Diversity of risk: Purebred dogs and cancer

As the second part of a larger analysis of the cancer claims of 1.61 million Nationwide®-insured dogs over a six-year period, the leading U.S. pet health insurer reviewed data relating to the relative risk of cancer in the 25 most popular purebred dogs, which body systems are affected, and at what ages these cancers commonly manifest. *March 2022*

Executive summary

Are mixed-breed dogs less prone to cancer than purebreds? Are some breeds of purebred dogs more – or less – likely to have cancer than the average of all breeds and mixes? Do some kinds of cancer hit some breeds worse than others? Every practicing veterinarian has an opinion based on many difficult diagnoses, but what does a biostatistical analysis of millions of pet-health insurance claims show?

In 2021, Nationwide's pet insurance division created a dedicated veterinary analytics team comprised of veterinarians and data scientists working in collaboration with Nationwide actuaries, analytics experts and technology partners. The goal: Providing pet owners, veterinary teams and the veterinary industry with information that contributes to informed, data-driven decisions for the care of companion animals.

For this paper, the veterinary analytics team studied the policy and claims data for more than 1.6 million Nationwide-insured dogs over a six-year period, comparing relative claims rates for cancer and some specific body systems affected by cancer across popular breeds, between purebred and non-purebred dogs, and by other variables such as age at first cancer claim.

The analysis shows:

- **Purebred dogs as a group have a higher risk for cancer claims than do crossbred and mixed-breed dogs.**
- **The relative risk for cancer claims in purebred dogs varies significantly**:
  - **By breed.** While some purebreds show as very high relative risk, the data show considerable variation across the 25 most popular breeds.
  - **By breed and affected body system.** The literature has long established that some purebreds are overrepresented in specific cancer types. Nationwide's data allow us to quantify those risks, and to identify which other breeds and body systems may be at greatest risk.
  - **By breed and age.** In examining which body systems are most commonly affected by cancer earliest in a dog's life, the data show that some breeds see significantly younger average ages for cancer claims.

The first white paper in the series, on the relative risk of cancer claims in crossbred dogs compared to their purebred progenitors, can be found at www.petinsurance.com/petdata, as will future analyses on cancer and other topics of interest. An expanded explanation of the methodology can be found there, as well.

These studies and others in works are part of a larger effort Nationwide supports in veterinary medicine: The greater use of "big data" by industry players, shared for the benefit of all.

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Purebred vs. non-purebred: Overall relative risk

Purebred dogs had significantly higher relative risk for cancer claims than non-purebreds, the latter defined as a group containing both random-bred mixed breeds and purpose-bred crosses such as Labradoodles or other offspring of two different breeds. As a group, purebred dogs account for approximately 60% of the dogs studied, with an overall cancer claims rate almost twice (189%, or 1.9x) that for non-purebreds.

This is a single-variable analysis, not controlling for factors such as nutrition, body condition score/obesity, age, pet size (more on this in the next paper in this series) and others. That noted, the sample size is so significant and the population so widely spread across thousands of veterinary practices in all states, in rural, suburban and urban locales, and with a wide variety of demographics reflected in the ownership of the 1.6 million dogs, that it is hard to escape the inevitable questions around genetic diversity and the role that genetics plays in many forms of cancer in dogs.

While the first study in this series, "Oodles of Doodles: Popularity and Health" (January 2022), narrowed the analysis to compare the relative cancer claim risk of popular poodle crosses compared to their purebred progenitors, this document stays within the purebreds, and explores the differences in cancer risk across this diverse population. Of note, a considerable number of breeds in the ranking by popularity – or policies in force, to be more precise – have relative risk not only below the average for all dogs but also below the average for non-purebreds.

Unless otherwise noted, all findings in this study are expressed as relative risk; that is, as the risk in comparison to the cancer claims rate for the average of all dogs. For example, Golden Retrievers have a relative risk of 195% compared to that of all dogs, which is also expressed as 1.9 times the risk, or a risk 95% higher than all dogs. On the other side of the average, the Pomeranian has a relative risk of roughly half the average cancer claims rates for all dogs; by the numbers, that's set forth as 45% relative risk or 55% lower than the average.

These relative risk values speak to the likelihood of dogs of that breed having submitted at least one claim for cancer. They do not infer overall health of the breed, the severity of a cancer condition or the effect of these cancer claims on the longevity of a breed.

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Cancer claim risk for top 25 breeds

Breed popularity has long been influenced by exposure in advertising and entertainment, and more recently by social media "influencers." Although a dog featured in a movie or owned by a celebrity is just as likely these days to be a random-bred rescue or a deliberate crossbred, purebred dogs are still very popular, and the popularity of individual breeds rises and falls over the decades. In the years following World War II, for example, the Cocker Spaniel was consistently at or near the top of individual dog registrations recorded by the American Kennel Club, but in 2020 the Cocker was the 30th most popular breed according to the same organization. More recently, the French Bulldog went from a relatively obscure dog (82nd in popularity in 1991) to the second most popular of all AKC breeds in 2020.[1]

As far as Nationwide's covered canines, roughly the same trends in breed popularity can be observed. Notably, almost 70% of all Nationwide-insured purebreds are included in the top 25 breeds. In looking at differences between purebreds, the natural inclination is to provide as comprehensive a list as possible – relative cancer claims risk for most if not all breeds, no matter how rare. In providing statistical significance for a depth of analysis that can include cancer claims by body system, however, the focus for this work is on the 25 most popular purebreds at Nationwide. All of these breeds have a sample size of at least 10,000 dogs across the sample period. Even when citing results for breeds outside of the Top 25, no analysis of an individual breed was performed unless a sample of sufficient size was present.

[1] "Look out, Labrador retrievers: French bulldogs now 2nd most popular US dog," Associated Press as published by USA Today, March 16, 2021.

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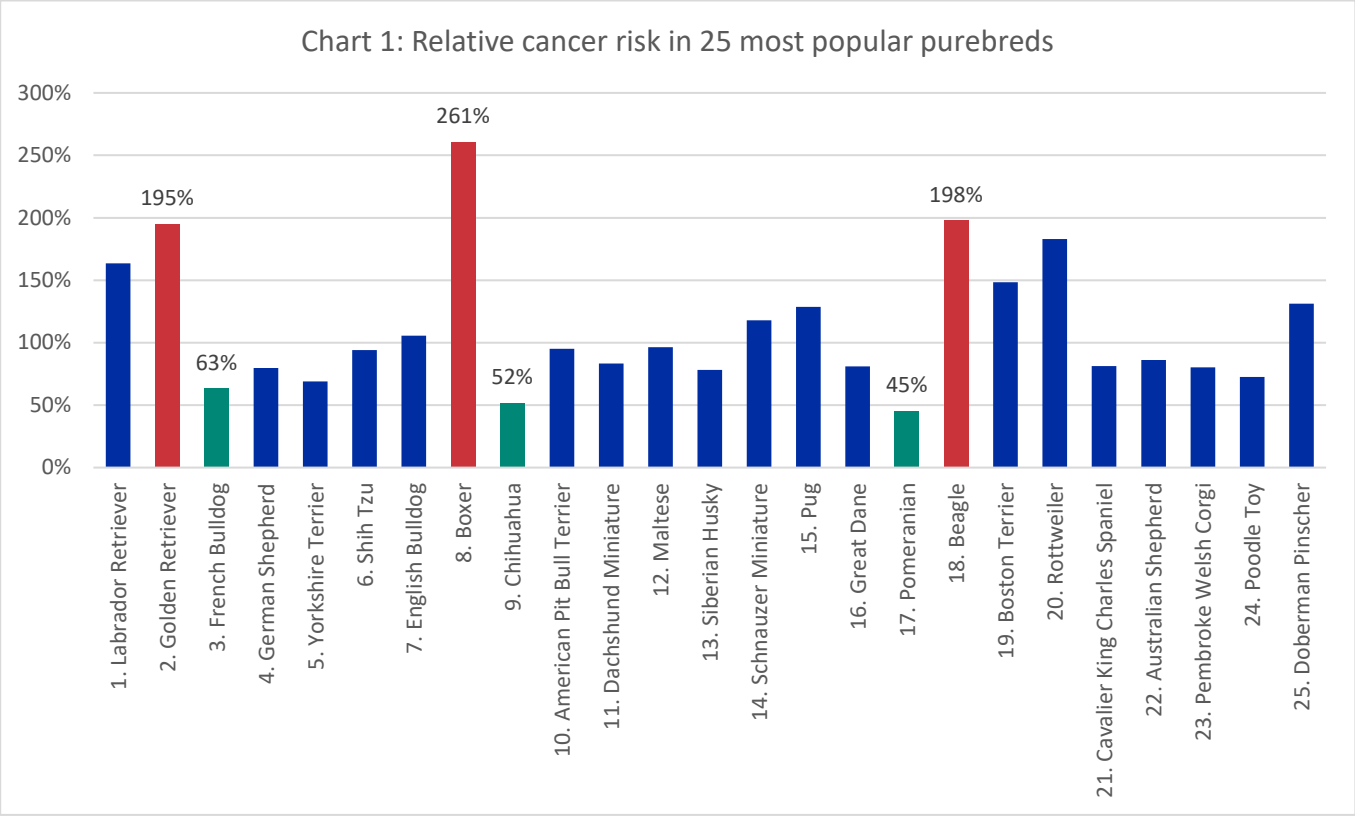
Cancer claim risk for top 25 breeds: All cancers

Chart 1 displays the relative risk by breed for the 25 most numerous purebred dogs. The three breeds with highest and lowest relative risk have been highlighted in different colors, the highest risks in dark red, and the lowest risks in dark green.



While Boxers, Beagles and Golden Retrievers have the highest relative risk, it's worth noting that the latter two breeds have risk values roughly in line with overall purebred cancer rate (189%), and that Boxers are the standout breed in this group with a relative risk of 261%. Conversely, the breeds with the lowest relative risk are Pomeranians, Chihuahuas and French Bulldogs. (It's not a coincidence that these are all small or toy breed dogs, a finding that will be explored in detail in the next publication.)

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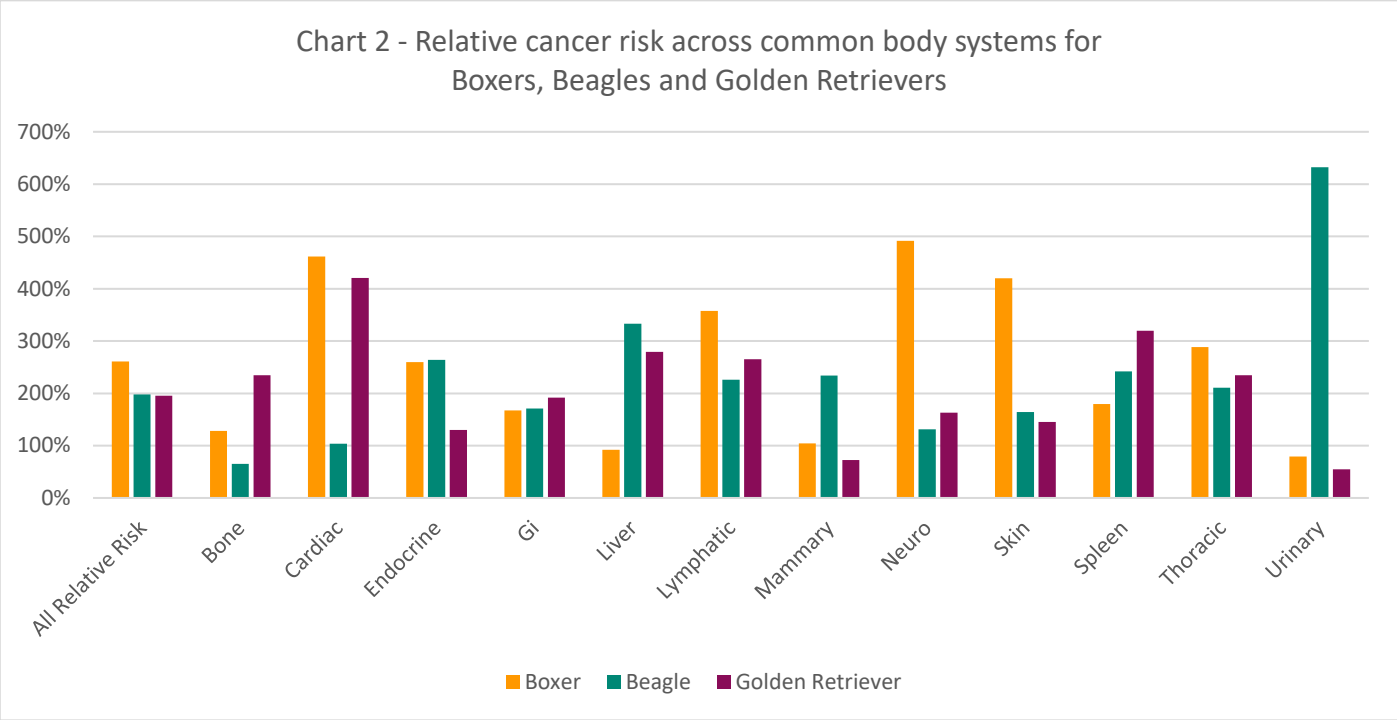
Cancer claim risk for three highest risk breeds: by body system

If we narrow the focus to those highest risk breeds in Chart 1 (Boxer, Beagle and Golden Retriever) the data show the body systems most affected as well as what may be driving those high overall relative risks. While most clinicians could name specific, common cancers that associated with these three breeds (for example, mast cell tumors in Boxers, transitional cell carcinoma in Beagles, and splenic hemangiosarcoma in Golden Retrievers), these breed predilections paint only part of the picture.

In Chart 2 below, we can see that these three breeds display high relative cancer risk across multiple body systems.



Boxers (orange bars in Chart 2) certainly do show a high relative risk for skin tumors (420%), but they also index highly for cardiac (462%), lymphatic (357%) and neurological (492%) cancer. While these other cancers may occur at a much lower rate than skin cancer, the high relative risks across multiple systems drives the increased overall relative risk.

Beagles (teal bars in Chart 2) show a similar pattern. While well known for bladder tumors (relative risk of 632% for urinary cancer claims), Beagles also show high relative risk across multiple other body systems, including endocrine (264%), liver (333%), mammary (234%) and spleen (242%).

The second most popular purebred, the Golden Retriever (purple bars in Chart 2), do show up, as expected, for splenic cancers (320%), but are also heavily overrepresented in bone (235%), cardiac (420%), liver (280%) and lymphatic (265%) cancer.

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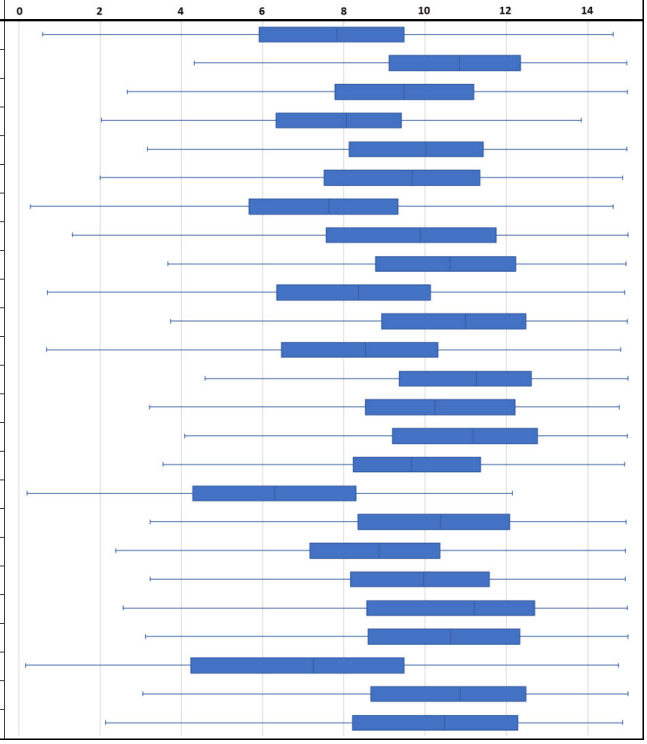
Cancer claim risk for top 25 breeds: Age of first cancer claim

Having looked at relative risk by body system for the three highest risk breeds, let's expand the view to the top 25 breeds and look at how average age of first cancer claim differs across these popular breeds. Table 1 below shows these breeds ranked by overall relative risk with the addition of age metrics: average age of first claim in column 4, and age distribution by first cancer claim in column 5. (For the age distribution box and whisker, see the Methodology section at the end of the document for a brief overview.)

Table 1

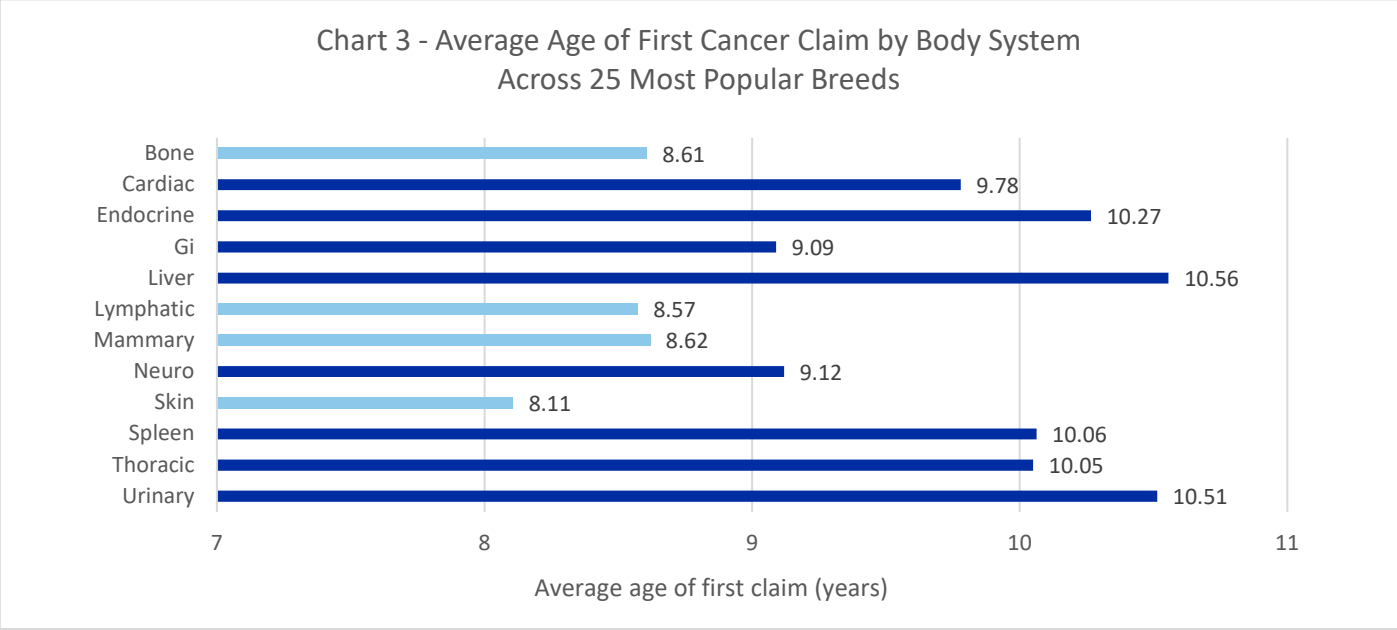
1. Breed Name	2. Overall Relative Cancer Risk	3. Breed Popularity Rank	4. Average Age at First Cancer Claim	5. Age Distribution of First Cancer Claim
Boxer	261%	8	7.6	
Beagle	198%	18	10.5	
Golden Retriever	195%	2	9.2	
Rottweiler	183%	20	7.8	
Labrador Retriever	164%	1	9.5	
Boston Terrier	148%	19	9.3	
Doberman Pinscher	131%	25	7.4	
Pug	129%	15	9.4	
Schnauzer Miniature	118%	14	10.3	
English Bulldog	106%	7	8.0	
Maltese	96%	12	10.5	
American Pit Bull Terrier	95%	10	8.3	
Shih Tzu	94%	6	10.8	
Australian Shepherd	86%	22	10.0	
Dachshund Miniature	83%	11	10.7	
Cavalier King Charles Spaniel	81%	21	9.5	
Great Dane	81%	16	6.2	
Pembroke Welsh Corgi	80%	23	9.9	
German Shepherd	80%	4	8.5	
Siberian Husky	78%	13	9.6	
Poodle Toy	73%	24	10.5	
Yorkshire Terrier	69%	5	10.3	
French Bulldog	63%	3	6.8	
Chihuahua	52%	9	10.4	
Pomeranian	45%	17	10.0	



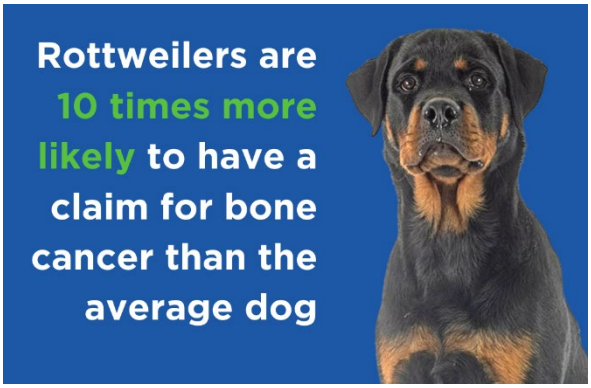
To look at the factors that weigh most heavily on average age at first claim, let's examine the three highest risk breeds with lower-than-average age at first cancer claim: Boxers (7.6 years), Rottweilers (7.8 years) and Dobermans (7.4 years). These lower ages at first cancer claim are likely driven by a number of factors, but most prominent among them in our dataset appears to be the body systems most commonly affected by cancer in these breeds.

Across all of the top 25 breeds, claims for skin cancer are, by far, the most common cause for first cancer claim, on average accounting for over 25% of the first claims by breed. Additionally, skin cancers are generally reported earliest in a pet's life, with first cancer claims for skin coming in, on average, more than two years earlier than those for urinary, liver or endocrine cancer (see Chart 3). Closely following

skin cancers in early-incidence are lymphatic, bone and mammary cancers – all of these body systems are highlighted in light blue in Chart 3.



For the three breeds mentioned above, this matters because those breeds either index heavily for skin claims (almost 50% of Boxer's first cancer claims are skin claims) and/or they index heavily on other cancer body systems with early emergence – both Rottweilers and Dobermans have bone cancer heavily represented as their first claims (31% and 16%, respectively, again unsurprising for the breeds) as well as weighing in moderately for lymphatic cancers as first claims.



Other breeds, such as the Great Dane, have a lower relative risk overall for a cancer claim, but that is offset by the relatively early age at which these breeds are diagnosed. As might be expected with this giant breed, the Great Dane has an inflated relative risk of bone cancer (404%, though considerably lower than the Rottweiler at 1009%), but their low overall relative risk for cancer (81%) is explained by a relative risk below 100% for cancer across almost all other body systems

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Methodology summary

The cancer claims analysis for this white paper and others in the series was complex, guided by breed experts and veterinarians and conducted/reviewed for adherence to statistical and biostatistical norms. In brief, the in-house veterinary analytics team looked at all Nationwide-insured dogs, identifying claims activity among 1,612,884 canines over a six-year period (October 2015 to September 2021). The team then identified claims codes relating to cancer diagnosis and treatment and assigned them to one of 23 body systems or a non-specific category. Any policy with a claim submission for a code for the diagnosis or treatment of cancer was used to calculate the relative risk for having submitted a cancer claim.[2]

With specific reference to the box and whisker age distribution shown in Table 1, the lower and upper edges of each box represent the 25th and 75th percentiles respectively and each box is centered around the median age at first cancer claim. The lines (whiskers) are capped with upper and lower bounds. Lower bound is the greater of minimum age or 25th percentile minus 1.5 times the interquartile range. Upper bound is the lesser of maximum age or 75th percentile plus 1.5 times the interquartile range.

A complete disclosure and discussion of cancer claims analysis methodology for all cancer studies in this series as well as any possible limitations of our analysis is available as a separate document at www.petinsurance.com/petdata.

Final note

This is the second of a series of white papers analyzing claims for cancer diagnosis and treatment in dogs, and the first of a larger series of analyses on companion animal health and veterinary industry financial trends. While most will be conducted by Nationwide's veterinary analytics team of veterinarians, biostatisticians, actuaries and science writers, others will be conducted with input from academic partners. As the leading U.S. pet health insurer with more than 1 million pets actively protected, Nationwide believes these studies to be of use to veterinary professionals and pet owners alike while helping to advance the use of industry data sources in developing guidance on pet selection and care to the benefit of all. A broader explanation of these concepts can be found in an article by Jules Benson, BVSc, MRCVS, Nationwide's Chief Veterinary Officer, on the website of VetSuccess.[3]

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To reach Nationwide's Veterinary Analytics Team with questions, comments or media requests, contact Nationwide's Corporate Communications team, news@nationwide.com.

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[2] Proprietary business reasons preclude the release of any Nationwide raw data to the public.
[3] "Pet health 'data' isn't a four-letter word: Why—and how—we all need to help," Jules Benson BVSc, MRCVS, VetSuccess blog, Aug. 31. 2021. https://vetsuccess.com/blog/pet-health-data-isnt-a-four-letter-word/