# Dogs as Cancer Sentinels: Research to Address Gaps in Human Cancer Prevention and Control

Peter Rabinowitz MD MPH
University of Washington
Center for One Health Research

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# Canaries and Coal Mines

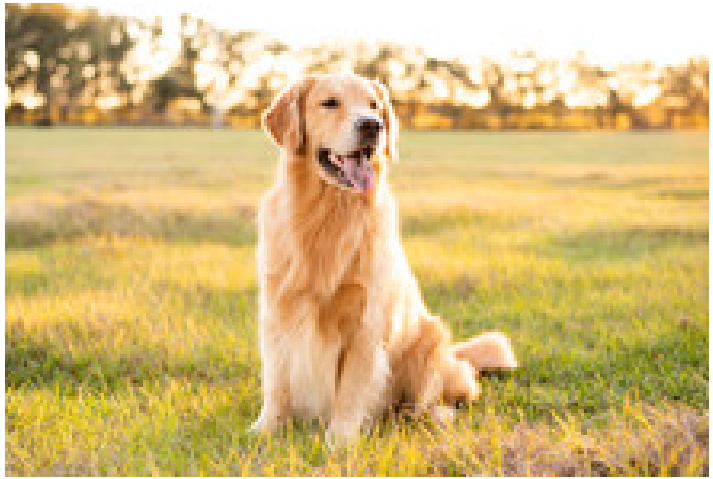
Canaries as sentinels for carbon monoxide exposure

# 3 Qualities of an Animal Sentinel for Human Risk for Environmental Hazards

- Greater susceptibility
- Greater exposure
- Shorter latency

# Susceptibility

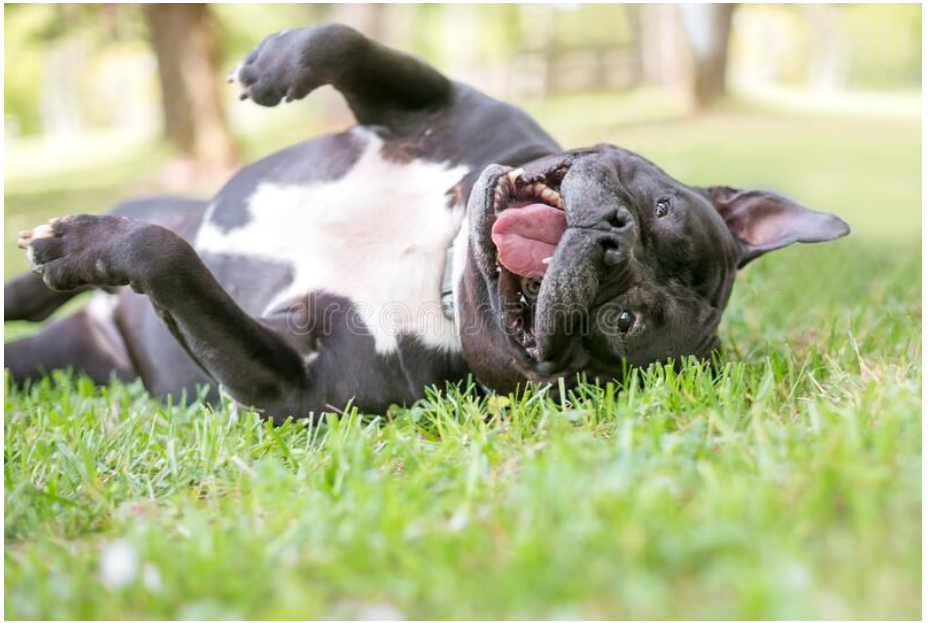
- Genetically determined- increased susceptibility in certain breeds
- Multiple examples
  - Osteosarcoma
  - Histiocytic sarcoma



Publicdomainpictures.net

# Exposure: Dogs vs. Humans

- Dogs less mobile
- May have more direct contact with environment



Dreamstime.com

# Dog Tags vs. Human Wrist Bands for Exposure Monitoring

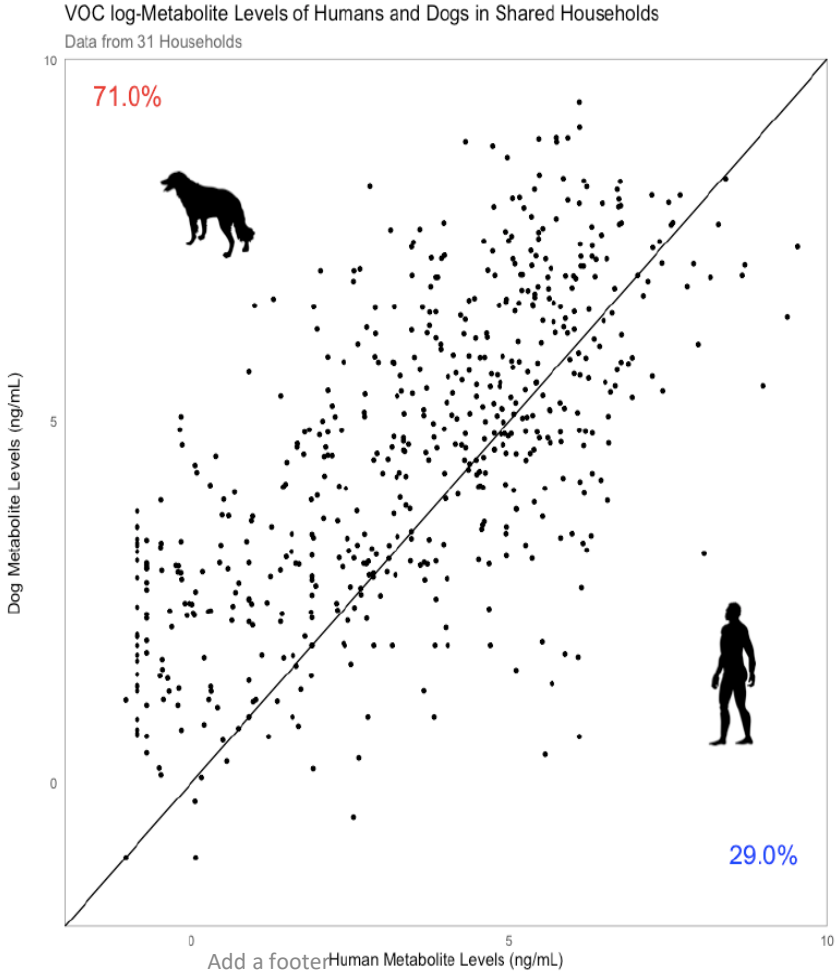
- Significant correlations found between measures on dog tags and human wristbands were observed (rs = 0.38-0.90; $p < 0.05$).
- Correlations with urinary biomarkers stronger in dog tags compared to human wristbands (rs = 0.50-0.71; $p < 0.01$) for organophosphate esters.

  - Wise et al 2020

https://factor.niehs.nih.gov/2020/7/papers/chemical-exposures/index.htm

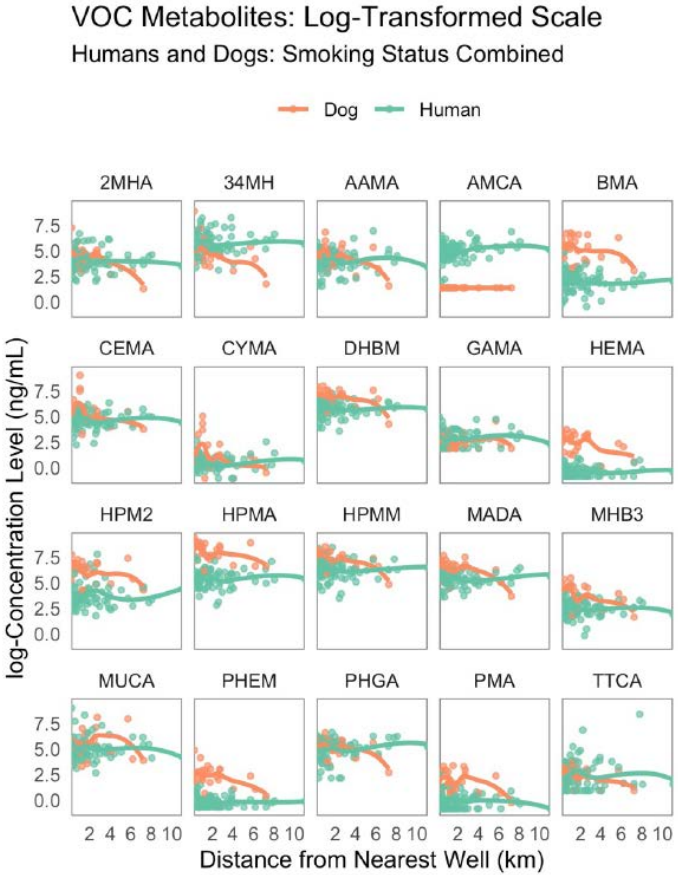
# Study of VOCs in Dogs and Humans sharing households near natural gas wells

Dogs had higher levels of VOCs



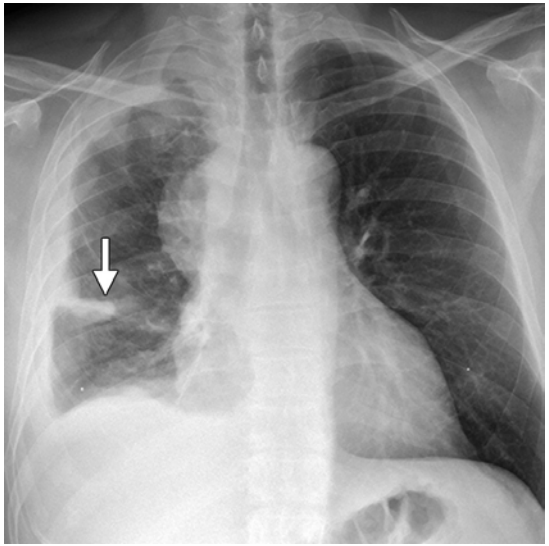

Rabinowitz et al 2020 unpublished

# Dog and Human Urinary VOC metabolites vs. Distance to Natural Gas Wells




Rabinowitz et al 2020 unpublished

# Latency: Humans Vs. Dogs



Pleural Mesothelioma in Humans
Mean age 60-70 years
(Nickell et al 2014)

Pleural Mesothelioma in Dogs
Mean age 7.9 years
(Head et al 2002)

# Chronology: Canine Cancer Sentinel Studies

- 1983: Harbison and Godleski : found asbestos bodies in 3/5 dogs with mesothelioma
- 1983: Glickman et al, case control (N=16) Owner exposure to asbestos associated with mesothelioma (OR = 8.0, CL 95%1.4-45.9)
- 1991 Hayes et al: Cases of canine malignant lymphoma (N=491) associated with exposure to 2-4D lawn chemicals (OR=1.3)
- 1992: Reif et al : Passive smoking exposure associated with lung cancer in short-nosed dogs (OR= 2.4, 95% confidence interval 0.7-7.8)
- 1998: Reif et al: Passive smoking associated with nasal cancer in long-nosed dogs 2.0 (OR=2.0 95% CI 1.0-4.1)

# Chronology: Canine Cancer Sentinel Studies

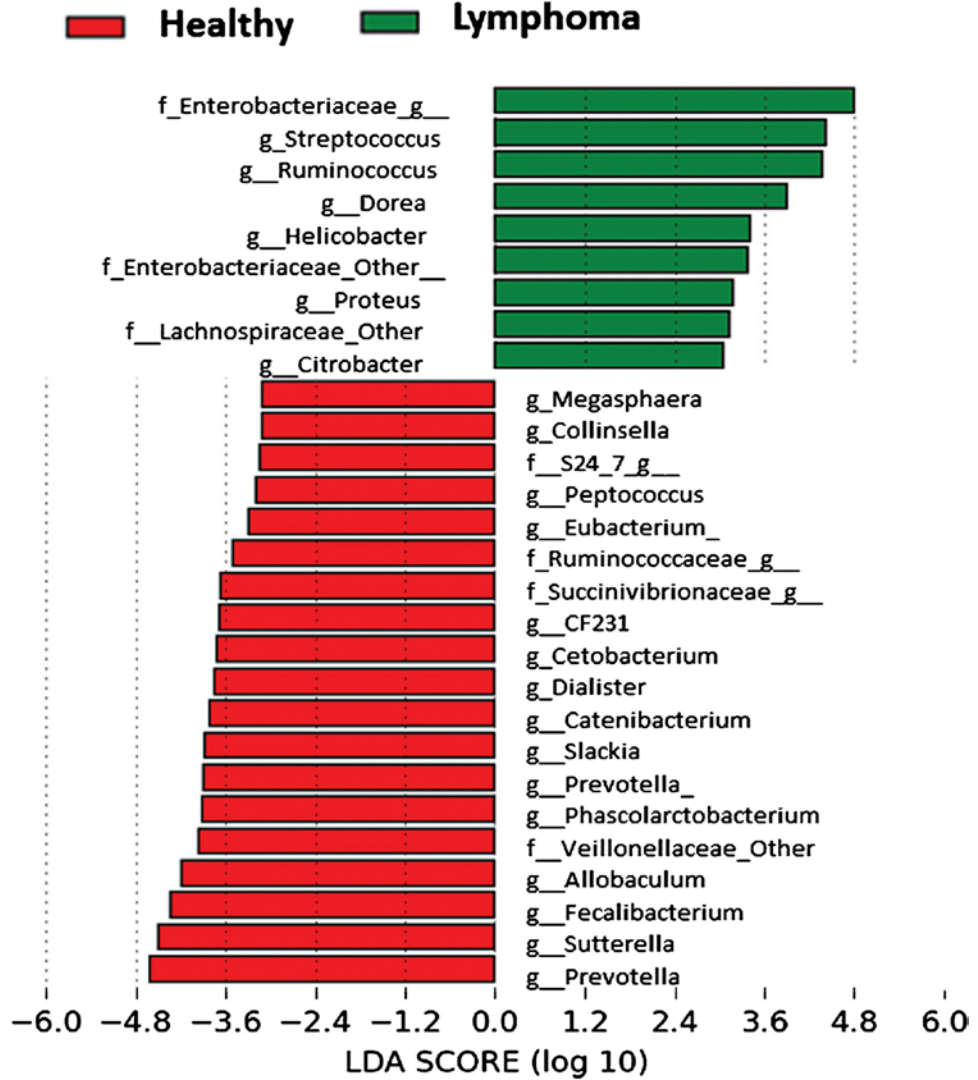
- 2009 Pastor et al: Canine lymphoma cases (N=608) associated with exposure to waste incinerators (rho= 0.25, P < .05), polluted sites (rho= 0.36, P < .001), and radioactive waste (rho= 0.51, P < .001)
- 2012 Biki et al: Canine lymphoma cases (N=263) associated with commercial lawn pesticide use (OR=1.7; 95% CI=1.1-2.7)
- 2017 Ruple et al: Found geographical variation in golden retriever lymphoma incidence
- 2020 Craun et al: Boxers with lymphoma (N=63) more likely to live near a nuclear power plant OR, 5.76; 95% CI, 1.54-20.06; P = .007) chemical suppliers; (OR, 2.28; 95% CI, 1.15-4.63; P = .02) or a crematorium (OR, 2.17; 95% CI, 1.02-4.38; P = .04).
- 2021 Smith et al: Urothelial Cell Cancer in dogs (N=63) associated with counties with higher water trihalomethanes (p < .0001) and air ozone levels (p=.0008). Also found lymphoma in boxers associated with counties with higher ozone (p=0.018) and airborne 1,3-butadiene and formaldehyde (p = .004-.005)

# Negative Studies

- 2008: Backer et al : No significant association between dogs with bladder cancer (N=100), and trihalomethane in water.
- 2020 Otto et al: 15 year follow up of World Trade Center rescue dogs (N=95), no increased cancer compared to controls, but more particles in lungs

# Microbiome and Lymphoma

- 2020 Gavazza et al
- Differences in gut microbiome between dogs with and without lymphoma



# Summary:

- Dogs have important differences from humans in terms of environmental carcinogens
  - Susceptibility
  - Exposure
  - Latency
- Few canine cancer sentinel studies performed to date, most show some association between environmental exposures and cancer.

Studies of dogs as sentinels have untapped potential for detecting environmental carcinogens and improving human cancer prevention.

Thank you!

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ne Health Research