Cost Effectiveness of Rabies Post Exposure Prophylaxis (PEP)

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Model

Cost effectiveness: net cost (in dollars) per life saved

$$\$/\text{ life saved PEP} = \frac{\$\text{ PEP} - (\text{Probability death} \times \$\text{ value Life})}{\text{Probability death if no PEP} - 0}$$

Assume PEP, when given per recommendations, is 100% effective

Model

Three cost effectiveness ratios

- Average Cost Effectiveness
  - average cost & median probability
- Least Cost Effectiveness
  - maximum cost & minimum probability
- Most Cost Effectiveness
  - minimum cost & maximum probability

Assumptions

- Clinical cases of human rabies have only one outcome (death)

- PEP for rabies, when given as per recommendations, is essentially 100% effective in preventing a clinical case of rabies

Assumptions

- Perspective: Societal
- Time Line: One year
- Discounting: No discounting
  - Exception : Value of life lost (see later)
- All costs adjusted to 2004 $

Inputs: Cost of biologics

Parameter	Average	Min	Max
Vaccine	$311	$113	$679
Number of doses	5	5	5
HRIG (6.3 ml dose)	$761	$326	$1,434
Total $ biologics	**$2,315**	**$889**	**$4,831**

Source: Kreindel, et al Public Health Reports, 1998, 113. 247-251
Adjusted to 2004 $

Inputs: Hospital and physician charges

Parameter	Average	Min	Max
Emergency room 1st visit	$122	$97	$156
Emergency room return visit	$100	$48	$156
# return emergency room visits	4	4	4
Physician's charge	$105	$59	$125
Physician's follow up	$100	$59	$129
# physician follow up visits	4	4	4
Total hospital costs	**$1,027**	**$584**	**$1,423**

Source: Kreindel, et al Public Health Reports, 1998, 113. 247-251
Adjusted to 2004 $

Inputs: Other Costs

Parameter	Average	Min	Max
Patient Indirect Costs	$700	$161	$2,161

Source: Shwiff et al: Journal of Wildlife Diseases (in press).
Adjusted to 2004 $

Inputs: Dollar Value of life

- Average present value of expected future lifetime earnings and housekeeping services, discounted at 3% and assuming an average life span of 75 years

- Value of Human Life (in 2004 $) = **$1,109,920**

Source:. S.D. Grosse. Appendix I: In Haddix et al., Prevention Effectiveness. 2003. Adjusted to 2004 $

Inputs: Probability of Rabies Transmission

- Lack of data
  - Except when have animal tested positive
- Delphi Technique (expert panel)
  - Scenarios of possible exposure
- Result: Wide range of probabilities

Inputs: Probabilities of Rabies Transmission

Type of exposure*	Median	Range
Skunk bite	0.05	0.1 –0.01
Possible Bat Bite Exposure	0.001	0.01 – .000001
Unknown Dog (bite)	0.00001	0.001 –0.00001
Unknown Dog (lick scabbed wound)	0.000001	0.00001 –0.000001
Unknown Cat (bite)	0.001	0.01 – 0.00001
Unknown Cat (lick scabbed wound)	0.000001	0.0001 – 0.000001
Exposure to Rabid Human†	0.000001	0.00001 –0.000001

*Animals not available for testing

† No recognized bite/saliva exposure

Source: Expert panel: In Vaidya et al. Forthcoming

Model

Cost effectiveness: net cost (in dollars) per life saved

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Assume PEP, when given per recommendations, is 100% effective

RESULTS
"Costs"

Rabies Transmission Scenario	First (Baseline) Cost Scenario	
Animal tests positive	Cost Saving	
Skunk bite*	Cost Saving	
Possible Bat Bite Exposure*	$2.9 million	(Cost Saving - $8.4 billion)
Dog (bite)*	$403 million	($524,080 - $840 million)
Dog (lick)*	$4 billion	($162 million - $8.4 billion)
Cat (bite)*	$2.9 million	(Cost Saving - $840 million)
Cat (lick)*	$4 billion	($15 million - $8.4 billion)
Exposure to Rabid Human †	$4 billion	($162 million - $8.4 billion)

*Animals not available for testing
† No recognized bite/saliva exposure

Sensitivity Analysis

Two additional cost scenarios:

- Doubled all PEP-associated costs, and kept the value of human life at baseline
- Doubled the value of human life whilst keeping the cost of PEP unchanged

Sensitivity Analyses: Other cost scenarios

Exposure scenario	2nd Cost Scenario	3rd Cost Scenario
Animal tests positive	Cost Saving - $573,080	Cost Saving
Possible Bat Bite Exposure*	$6.9 million (Cost Saving - $17 billion)	$1.8 million (Cost Saving - $8.4 billion)
Dog (bite)*	$807 million ($2.2 million - $1.7 billion)	$401 million (Cost Saving - $839 million)
Dog (lick)*	$8 billion ($326 million - $17 billion)	$4 billion ($161 million - $8.4 billion)
Exposure to Rabid Human†	$8 billion ($326 million - $17 billion)	$4 billion ($161 million - $8.4 billion)

*Animals not available for testing

† No recognized bite/saliva exposure

Conclusions

- Cost saving if patient is bitten by a rabid animal that has tested positive for rabies
- Cost saving if it is a bite from a reservoir/vector species (e.g. skunk bite)
- On average, no cost saving for all other scenarios of rabies transmission
- Very wide range of cost effectiveness for most of the scenarios

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Limitations

- Dollar Value of Human Life
- Wide Range of Probabilities
  - Most important input
- Some scenarios of rabies transmission might have been missed