Environmental Exposure and Cancer in Companion Dogs

Audrey Ruple

DVM, MS, PhD, DipACVPM, MRCVS
Associate Professor
Department of Population Health Sciences
Virginia-Maryland College of Veterinary Medicine

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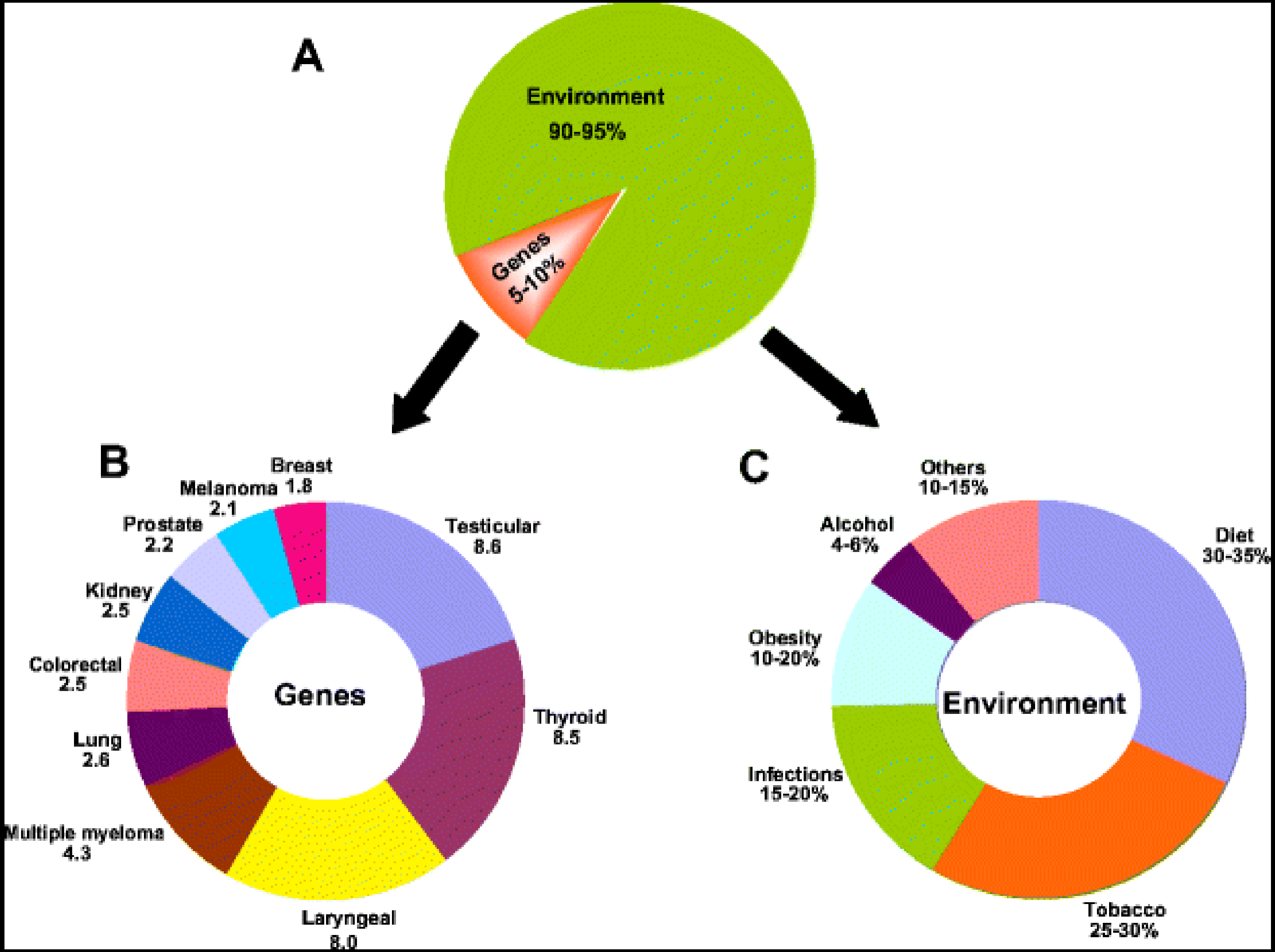
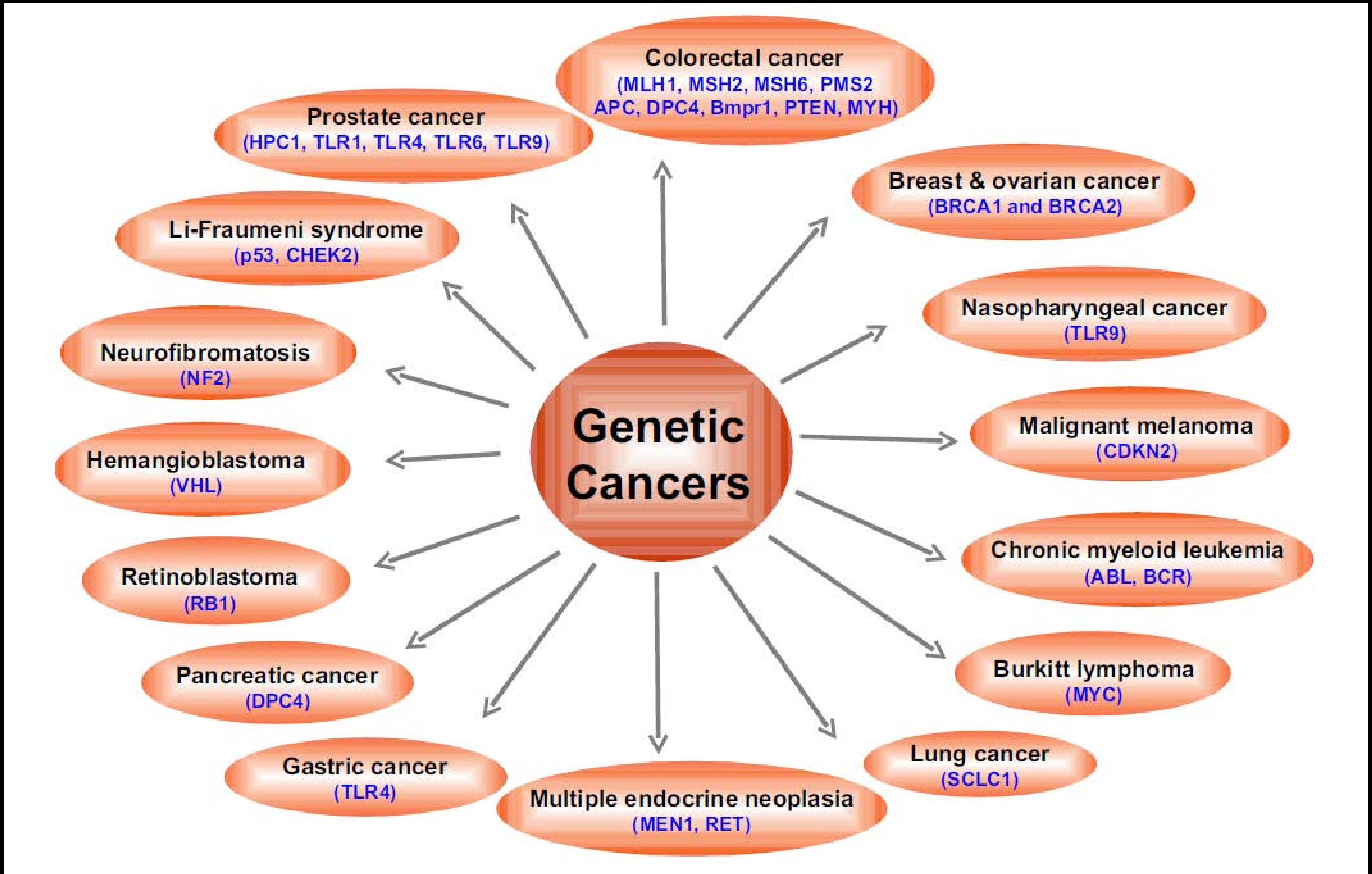
Genetics-Environment



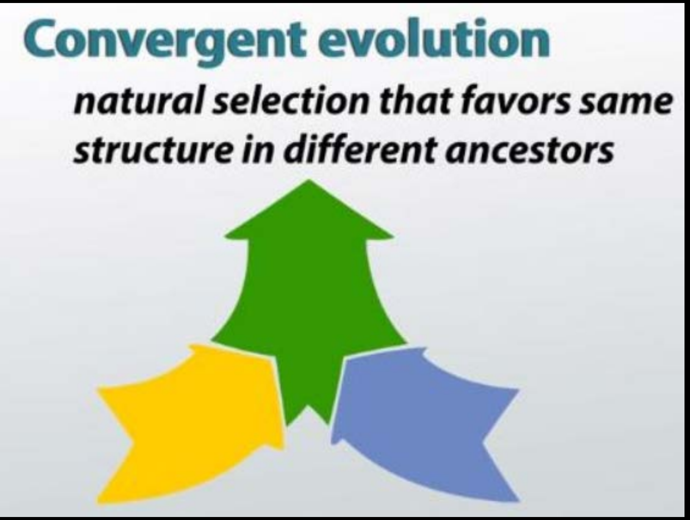
Pharm Res **25,** 2097–2116 (2008). doi.org/10.1007/s11095-008-9661-9

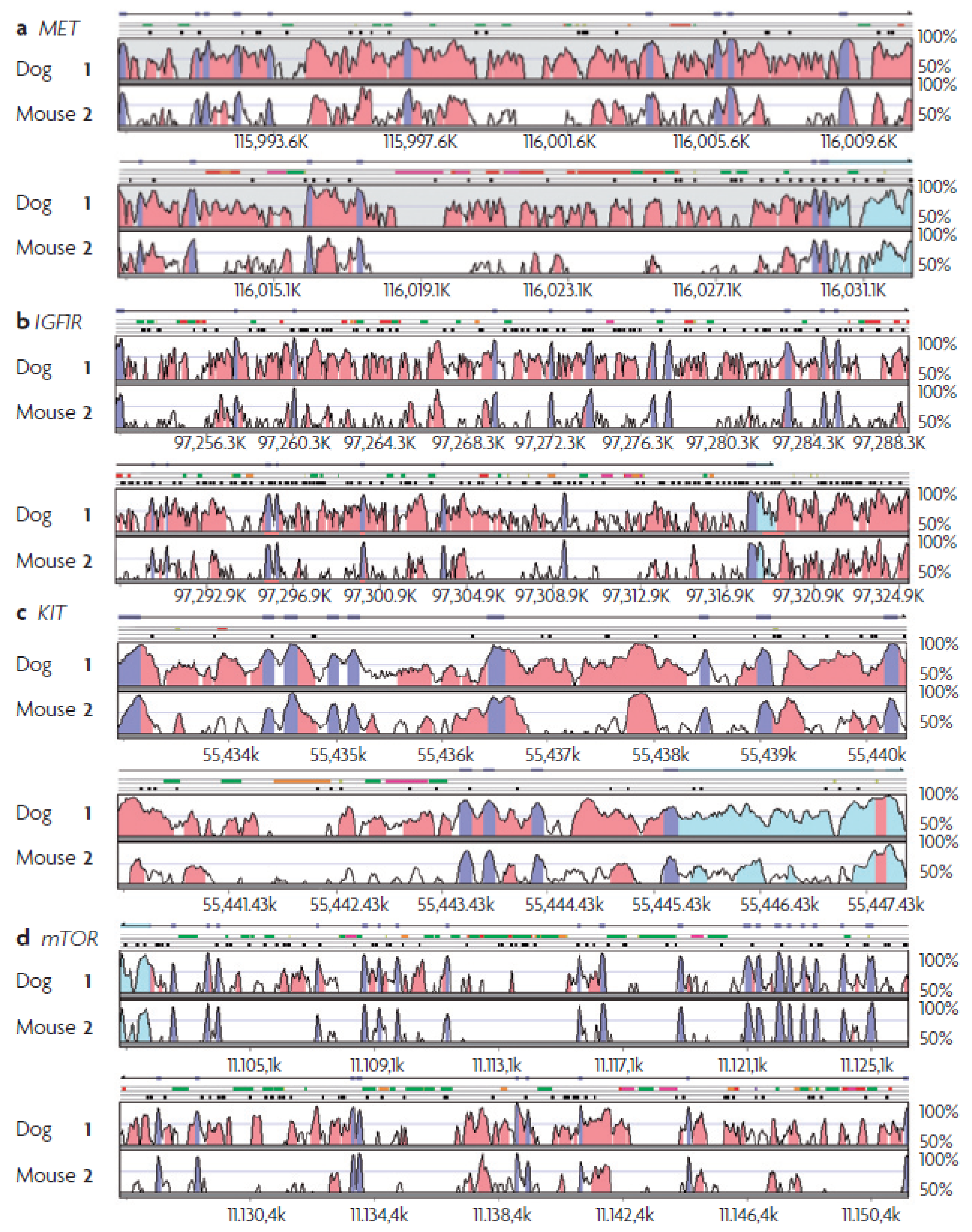
Genes associated with cancers in humans



Pharm Res **25,** 2097–2116 (2008). doi.org/10.1007/s11095-008-9661-9

Dogs share ~650 Mb of ancestral sequence with humans

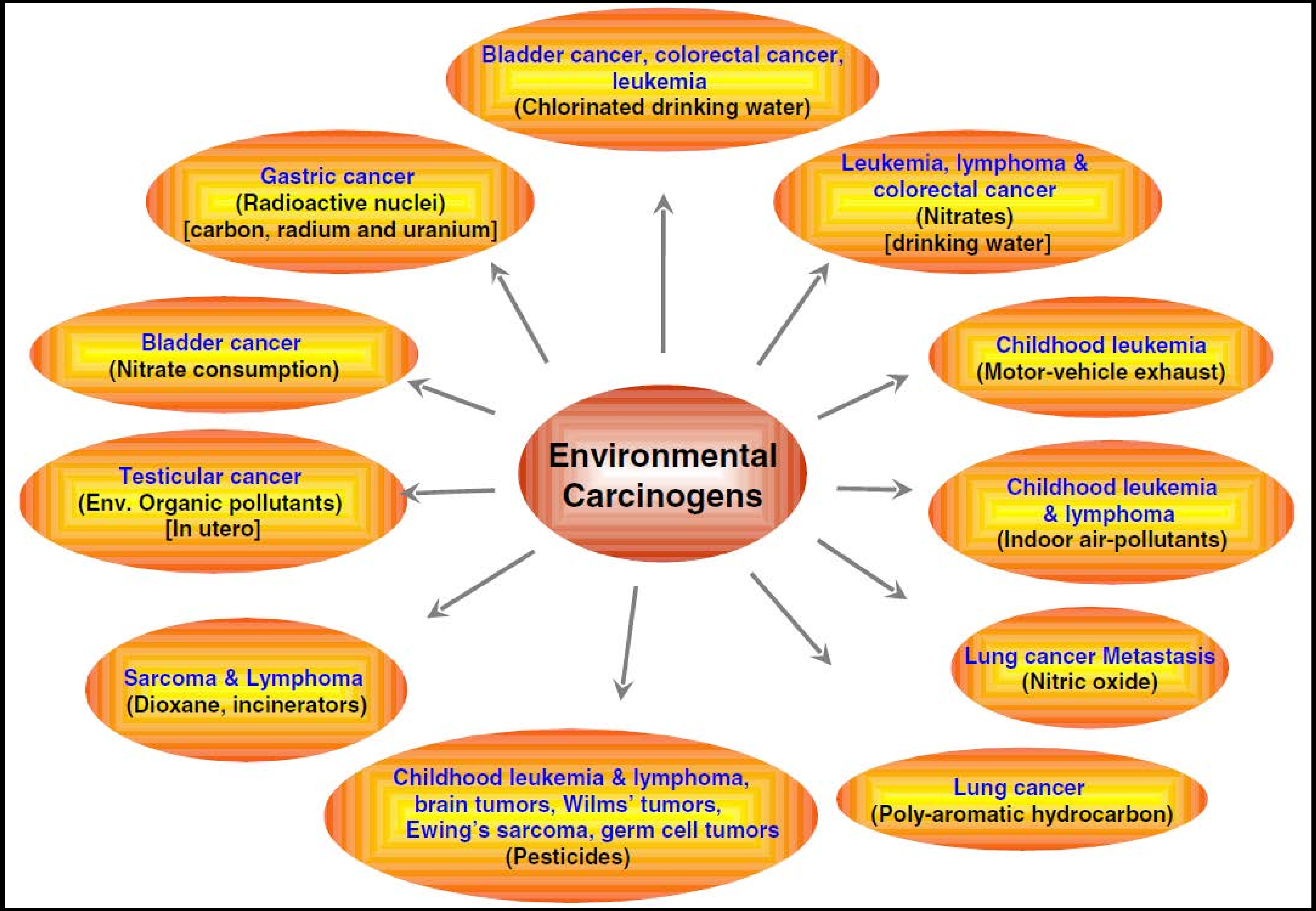




Nat Rev Cancer **8,** 147–156 (2008) doi.org/10.1038/nrc2273

Dogs as a genetic model for humans...

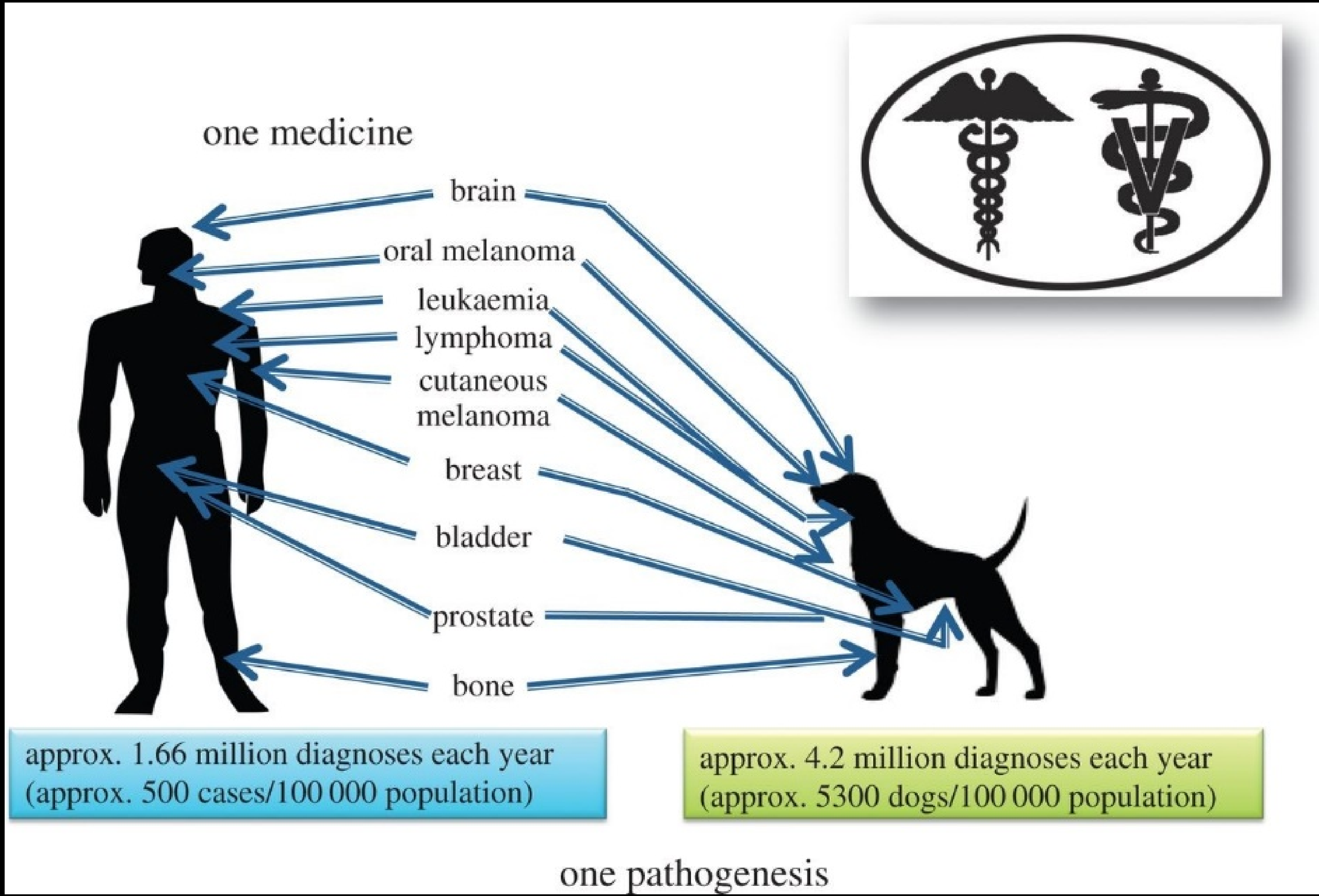
Environmental carcinogens associated with cancers in humans



Pharm Res **25,** 2097–2116 (2008). doi.org/10.1007/s11095-008-9661-9

Our shared environment

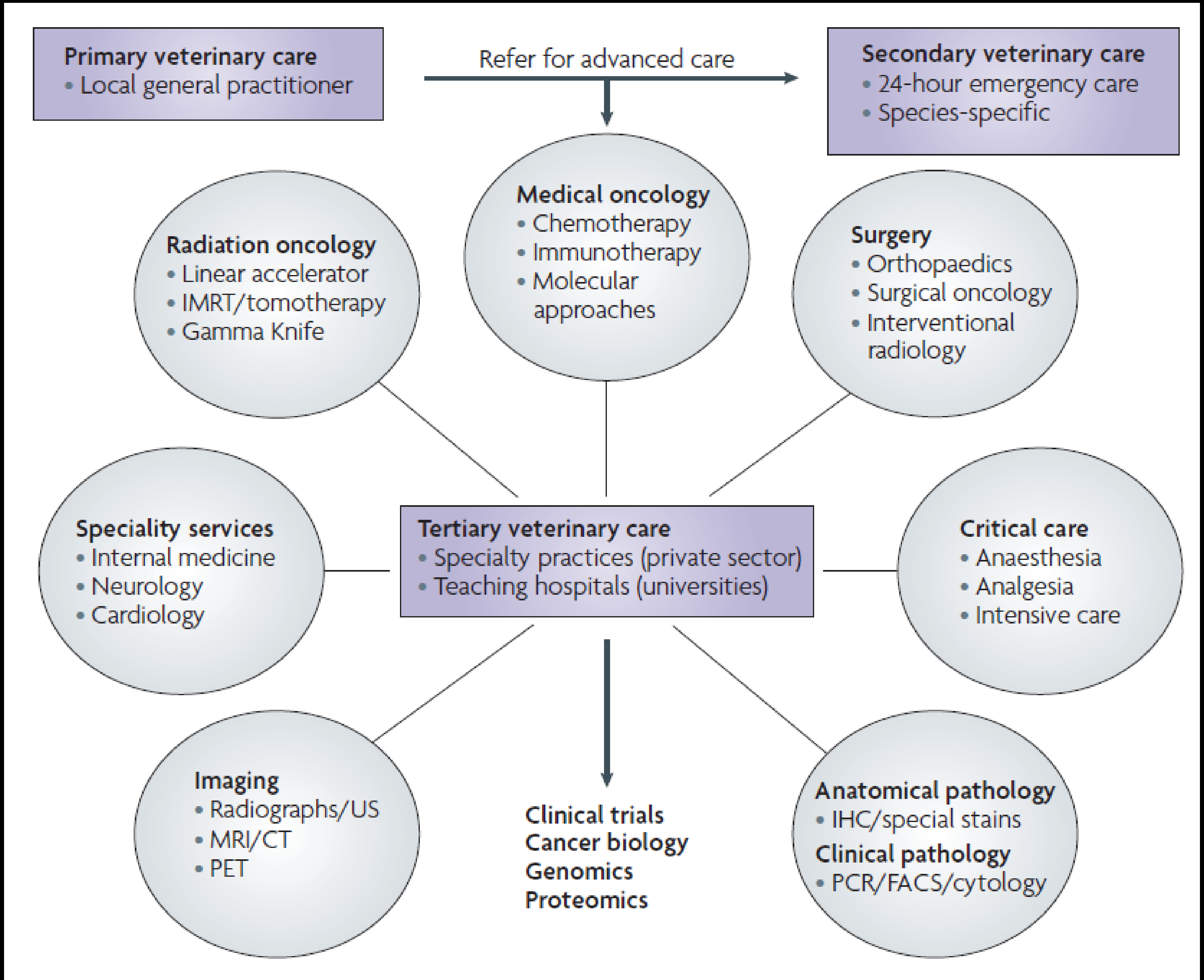
Cancer incidence in dogs



Philos Trans R Soc Lond B Biol Sci. 2015 Jul 19;370(1673):20140231. doi: 10.1098/rstb.2014.0231.

Advantages of the companion dog model

- Spontaneous
  - Welfare
- Short lived
- Advanced healthcare



Nat Rev Cancer **8**, 147–156 (2008) doi.org/10.1038/nrc2273

HeroDogAward.org

Animals as Sentinels of Environmental Health Hazards

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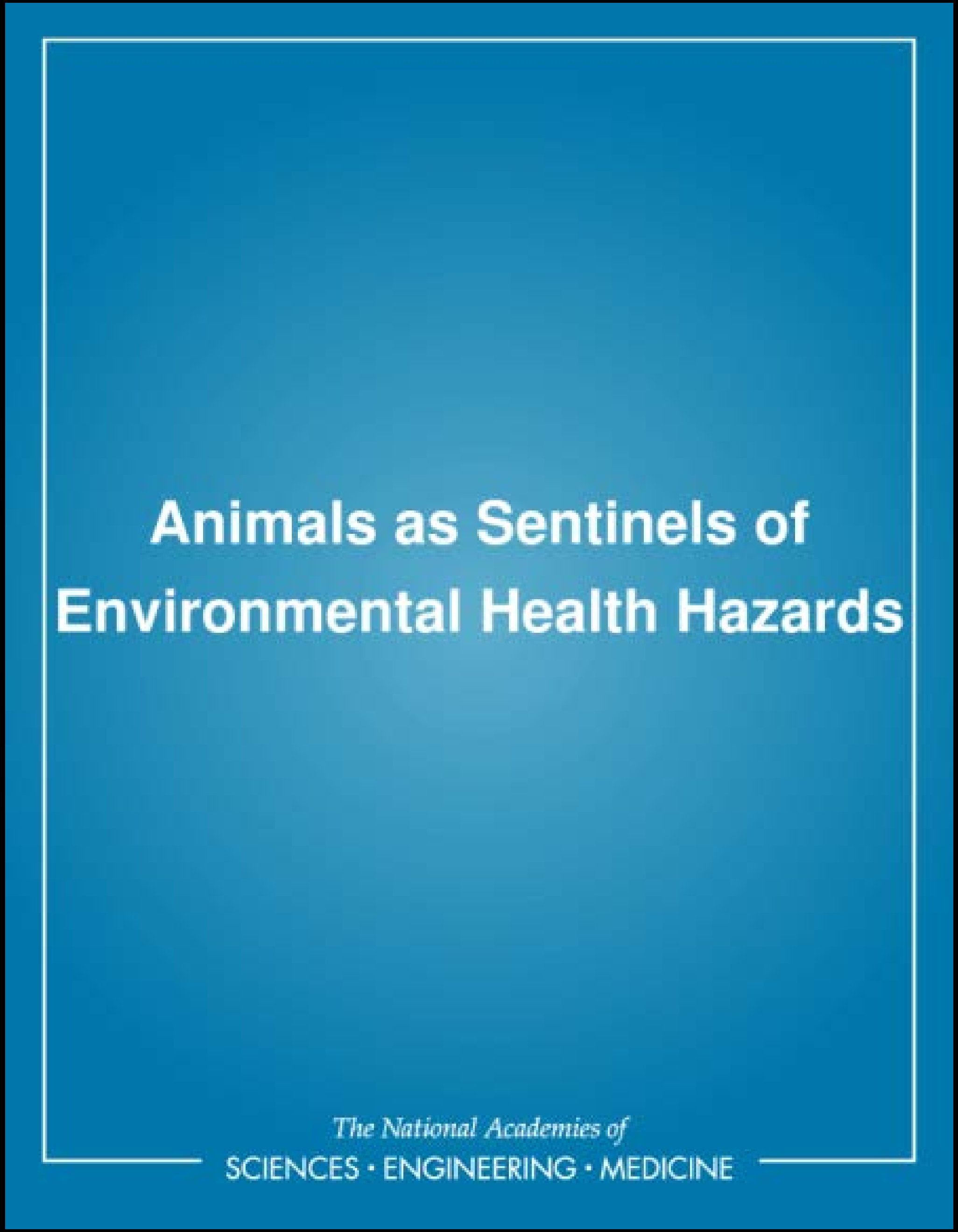
SCIENCES · ENGINEERING · MEDICINE



Committee on Animals as Monitors of Environmental Hazards

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Observational studies

These findings indicate that well-designed epidemiological studies of spontaneous tumors in pet animals may provide insight into the role of environmental factors in human cancers and serve as a valuable sentinel model to identify environmental health hazards for humans.

Env Res 32(3), 1983
doi.org/10.1016/0013-9351(83)90114-7

Mesothelioma

Matched Pair Analysis of Risk Factors for Canine Mesothelioma

Risk factor	Noncancer controls			Cancer controls		
	Odds ratio	No. D.P.[a]	Confidence limits (95%)	Odds ratio	No. D.P.[a]	Confidence limits (95%)
Domestic and owner occupational exposures						
Home remodeling or construction	0.3	8	0.1–1.2	0.4	10	0.1–1.6
Addition of home insulation	0.5	6	0.1–2.6	0.8	7	0.2–3.3
Home in vicinity of asbestos-related industry	2.0	6	0.4–10.6	0.8	7	0.2–3.3
Occupation or hobby asbestos related	8.0	9	1.4–10.6	2.3	10	0.6–8.7
Urban (vs rural) residence of dog						
First residence	[c]	5	—	1.5	9	0.4–5.3
Longest residence	4.0	5	0.5–30.3	1.2	11	0.4–3.9
Residence at diagnosis	2.0	6	0.5–10.6	1.0	10	—
Management of dog						
Source: stray vs all other	2.0	3	0.2–21.0	[b]	4	—
Time outside: ≥50% vs <50%	5.0	6	0.7–34.5	2.5	7	0.5–12.2
Supervision: allowed to roam vs confined	2.0	9	0.5–7.8	3.0	8	0.7–13.8
Pesticides used on dog						
Flea powder	5.0	6	0.7–34.5	1.7	8	0.4–6.9
Flea spray	3.0	4	0.4–25.8	1.5	10	0.4–5.3
Flea dip	2.5	7	0.5–12.2	1.5	10	0.4–5.3
Flea collar	1.3	7	0.3–5.9	1.0	6	—
Any pesticide	11.0	5	1.5–82.1	5.0	6	0.7–35.5

Env Res 32(3), 1983
doi.org/10.1016/0013-9351(83)90114-7

Mesothelioma

MATCHED PAIR ANALYSIS OF RISK FACTORS FOR CANINE MESOTHELIOMA

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Env Res 32(3), 1983
doi.org/10.1016/0013-9351(83)90114-7

Bladder Cancer (TCC)

EPIDEMIOLOGIC STUDY OF INSECTICIDE EXPOSURES, OBESITY, AND RISK OF BLADDER CANCER IN HOUSEHOLD DOGS

Lawrence T. Glickman, Frances S. Schofer, Linda J. McKee

Department of Clinical Studies, University of Pennsylvania, School of Veterinary Medicine, Philadelphia, Pennsylvania

John S. Reif

Department of Environmental Health, Colorado State University, Fort Collins, Colorado

Michael H. Goldschmidt

Department of Pathobiology, University of Pennsylvania, School of Veterinary Medicine, Philadelphia Pennsylvania

*J of Tox and Env Hlth 28***(4)** 1989

Lymphoma

Case-Control Study of Canine Malignant Lymphoma: Positive Association With Dog Owner's Use of 2,4-Dichlorophenoxyacetic Acid Herbicides

Howard M. Hayes, Robert E. Tarone, Kenneth P. Cantor, Carl R. Jessen, Dennis M. McCurnin, Ralph C. Richardson*

J Natl Cancer Inst 83, 1991

Bladder Cancer (TCC)

Herbicide exposure and the risk of transitional cell carcinoma of the urinary bladder in Scottish Terriers

Lawrence T. Glickman, VMD, DrPH; Malathi Raghavan, DVM, PhD;
Deborah W. Knapp, DVM, MS, DACVIM; Patty L. Bonney; Marcia H. Dawson, DVM

J Am Vet Med Assoc 224(8) **2004**

Bladder Cancer (TCC)

Factor	No. of case dogs (%)	No. of control dogs (%)	OR (95% CI)	*P* value
Residence				
Urban	13 (16)	16 (19)	NA	NA
Suburban	51 (61)	49 (59)	1.28 (0.56–2.94)	0.56
Rural or farm	19 (23)	18 (22)	1.30 (0.49–3.45)	0.60
Access to lawn or garden (treated or nontreated)				
None or sporadic	9 (11)	19 (23)	NA	NA
Seasonal or year-round	74 (89)	64 (77)	2.44 (1.03–5.77)	0.04
Access to herbicide-treated lawn or garden				
None or sporadic	37 (45)	57 (69)	NA	NA
Seasonal or year-round	39 (47)	14 (17)	4.29 (2.05–8.97)	< 0.001
Access to insecticide-treated lawn or garden				
None or sporadic	47 (57)	56 (68)	NA	NA
Seasonal or year-round	29 (35)	15 (18)	2.30 (1.11–4.80)	0.03
Treatment of lawn or garden to which dog had access				
None	20 (24)	42 (51)	NA	NA
Insecticide only	13 (16)	14 (17)	1.95 (0.77–4.91)	0.16
Herbicide only	22 (27)	9 (11)	5.13 (2.00–13.15)	< 0.001
Both insecticide and herbicide	20 (24)	6 (7)	7.00 (2.43–20.13)	< 0.001
Exposure to insecticides indoors				
No	39 (47)	49 (59)	NA	NA
Yes	42 (51)	33 (40)	1.60 (0.86–2.97)	0.14

Owners were provided a list of commonly used lawn and garden chemicals and asked to indicate what chemicals their dogs had been exposed to during the year prior to diagnosis of TCC for case dogs and during a comparable period for control dogs. *See* Table 3 for key.

J Am Vet Med Assoc 224(8) **2004**

Pesticides in human populations

Cancer Causes & Control (2020) 31:583–599
https://doi.org/10.1007/s10552-020-01301-4

ORIGINAL PAPER

Check for updates

Pesticide use and risk of Hodgkin lymphoma: results from the North American Pooled Project (NAPP)

Lidija Latifovic[1,11] · Laura E. Beane Freeman[2] · John J. Spinelli[3,4] · Manisha Pahwa[1,5] · Linda Kachuri[1,6] · Aaron Blair[2] · Kenneth P. Cantor[2] · Shelia Hoar Zahm[7] · Dennis D. Weisenburger[8] · John R. McLaughlin[1,10,11] · James A. Dosman[9] · Punam Pahwa[9] · Stella Koutros[2] · Paul A. Demers[1,11] · Shelley A. Harris[1,11]

Received: 4 July 2019 / Accepted: 7 April 2020 / Published online: 20 April 2020

Abstract
Purpose The purpose of this study was to investigate associations between pesticide exposures and risk of Hodgkin lymphoma (HL) using data from the North American Pooled Project (NAPP).
Methods Three population-based studies conducted in Kansas, Nebraska, and six Canadian provinces (HL = 507, Controls = 3886) were pooled to estimate odds ratios and 95% confidence intervals for single (never/ever) and multiple (0, 1, 2–4, ≥ 5) pesticides used, duration (years) and, for select pesticides, frequency (days/year) using adjusted logistic regression models. An age-stratified analysis (≤ 40/ > 40 years) was conducted when numbers were sufficient.
Results In an analysis of 26 individual pesticides, ever use of terbufos was significantly associated with HL (OR: 2.53, 95% CI 1.04–6.17). In age-stratified analyses, associations were stronger among those ≤ 40 years of age. No significant associations were noted among those > 40 years old; however, HL cases ≤ 40 were three times more likely to report ever using dimethoate (OR: 3.76 95% CI 1.02–33.84) and almost twice as likely to have ever used malathion (OR: 1.86 95% CI 1.00–3.47). Those ≤ 40 years of age reporting use of 5 + organophosphate insecticides had triple the odds of HL (OR: 3.00 95% CI 1.28–7.03). Longer duration of use of 2,4-D, ≥ 6 vs. 0 years, was associated with elevated odds of HL (OR: 2.59 95% CI 1.34–4.97).
Conclusion In the NAPP, insecticide use may increase the risk of HL, but results are based on small numbers.

Keywords Pesticide · Insecticide · Organophosphate · Hodgkin lymphoma · Cancer · Case–control

IEA

International Journal of Epidemiology, 2016, 792–805
doi: 10.1093/ije/dyv195
Advance Access Publication Date: 27 September 2015
Original article

Environmental Exposures and Cancer

Occupational exposure to pesticides and bladder cancer risk

Stella Koutros,[1]* Debra T Silverman,[1] Michael CR Alavanja,[1] Gabriella Andreotti,[1] Catherine C Lerro,[1] Sonya Heltshe,[2] Charles F Lynch,[3] Dale P Sandler,[4] Aaron Blair[1] and Laura E Beane Freeman[1]

[1]Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Bethesda, MD, USA, [2]Seattle Children's Hospital Research Institute, University of Washington School of Medicine, Department of Pediatrics, Seattle, WA, USA, [3]College of Public Health, University of Iowa, Iowa City, IA, USA and [4]Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, NC, USA

*Corresponding author. Occupational and Environmental Epidemiology Branch, Division of Cancer Epidemiology and Genetics, National Cancer Institute, 9609 Medical Center Dr., Bethesda, MD 20892, USA. E-mail: KoutrosS@mail.nih.gov

Environmental Tobacco Smoke

Reif, 1998[54]	Positive trend for number of packs smoked by owner and increased risk of canine nasal cancer among long-nosed (dolichocephalic) dogs.
Reif, 1992[55]	Statistically nonsignificant positive association for living with ≥1 versus no smokers and canine lung cancer risk. Association was stronger among short-nosed dogs (brachycephalic or mesocephalic).
Marconato, 2009[43]	Any ETS exposure was positively associated with canine lymphoma, compared with no exposure.

doi.org/10.1016/B978-0-323-59496-7.00004-9

Environmental pollutants

Bettini, 2010[112]	Pulmonary anthracosis (high versus none) positively associated with canine lung cancer risk.
Marconato, 2009[43]	Living in geographic areas exposed to toxic waste positively associated with canine cancer risk (all tumors and lymphoma), compared with living in an unexposed area. No associations observed for canine mast cell tumors, canine mammary cancer, or feline cancers.
Gavazza, 2001[66]	Living in an industrial neighborhood was positively associated with canine lymphoma risk, compared with living in any other neighborhood. Use or storage of paints and solvents was positively associated with lymphoma risk, compared with no use of chemicals.
Bukowski, 1998[113]	Cumulative kerosene or coal heat exposure was positively associated with sinonasal cancer risk.

doi.org/10.1016/B978-0-323-59496-7.00004-9

Fifteen-year surveillance of pathological findings associated with death or euthanasia in search-and-rescue dogs deployed to the September 11, 2001, terrorist attack sites

Cynthia M. Otto DVM, PhD
Elizabeth Hare PhD
John P. Buchweitz PhD
Kathleen M. Kelsey MS, MBA
Scott D. Fitzgerald DVM, PhD

From the Penn Vet Working Dog Center (Otto, Hare, Kelsey) and Department of Clinical Sciences and Advanced Medicine (Otto), School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104; Dog Genetics LLC, Astoria, NY 11102 (Hare); and Department of Pathobiology and Diagnostic Investigation (Buchweitz) and Diagnostic Center for Population and Animal Health (Fitzgerald), College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824.

Address correspondence to Dr. Otto (cmotto@vet.upenn.edu).

OBJECTIVE
To compare the cause of death (COD; whether by natural death or euthanasia for poor quality of life caused by a primary pathological condition) between search-and-rescue (SAR) dogs deployed to the World Trade Center, Pentagon, or Fresh Kills Landfill on Staten Island following the 9/11 terrorist attacks and SAR dogs that were not deployed to these sites.

ANIMALS
95 deployed SAR dogs (exposed dogs) and 55 nondeployed SAR dogs (unexposed dogs).

PROCEDURES
Following natural death or euthanasia, 63 dogs (44 exposed and 19 unexposed) underwent a necropsy examination. For the remaining 87 dogs, the COD was categorized on the basis of information obtained from medical records or personal communications.

RESULTS
The median age of death was 12.8 years for exposed dogs and 12.7 years for unexposed dogs. The COD was not impacted by deployment status. In the 150 exposed and unexposed dogs, degenerative conditions were the most common COD followed by neoplasia. Respiratory disease was infrequent (overall, 7 [4.7%] dogs); 4 of 5 cases of pulmonary neoplasia occurred in unexposed dogs. However, in dogs that underwent necropsy, pulmonary particulates were reported significantly more often in exposed dogs (42/44 [95%]), compared with unexposed dogs (12/19 [63.2%]).

CONCLUSIONS AND CLINICAL RELEVANCE
No difference was found in the COD on the basis of disease category and organ system involved between exposed and unexposed SAR dogs. The long life spans and frequency of death attributed to degenerative causes (ie, age-related causes) suggested that the risk of long-term adverse health effects in this population of SAR dogs was low. (*J Am Vet Med Assoc* 2020;257:734–743)

animals

Review

Veterinary Big Data: When Data Goes to the Dogs

Ashley N. Paynter [1], Matthew D. Dunbar [2], Kate E. Creevy [3] and Audrey Ruple [4,*]

1 Department of Biology, College of Arts and Sciences, University of Washington, Seattle, WA 98195, USA; apaynt@uw.edu
2 Center for Studies in Demography and Ecology, University of Washington, Seattle, WA 98195, USA; mddunbar@uw.edu
3 Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Texas A&M University, College Station, TX 77843, USA; kcreevy@cvm.tamu.edu
4 Department of Public Health, College of Health and Human Sciences, Purdue University, West Lafayette, IN 47907, USA
* Correspondence: aruple@purdue.edu

Simple Summary: Big data has created many opportunities to improve both preventive medicine and medical treatments. In the field of veterinary medical big data, information collected from companion animals, primarily dogs, can be used to inform healthcare decisions in both dogs and other species. Currently, veterinary medical datasets are an underused resource for translational research, but recent advances in data collection in this population have helped to make these data more accessible for use in translational studies. The largest open access dataset in the United States is part of the Dog Aging Project and includes detailed information about individual dog participant's physical and chemical environments, diet, exercise, behavior, and comprehensive health history. These data are collected longitudinally and at regular intervals over the course of the dog's lifespan. Large-scale datasets such as this can be used to inform our understanding of health, disease, and how to increase healthy lifespan.

Abstract: Dogs provide an ideal model for study as they have the most phenotypic diversity and known naturally occurring diseases of all non-human land mammals. Thus, data related to dog health present many opportunities to discover insights into health and disease outcomes. Here, we describe several sources of veterinary medical big data that can be used in research. These sources include medical records from primary medical care centers or referral hospitals, medical claims data from animal insurance companies, and datasets constructed specifically for research purposes. No data source provides information that is without limitations, but large-scale, prospective, longitudinally collected data from dog populations are ideal for further research as they offer many advantages over other data sources.

Keywords: big data; personalized healthcare; companion animal medicine; comparative medicine; one health

Citation: Paynter, A.N.; Dunbar, M.D.; Creevy, K.E.; Ruple, A. Veterinary Big Data: When Data Goes to the Dogs. *Animals* **2021**, *11*, 1872. https://doi.org/10.3390/ani11071872

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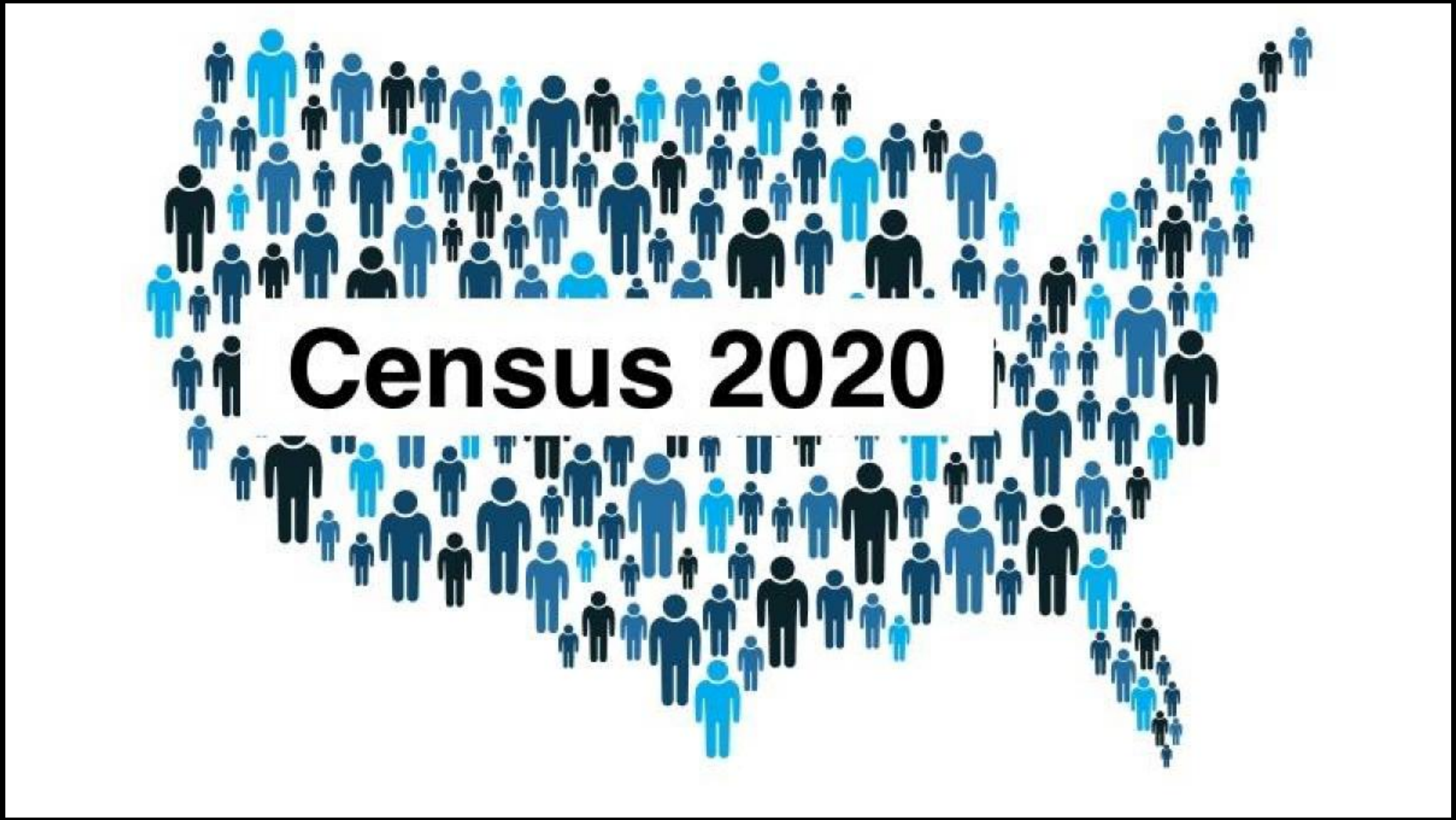
Dog Aging Project

Longer, healthier lives. Together.

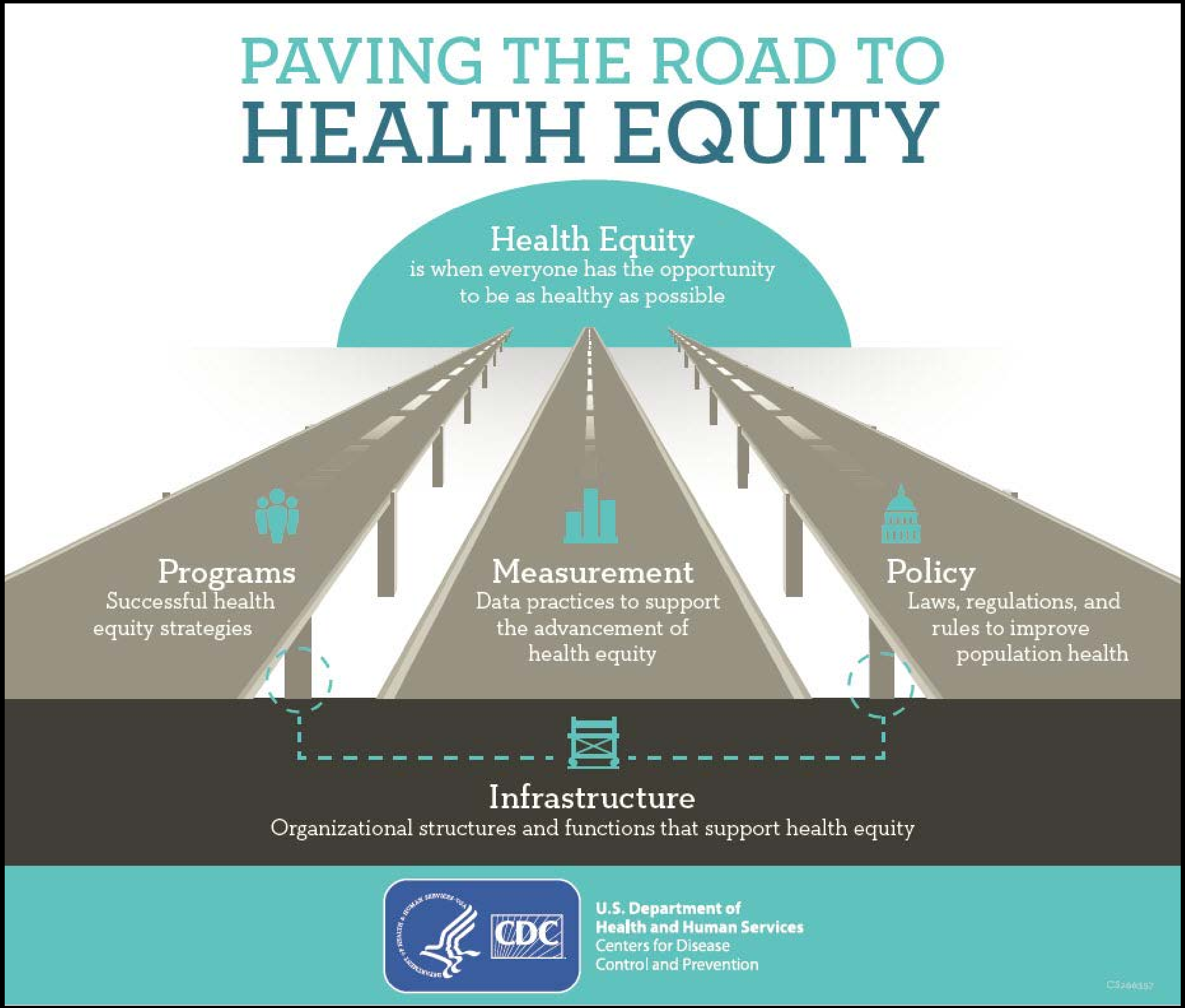
Limitations

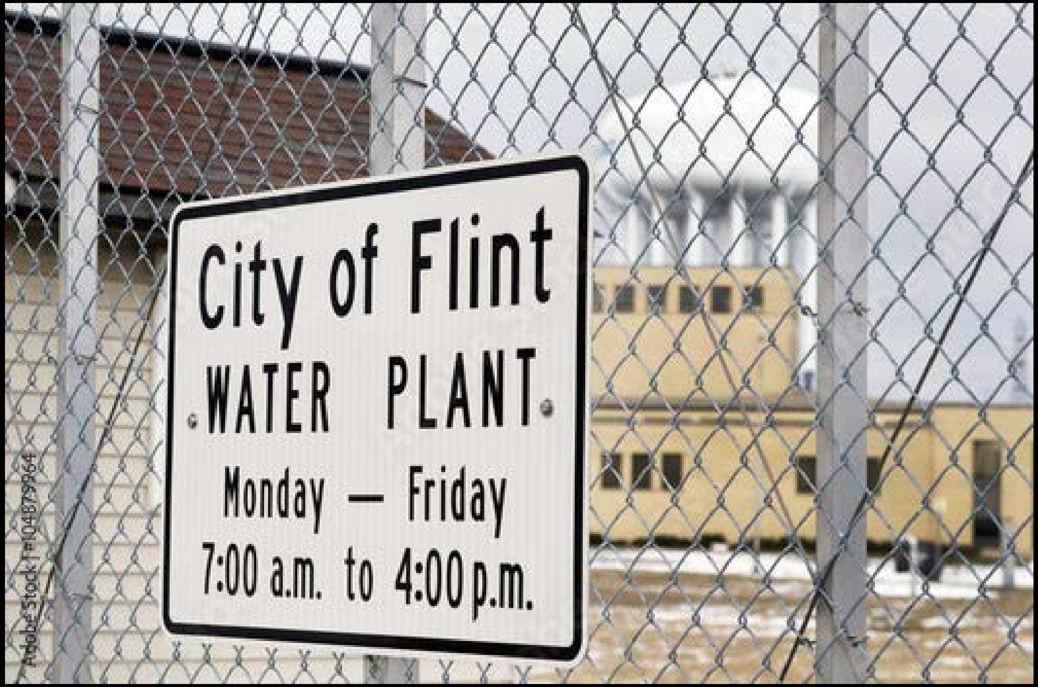


Limitations

NPCR
NATIONAL PROGRAM OF
CANCER REGISTRIES
QUALITY CANCER DATA
ACROSS THE US

Limitations





Investigation of blood lead concentrations in dogs living in Flint, Michigan

Daniel K. Langlois DVM

John B. Kaneene DVM, MPH, PhD

Vilma Yuzbasiyan-Gurkan PhD

Barbara L. Daniels

Hilda Mejia-Abreu PhD

Nancy A. Frank DVM, MPH

John P. Buchweitz PhD

From the Department of Small Animal Clinical Sciences (Langlois, Yuzbasiyan-Gurkan, Daniels), the Center for Comparative Epidemiology (Kaneene), the Office for Diversity and Inclusion (Mejia-Abreu), and the Department of Pathobiology and Diagnostic Investigation (Buchweitz), College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824; and the Animal Industry Division, Michigan Department of Agriculture and Rural Development, Lansing, MI 48909 (Frank).

Drs. Langlois and Buchweitz were both principal investigators for the study.

Address correspondence to Dr. Langlois (langlo21@cvm.msu.edu).

OBJECTIVE
To measure blood lead concentrations (BLCs) in dogs living in Flint, Mich, following a declared water crisis and to assess potential associations of BLCs with demographic data, water sources, and clinical signs in these dogs.

DESIGN
Cross-sectional study.

ANIMALS
284 dogs residing in Flint, Mich (test population), and 47 dogs residing in East Lansing, Mich (control population), and immediately adjacent areas.

PROCEDURES
Blood samples were collected at free screening clinics in Flint (test population) and at the Michigan State University College of Veterinary Medicine Veterinary Medical Center (control population). Owners of test population dogs completed questionnaires providing demographic and clinical information. Hematologic evaluations were performed; BLCs were measured by inductively coupled plasma–mass spectrometry.

RESULTS
4 of 284 test population dogs had BLCs > 50 ppb; an additional 20 had BLCs > 20 ppb. Overall, BLCs of test population dogs were higher than those of control dogs. Within the test population, young dogs (≤ 2 years of age) had higher BLCs than old dogs (≥ 6 years of age). Only 7.2% of test population dogs were drinking unfiltered tap water at the time of screening; however, dogs that had been receiving filtered or bottled water for ≤ 3 months before screening had higher BLCs than did those that received such water for > 3 months.

CONCLUSIONS AND CLINICAL RELEVANCE
Taken together, findings suggested that the impact of the Flint water crisis extended to companion animals. Results highlighted the importance of maintaining awareness of lead exposure and considering both human and animal well-being in cases of environmental toxicant exposures. (*J Am Vet Med Assoc* 2017;251:912–921)

Despite the wealth of studies of and scientists' and regulators' interest in the use of animals as sentinels for environmental health hazards, the committee notes that this approach has not gained widespread acceptance. One reason might be the institutional inertia that accompanies integration of new scientific methods into the risk-assessment process and use of the results for risk management. Many government agencies do not recognize the importance of animals sentinels or agree on how to compare the findings obtained with them and the findings obtained with more traditional methods. In addition, research on and development of animals sentinels have generally not had high priority in funding agencies, although they probably will with increasing attention to animal welfare and the search for humane alternatives to laboratory-animal experimentation. The committee feels that potential users of animal-sentinel data generally are not aware of possible applications of these alternative methods and that traditional rodent models for toxicity testing are perceived as superior to such alternative methods.

The National Academies Press. https://doi.org/10.17226/1351.

Audrey Ruple
aruple@vt.edu
@audreyruple

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