Preventing Cancer in Dogs and Cats: Is It Possible?

CHAPTER 1

In the United States, cancer is the leading cause of death in dogs even when researchers control for breed dispositions. In other words, in large purebred dogs, cancer accounts for 50% of deaths and in smaller breeds it accounts for 15–20% (Rafalko et al. 2023). Cancer is also the leading cause of death in senior cats (Kent et al. 2022). In humans, cancer mortality comes second only to heart disease, but current epidemiologic studies are predicting that cancer will soon surpass heart disease as the number one killer of Americans. Researchers now estimate that one in two people born in the United States or United Kingdom in 1961 will be diagnosed with some form of cancer in their lifetime (https://www.nhs.uk/conditions/cancer/#:~:text=1%20in%202%20people%20will,of%20cancer%20during%20their%20lifetime and Howlader et al. 2015). According to the World Health Organization, one in five people across the globe will be diagnosed with cancer in their lifetime (www.who.int).

These concerning statistics are interesting given that the significant expenditure on cancer research and treatment since 1971 has yielded a profound surfeit of information, yet clearly limited increases in survival rates (www.cms.gov).

In 1970, *The New England Journal of Medicine (NEJM)* reported that the risk of death from cancer was 162 out of 100,000. Four decades *after* President Nixon declared a war on cancer by signing into law the Cancer Care Act, *NEJM* reported that the risk of death from cancer had increased to 186 out of 100,000.

Is it because we're living longer and have superior diagnostic tools compared to 40 years ago? Maybe. But in a 2017 study that appeared in the *Journal of the National Cancer Institute*, researchers found that people born after 1990 have twice the risk of developing colon cancer than a young adult and four times the risk of developing rectal cancer (Howlader et al. 2015).

As touched on above, healthcare spending in the United States seems to focus heavily on treating disease rather than preventing it. In 2022, an impressive $4.5 trillion was allocated to healthcare with less than 3% of that allocation spent on prevention. Similarly, spending specifically on cancer care predominantly prioritizes treatment over prevention (www.cms.gov).

In 2020, roughly $209 billion was spent on cancer-related care in the United States with a small portion dedicated to preventive strategies, like screening and early detection. Equally as concerning, in 2021, the National Cancer Institute reported that the financial burden on patients amounted to $21 billion with $16.2 billion being attributed to out-of-pocket expenses and $4.8 billion accounting for the time costs incurred by patients. Put simply, dealing with cancer is incredibly costly even for those with insurance coverage (www.cancer.gov).

Regrettably, despite this financial burden on our healthcare system, mortality rates have not decreased with the same gusto. A recent study conducted in 2022 by researchers from Yale and Vassar pointed out that although the United States spends double the amount on cancer treatments compared to other high-income nations, its mortality rates are only marginally better than average. This seems to indicate that increased spending does not lead to advancements in survivorship since countries like Australia, Finland, and Japan achieve lower mortality rates while spending less (news.yale.edu).

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Given these observations, it appears paradoxical that investments in cancer prevention initiatives in the United States – such as public health campaigns, lifestyle interventions, programs to make whole foods financially competitive with ultra-processed foods, and screening programs – are remarkably lower than expenses for providing care. This, despite the data showing that preventive measures, such as programs to help people quit smoking, can make a significant difference in reducing cancer-related deaths (www.cdc.gov).

Although compared to our knowledge on cancer treatment, there is a dearth of information on prevention, several relatively recent studies have shed some light on human cancer prevention. In 2002, a study appearing in the *European Journal of Cancer Prevention* revealed the relationship between weight control, exercise, and incidents of cancer. Researchers concluded that between one-fourth and one-third of a variety of cancers could be prevented with appropriate exercise and weight control (Vainio et al. 2002).

A study published in 2016 in the *Journal of the American Medical Association* that included 1.4 million participants found that maintaining a healthy weight and weekly exercise reduced cancer diagnosis risk by as much as 40% in Caucasians. In addition, researchers concluded that lifestyle modification could prevent nearly 50% of all cancer deaths. To put this in perspective, reducing the risk of cancer by 40% translates to 800,000 Americans *not* being diagnosed with cancer each year. The authors of that study also concluded that the amount of exercise needed for protective effects equated to walking at 3 mph, 30 minutes per day, 5 days a week (Moore et al. 2016).

Finally, many studies have found that poor dietary habits are associated with cancer risk. Namely, five prospective studies with large cohorts that often get applauded are the Adventist Health Study, the Adventist Health Study II, the Oxford cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC)-Oxford, the Oxford Vegetarian Study, and the UK Women's Cohort Study. All but one of these studies found that vegetarians and/or vegans had lower risk of developing certain types of cancer and in one study a reduced risk for all cancers. The UK's Women's Cohort Study found that decreased meat consumption, but not necessarily a strict vegetarian diet, reduced the risk of breast cancer (Beeson et al. 1989; Butler et al. 2008; Orlich et al. 2013; Crowe et al. 2011; Appleby et al. 1999; Cade et al. 2017).

In 2019, a study published by Oxford University Press found that 5% of all invasive cancers among US adults over the age of 20 were associated with seven dietary factors, including low intake of vegetables, fruits, and whole grains and high intake of processed meats, red meats, total dairy products, and sugar-sweetened beverages (Zhang et al. 2019). Another study, published in 2014, looked at 61,647 British citizens over 14.9 years and found that cancer incidence was significantly lower in vegetarians and pescatarians compared to meat eaters (Key et al. 2014).

Similar trends are seen in veterinary medicine, where treatment takes precedence over prevention, and we rarely consider cancer prevention in veterinary school or when educating pet families. There are only a few small studies that try to illuminate causes and, therefore, prevention, which will be discussed below. In addition, veterinary cancer treatment options, such as surgery, chemotherapy, some small molecule inhibitors, emerging immunotherapies, and radiation are similar to those used in human medicine, and they can be equally as costly. Pet parents face significant financial burdens when caring for a pet with cancer, similarly, albeit disproportionate, to the financial strain experienced by human cancer patients.

It's no secret to the reader that the veterinary research generally pales in comparison to the large-scale studies, generous funding, and extensive treatment infrastructure seen in human oncology. Though it seems, even if it didn't, improvement in survival times would not be a guarantee. Consequently, to make an impact on cancer mortality statistics, it behooves us, and especially the general practitioner on the front lines, to focus as much attention as possible on prevention, rather than waiting for the elusive perfect "lock and key" drug or for veterinary cancer treatments to catch up to those utilized in humans.

Below you'll find an introduction into some evidence-based cancer preventative strategies (mostly for humans).

DIET

A diet composed of whole, minimally processed foods is increasingly considered by many as the cornerstone of human cancer prevention. Such a diet is rich in phytonutrients, antioxidants, and other bioactive compounds that have been shown to have anticancer properties through a variety of mechanisms, including chemoprevention, reduction of chronic inflammation, and promoting a robust gut microbiome. In addition, highly processed foods contain advanced glycation end products (AGEs) and acrylamide, both of which have a large volume of data linking their consumption with not only cancer but also several other chronic conditions, including heart disease, diabetes, Alzheimer's, and slow walking in older individuals (yes, there is a published study on this subject). Of course, like many things found in published literature, we can also find contradicting studies (Sugita et al. 2021; Semba et al. 2010; Prasad et al. 2017).

Chemopreventive nutrients such as glucosinolates, found in cruciferous vegetables, have been shown to induce phase II detoxification enzymes, thereby neutralizing potential carcinogens before they can cause damage. Antioxidants like vitamins C and E, as well as carotenoids, scavenge free radicals, reducing oxidative stress, a key driver of carcinogenesis (Mithen et al. 2000; Ames et al. 1993; Mordecai et al. 2023; Vanduchova et al. 2019; Iahtisham-Ul-Haq et al. 2022; Rizzo et al. 2017). In a case-control study involving 166 Scottish Terriers, the risk of transitional cell carcinoma was found to be significantly lower in dogs that ate vegetables at least three times per week, in addition to their regular dog food. The vegetable(s) with the most benefit was not determined (Raghavan et al. 2005).

The gut microbiome, often referred to as our "second genome," is a complex and dynamic community of microorganisms that influences the immune system, modulates inflammation, and affects the metabolism of dietary components, all of which are factors in cancer development (Garrett 2015; Ji et al. 2023). Dysbiosis, or an imbalance in the gut microbiome, has been linked to an increased risk of cancer in both humans and animals. Specifically, in veterinary medicine dysbiosis has been linked to the development of intestinal lymphoma in dogs and cats (Omori et al. 2017; Breczko et al. 2024; Marsilio et al. 2019; Mahiddine et al. 2022; Gavazza et al. 2018; Garraway et al. 2018).

When we think of the microbiome, it's important to consider not just the bacteria, but also what feeds the bacteria and the beneficial compounds produced by those bacteria. In other words, gut microbiota homeostasis is maintained by prebiotics, probiotics, and postbiotics, and some researchers believe that this area of science is underutilized when it comes to not only maintaining health, but also potentially in treating disease (Ji et al. 2023).

The agreed-upon scientific definition of "prebiotic" has been evolving since 1995, but put simply, prebiotics are nondigestible fibers that promote the growth of beneficial gut bacteria. Common prebiotics include inulin, fructooligosaccharides (FOS), galactooligosaccharides (GOS), and beta glucans. These fibers are fermented by gut bacteria, producing short-chain fatty acids (SCFAs) like butyrate, which has anti-inflammatory and anticancer properties (Gibson and Roberfroid 1995; Carlson et al. 2018).

All prebiotics are fiber, but not all fibers are considered prebiotics. That said, all types of fiber have been shown to have a variety of health benefits. Sources of prebiotic fibers for humans include chicory, onion, leeks, garlic, asparagus, banana, Jerusalem artichoke, soybeans, oats, whole wheat, mushrooms, and algae (Sabater-Molina et al. 2009; Carlson et al. 2018; Slavin 2013). Other sources of functional fibers include vegetables, legumes in general, and fruit (Slavin 2013).

Probiotics are live microorganisms that confer a health benefit to the host when administered in adequate amounts. Studies have shown that probiotics can enhance the gut microbiome, improve immune function, and reduce inflammation, all of which contribute to cancer prevention (Rafter 2003; Tsilingiri and Rescigno 2013).

Postbiotics are the metabolic byproducts of probiotics, including SCFAs, enzymes, and other bioactive compounds. These substances have been shown to have various health benefits, including enhancing gut barrier function and modulating immune responses, both of which are important for cancer prevention (Tsilingiri and Rescigno 2013). However, it has also been found that there is a wide range in response between individuals for the same dietary fiber, even in controlled systems (Carlson et al. 2018).

Feeding a varied diet is essential for maintaining a healthy gut microbiome, which is increasingly recognized as a key player in cancer prevention. Studies in humans have shown that dietary diversity promotes a more diverse and resilient microbiome, which is associated with better health outcomes, including a reduced risk of cancer (Claesson et al. 2012). While research in veterinary medicine is still emerging, research in dogs has shown that certain bacterial populations are associated with a reduced risk of cancer. For example, *Lactobacillus* and *Bifidobacterium* species, which are commonly found in probiotics, have been shown to inhibit the growth of cancer cells in vitro and reduce the incidence of cancer in animal models (Rafter 2003). In addition, others have shown strong similarities between human and companion animal microbiota and how the microbiome in general influences carcinogenesis through inflammation, genomic integration, and metabolic reprogramming (Aluai-Cunha et al. 2023).

In 2021, Japanese researchers published data showing that processed dog food, whether dry kibble or canned, contains very high levels of acrylamide. While a 2015 study suggested that acrylamide might not be the carcinogen we once thought it was, the Japanese researchers showed that dogs eating a purely processed diet everyday are consuming three times the amount of acrylamide than the average human. Since there are numerous studies showing acrylamide causes cancer in rats, we cannot yet discount acrylamide as a carcinogen in dogs (Sugita et al. 2021; Pelucchi et al. 2015).

In humans, increased plasma levels of AGEs are associated with eating a diet composed of highly processed foods and are thought to predispose people to oxidative stress and chronic inflammation, contributing to obesity, type 3 diabetes mellitus, cardiovascular disease, atherosclerosis, systemic hypertension, stroke, and some cancers like liver, stomach, and breast cancer (Mirmiran et al. 2018; Nowotny et al. 2018; Gill et al. 2019; Uribarri et al. 2015; Wada et al. 2022; Peterson et al. 2024; Wang et al. 2024). Since most dogs eat a 100% highly processed diet, some estimate that their daily intake of AGEs is over 100 times higher than adult humans consuming a Western diet, and, therefore, the burden of AGEs on canine health might be even more substantial than for humans (van Rooijen et al. 2014; Bridglalsingh et al. 2024).

A 2024 study found that eating ultra-processed canned wet dog food was associated with higher plasma levels of AGEs compared to ultra-processed dry dog food and minimally processed mildly cooked food (Bridglalsingh et al. 2024). In a study published in 2020, both dogs and cats fed a dry processed diet were found to have higher levels of AGEs in their urine than those fed a raw food diet (Palaseweenun et al. 2021). Further research is needed to link higher levels of AGEs in dogs and cats to cancer development or any other disease.

WEIGHT MANAGEMENT

Obesity is a significant risk factor for cancer, as it is associated with chronic inflammation, insulin resistance, and altered hormone levels, all of which can contribute to carcinogenesis (Venkatasamy et al. 2013; Calle et al. 2003). Studies in humans and animals have shown that obesity is linked to an increased risk of several types of cancer, including mammary, bladder, and colorectal cancers (Calle et al. 2003). In dogs and cats, maintaining an ideal body weight might be important for reducing cancer risk (Marchi et al. 2022).

ENVIRONMENT

AVOIDING CARCINOGENS

Environmental carcinogens are a significant concern for both humans and pets. Certain chemicals and pollutants have been linked to an increased risk of cancer in dogs and cats, particularly those that share the same living environment as their owners.

SECONDHAND TOBACCO SMOKE

Secondhand tobacco smoke is a well-known carcinogen that affects both humans and animals. A study by Bertone-Johnson et al. (2000) found that cats exposed to secondhand smoke were more likely to develop lymphoma, with the risk increasing with the duration and intensity of exposure (Bertone-Johnson et al. 2000). This is likely because cats groom themselves frequently, ingesting carcinogens that settle on their fur.

PESTICIDES AND HERBICIDES

Exposure to certain pesticides and herbicides has also been linked to cancer in pets. A study by Hayes et al. (1991) found that dogs exposed to lawns treated with 2,4-D, a common herbicide, had a significantly higher risk of developing malignant lymphoma (Hayes et al. 1991). Similarly, other studies have found associations between pesticide exposure and the development of bladder and mammary tumors in dogs.

TOXINS IN WATER

Contaminants in tap water, such as hexavalent chromium, dichloroacetic acid, and trichloroacetic acid, have been shown to be carcinogenic in animal studies. Pet owners can check the quality of their local water supply by using resources like the Environmental Working Group's Tap Water Database, which provides information on contaminants present in municipal water supplies (Villanueva et al. 2015). If necessary and when possible, water filtration systems can be used to reduce exposure to these harmful substances.

EXERCISE AND CANCER PREVENTION

Regular physical activity has been shown to reduce the production of pro-inflammatory cytokines and increase the production of anti-inflammatory cytokines, thereby reducing systemic inflammation, a known carcinogen. Exercise enhances the activity of natural killer cells and other components of the immune system that play a role in identifying and destroying cancer. Finally, exercise increases insulin sensitivity, helps to maintain a healthy body weight, and reduces anxiety, all of which seem to be important factors in human cancer prevention (Friedenreich and Orenstein 2002; Pedersen and Hoffman-Goetz 2000).

SUPPLEMENTS

While a balanced, whole food diet should provide most of the nutrients needed for general health and cancer prevention, there are situations when supplementation may be necessary. For example, certain animals may be predisposed to low levels of vitamin D or B12 due to genetic factors or underlying health conditions.

Vitamin B12 is essential for DNA synthesis and repair, and deficiencies have been linked to an increased risk of cancer (Smith et al. 2018).

Vitamin D plays a crucial role in immune function and cellular differentiation, and there is growing evidence that it may also play a role in cancer prevention. In humans, low levels of vitamin D have been associated with an increased risk of several types of cancer, including colorectal, breast, and prostate cancer (Giovannucci 2005). While research in dogs and cats is limited, relatively recent studies have raised concerns about low vitamin D levels in some dogs and their potential link to cancer.

Selting et al. (2016) found that dogs with lymphoma had significantly lower serum vitamin D levels compared to healthy controls, suggesting a possible role of vitamin D deficiency in the development of cancer (Selting et al. 2016). Similarly, Wakshlag et al. (2011) found that dogs with osteosarcoma had lower levels of circulating vitamin D metabolites compared to healthy dogs, indicating a potential role for vitamin D in bone cancer prevention (Wakshlag et al. 2011). More research is needed to elucidate cause versus effect.

Given these findings, veterinarians could consider routine testing of vitamin D and B12 levels in at-risk pets, such as those with signs of inflammatory bowel disease and those breeds that are predisposed to cancer or other conditions that affect nutrient absorption. If deficiencies are detected, appropriate supplementation should be initiated, along with efforts to address the underlying cause.

PUTTING IT ALL TOGETHER

If cancer prevention is possible, it's probably going to require a multifaceted approach that might include slightly increasing consumption of whole fruits and vegetables (dogs), increasing regular exercise, maintaining a healthy weight, and, when possible, avoiding carcinogens like those found in highly processed foods, secondhand tobacco smoke, tap water toxins, herbicides, and pesticides.

Additionally, early detection through regular checkups and possibly emerging diagnostic screening tools could play a crucial role in catching cancer early, when treatment outcomes are often better and costs are minimized.

WHAT I TELL THE FAMILIES

Obviously, I'm an oncologist, so I don't see patients when cancer prevention is possible. Still, I don't dodge that very common question: "Doc, what should I feed my dog or cat?"

Let me first address cats. Cats are challenging! They are obligate carnivores and can be picky even when they're perfectly healthy. Getting a cat to eat what you think is best is, well, sometimes just a fool's errand. Couple that with the fact that, most of the time, we just don't know – other than the obvious choice of something that's well-balanced and contains a high-quality source of ingredients.

Now here's what I say to my canine pet parents. Research on the human side and a very tiny bit on the veterinary side suggests that a minimally processed diet rich in whole foods, including a variety of vegetables and maybe certain fruits, might improve immune function, maintain a healthy microbiota, reduce risk of cancer, and potentially even offer a survival benefit to those who already have cancer (Farvid et al. 2020). If it fits in your budget, and the patient enjoys it, I suggest feeding a mildly cooked, commercially prepared whole-food diet plus added veggies like broccoli, carrots, bell peppers, and/or dark berries. If that doesn't work with your budget, feed the highest-quality, commercially prepared dog food plus added whole cooked meats, veggies, and/or berries. If possible, replace all processed treats with whole foods.

That said, there's no definitive evidence that this will be helpful, and some would argue that adding vegetables to the diet of a dog who is also receiving chemotherapy could contribute to negative gastrointestinal side effects.

In addition, if possible, the patient should be walked at least three times per week. Obviously, if they are weak and in pain, this doesn't make sense, but most patients, at initial diagnosis, are still feeling well enough to start or continue regular exercise.

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