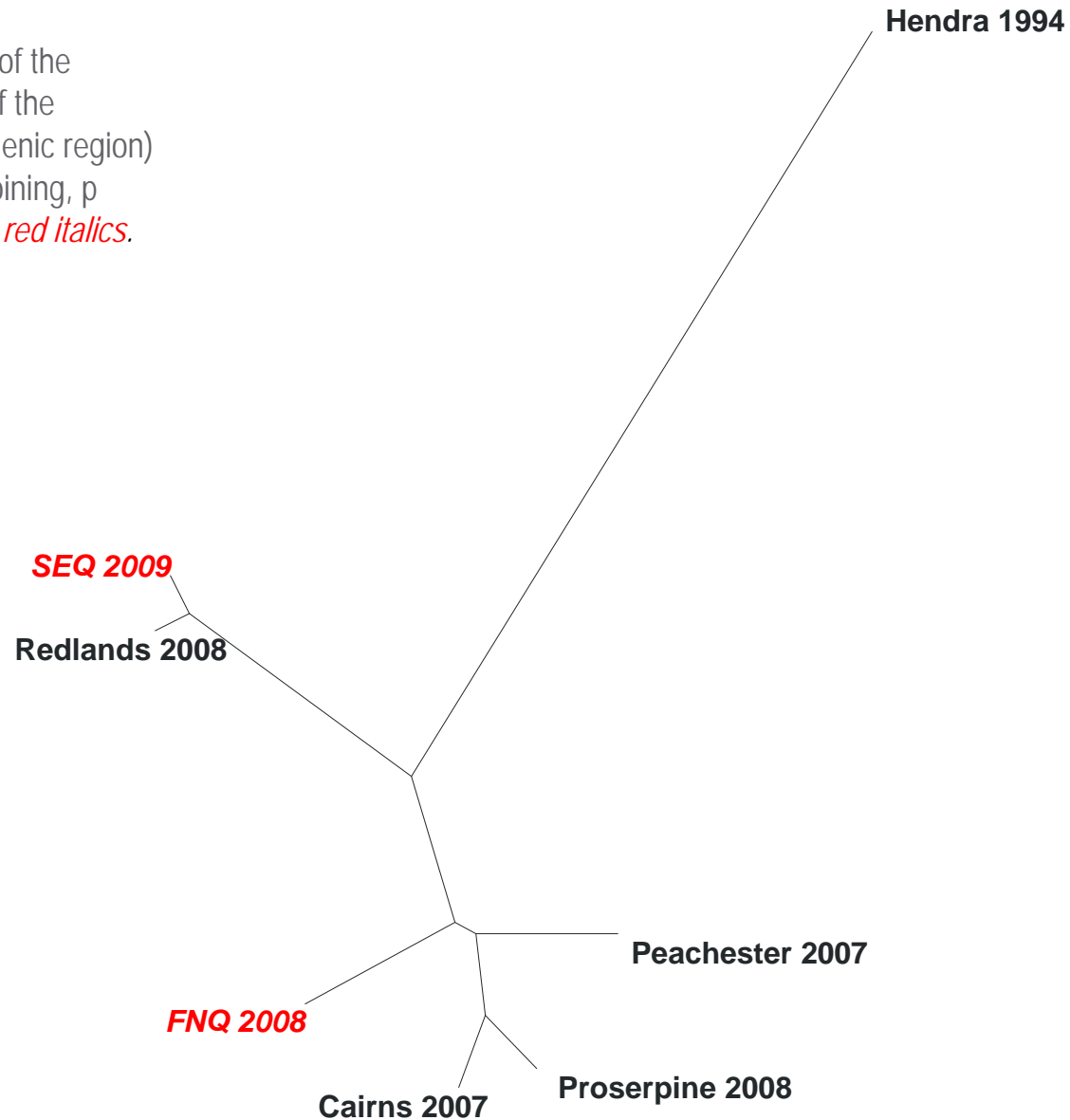
under roost pooled urines..

Date collected	Location collected	Species	# Pooled samples	Taqman PCR
30/07/2008	SEQ	<i>P. polio</i>	20	Neg
08/08/2008	SEQ	<i>P. polio</i>	18	Neg
17/09/2008	SEQ	<i>P. polio</i>	4	Neg
20/11/2008	FNQ	<i>P. cons</i>	20	Pos (# 11, 12, 14)
28/11/2008	SEQ	<i>P. polio, P. alecto, P. scap</i>	4	Neg
4/12/2008	SEQ	<i>P. polio, P. alecto</i>	35	Neg
18/12/2008	FNQ	<i>P. cons</i>	21	Neg
16/12/2008	FNQ ¹	<i>P. scap</i>	17	Neg
6/02/2009	SEQ	<i>P. alecto</i>	20	Neg
12/02/2009	SEQ	<i>P. alecto, P. polio, P. scap</i>	20	Pos (# 10)
25/02/2009	SEQ	<i>P. alecto, P. polio, P. scap</i>	21	Neg
6/03/2009	SEQ	<i>P. alecto, P. polio, P. scap</i>	18	Neg
22/11/2008	FNQ	<i>P. cons</i>	24	Neg
25/11/2008	FNQ	<i>P. cons</i>	22	Neg
27/03/2009	FNQ	<i>P. alecto</i>	14	Neg
9/04/2009	SEQ	<i>P. polio</i>	20	Neg
26/03/2009	SEQ	<i>P. alecto, P. polio</i>	18	Neg
25/3/2009	SEQ	<i>P. alecto, P. polio</i>	15	Neg
24/03/2009	SEQ	<i>P. alecto, P. polio</i>	20	Neg
17/04/2009	SEQ	<i>P. alecto, P. polio</i>	13	Neg

[364]

phylogenetic analysis of Hendra strains..

for nucleotide 1500 to 2240 of the genome (carboxy terminal of the Nucleoprotein and the intergenic region) using Mega 4.0 (Neighbor-joining, p distances). Bat sequence in *red italics*.



QPIF Hendra virus webpage ..

If you suspect Hendra virus, please contact **Biosecurity Queensland** immediately on **13 25 23** or contact the **Emergency Disease Watch Hotline on 1800 675 888**.

Overview

- [Hendra virus overview](#)

Get a copy of the report

- Download: '[Independent review of Hendra virus cases](#)' (PDF, 480 kB)

For veterinarians

- Updates from the Chief Veterinary Officer:
[2009, April 3](#) | [2008, August 19](#) | [2008, August 8](#) | [2008, July 28](#)
- [Guidelines for veterinarians handling potential Hendra virus infection in horses](#)
Version 3, April 2009
- [Submitting samples for analysis](#)
- [Safe use of personal protective equipment \(PPE\)](#)

For communities

- [Hendra virus: important information for horse owners](#) (PDF, 262 kB)
Download your copy today.
- [Fact sheet: important community information](#) (PDF, 71 kB)
(including advice to horse owners)
- [Fact sheet: Hendra virus infection](#)
(from Queensland Health)

Research

- [Initial experimental characterisation of HeV \(Redland Bay 2008\) infection in horses](#) (PDF, 222 kB)

Report authored by Deborah Middleton, CSIRO AAHL

- [Research into Hendra virus: the story so far](#)
Research participants, progress, challenges and current work.

- [Hendra virus: the initial research](#)

This information sheet reports on the emergence of Hendra virus in horses and on research into reservoir hosts and transmission studies in fruit bats, horses and cats.

▪ [Scientific papers](#)

guidelines for veterinarians..

http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/4790_13371_ENA_HTML.htm

acknowledgements..

- Biosecurity Queensland (Deb Melville, Carol de Jong, Craig Smith).
- Queensland Health Forensic & Scientific Services lab (Ina Smith and colleagues).
- CSIRO AAHL.

funding

- Australian Biosecurity CRC for Emerging Infectious Diseases.
- Australian DAFF (WEDPP Program)
- USA Consortium for Conservation Medicine



managing the risk of spillover..

for a given colony of flying foxes, the probability of spillover depends on

- the proportion of susceptible flying foxes,
- the introduction of infection,
- the colony size..

plus

- the density of horses at roosting/feeding sites,
- the susceptibility of individual horses.
- the virus strain/virus dose/route of infection.

managing the risk of spillover..

- cases are rare (relative to the size of the horse population)
- future spillover events should be expected.
- increased awareness, alertness and preparedness in horse-owning and veterinary communities.
- encourage husbandry practices to minimize risk of exposure.

managing the risk of spillover..

- undertake exclusion-testing on horses fitting the case definition.
- implement strict biosecurity measures, monitoring of in-contacts, and disinfection if spillover occurs.
- experimental vaccine trialed, but commercial availability uncertain.
- natural host management strategies, risk forecasts, and risk mapping limited by incomplete knowledge of the ecology of the virus in bats.

clinical features..

- acute onset, $\uparrow T$, $\uparrow HR$
initially presenting as
 - depressed/inappetant
 - restless/colicky
- rapidly progressing to
- cardiovascular collapse
 - +/- severe respiratory disease
 - +/- severe neurological disease
- and sometimes exhibiting
- oedematous facial swelling
 - terminal frothy nasal discharge
 - stranguria



Hendra case, Cairns, 1999 (Jack Shield, then DPI&F)