

VOLUME 10 ISSUE 1 2024

ISSN 2454 – 3055



**INTERNATIONAL
JOURNAL OF
ZOOLOGICAL
INVESTIGATIONS**

***Forum for Biological and
Environmental Sciences***

Published by Saran Publications, India



International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India



ISSN: 2454-3055

Cancer in Domestic Animals in India: Understanding Prevalence, Causes, and Treatment

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Received: 23rd October, 2023; **Accepted:** 6th December, 2023; **Published online:** 19th February, 2024

<https://doi.org/10.33745/ijzi.2024.v10i01.030>

Abstract: India has witnessed a significant rise in cancer cases among domestic animals, especially dogs and cats. This review explores the prevalence, causes, and treatment options for cancer in these animals within the Indian context. The review highlights various cancer forms, such as carcinomas affecting organs and glands and sarcomas impacting supporting tissues. It discusses the concept of remission and the varied forms of lymphoma in dogs and cats. This review emphasizes the need for comprehensive research and awareness, focusing on the role of veterinary oncologists in India. In conclusion, addressing the increasing incidence of cancer in domestic animals requires a multifaceted approach to safeguard their health and contribute to cancer research.

Keywords: Cancer incidence, Domestic animals, India, Veterinary diagnostics. Zoopharmacognosy

Citation: Ray Pallab: Cancer in domestic animals in India: Understanding prevalence, causes, and treatment. Intern. J. Zool. Invest. 10(1): 277-286, 2024.

<https://doi.org/10.33745/ijzi.2024.v10i01.030>



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Introduction

Cancer incidence among domestic animals in India has increased in recent years, possibly due to factors like extended life expectancy and advancements in veterinary diagnostics. Despite global concerns about cancer due to environmental factors, research on cancer in Indian domestic animals remains limited (Karnik *et al.*, 2020). Industrialization and modern agricultural practices have introduced potentially carcinogenic chemicals into the environment. Up to 50% of elderly dogs and cats may get cancer, a genetic disease triggered by DNA changes, and it is the most common cause of mortality in these

animals. Notably, one in five cats and one in four dogs will experience cancer at some point. Although not all cases are dire, comprehensive research and awareness are crucial to better understand and address cancer in domestic animals (Adam *et al.*, 2010).

Cancer is a formidable adversary that affects not only humans but also our cherished canine and feline companions in India. Surprisingly, domestic animal cancer incidence closely resembles human cancer incidence. Cats, intriguingly, exhibit a slightly lower frequency of cancer occurrence than their human counterparts,

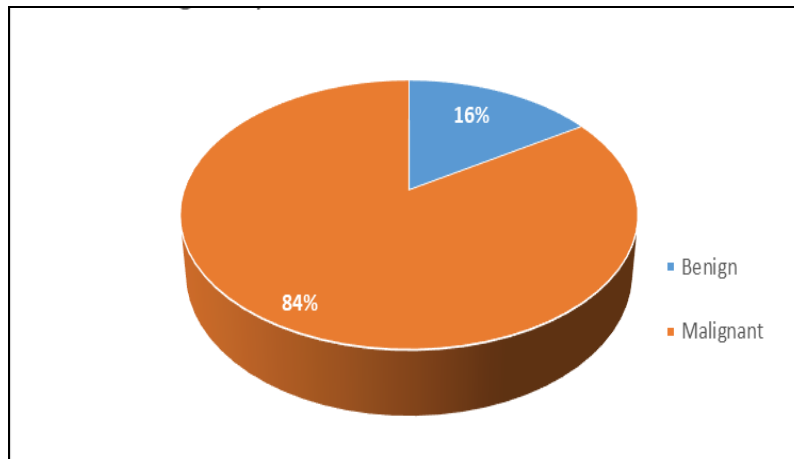


Fig. 1: Types of cancer found in Domestic Animals (Karnik *et al.*, 2020).

while dogs seem to experience cancer slightly more frequently. It is worth noting that, akin to humans, the likelihood of cancer increases with age for most species. In the realm of pets, the risk of cancer surges for those aged ten and older, with nearly half of all deaths in this age group attributed to this insidious disease. However, the onset of cancer is not confined to the twilight years; even young animals can fall prey to its devastating grip, indicating that age is but one of several factors contributing to cancer development. Around 1 in 4 dogs were encounter neoplasia, or abnormal tissue growth, at some point, with the risk increasing as dogs age. Dogs experience cancer at a rate similar to humans, while feline cancer data is limited. Diagnosing neoplasia involves medical history, physical exams, radiographs, blood tests, ultrasounds, and cytology or biopsies. Advanced imaging like CT, MRI, and PET scans aids in locating tumors (Baioni *et al.*, 2017).

Cancer, in essence, is a form of neoplasia, signifying the growth of abnormal cells that, though not always, tend to coalesce into a mass, commonly referred to as a tumor or neoplasm. A defining characteristic of all neoplastic cells is their lack of restraint in normal growth control mechanisms. Neoplasms come in two principal forms: Benign and Malignant.

- **Benign Tumors:** These growths, though forming a mass, remain confined and do not encroach

upon adjacent tissues. However, when they reach a size that compresses healthy tissue, treatment or removal becomes necessary.

- **Malignant Neoplasms:** These are more aggressive and possess the ability to invade surrounding tissues or spread to distant sites, a phenomenon known as metastasis. Malignant neoplasms, often referred to as cancer, pose greater treatment challenges.

Mostly domestic animals suffer from malignant cancers in which tissue within an animal's body can potentially harbor neoplastic cells, leaving no area immune to their insidious presence (Fig. 1). Neoplasms derive their names from the type of cell or organ in which they originate (Karnik *et al.*, 2020). Owners must diligently monitor pets for signs of cancer, such as changes in behaviour, eating habits, or activity levels. Routine veterinary screenings and advanced diagnostics like X-rays, MRI, CT scans, and colonoscopies play a crucial role in early cancer detection. Early detection enhances treatment success, similar to human medicine. Figure 2 shows how the Shine-On suspicion (SOS) test is used to check dogs who have reached the age where they are more likely to develop cancer for the presence of incipient or developing hemangiosarcoma, a terminal tumour made up of blood vessel-forming cells. The SOS test counts uncommon hemangiosarcoma-associated cells in blood and determines risk using flow cytometry and artificial intelligence. Dogs at

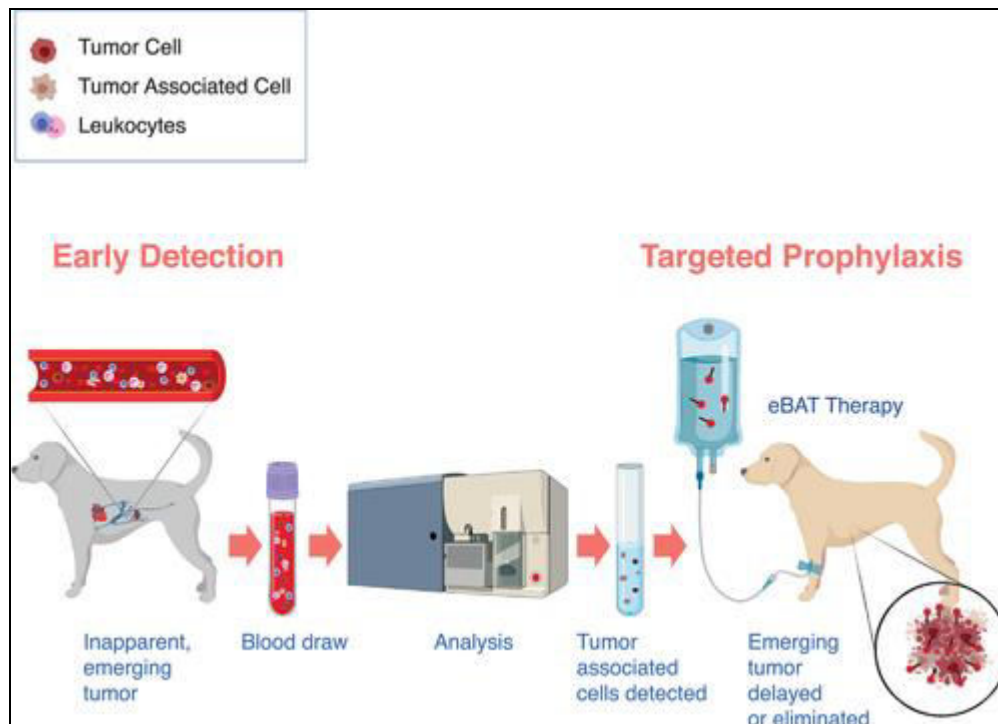


Fig. 2: Early Detections and Cancer Prevention Strategies (Adam *et al.*, 2010).

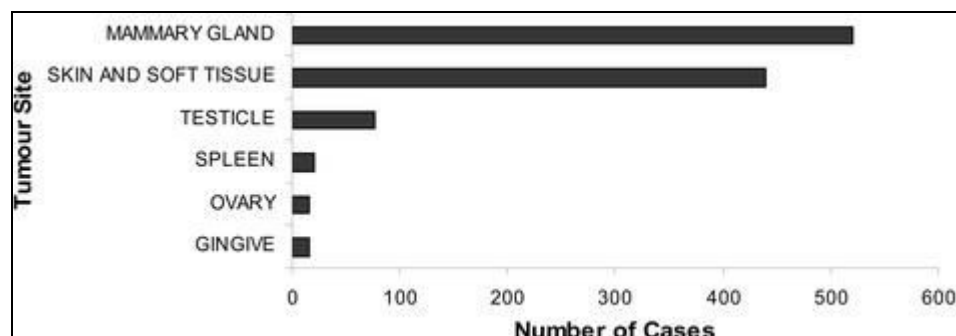


Fig. 3: Number of cases by tumour site (Gupta and Tiwari, 2012).

high risk could get targeted prophylaxis, such as treatment with the medication eBAT, in an effort to stop or delay the onset of clinical hemangiosarcoma (Karnik *et al.*, 2020). This review aimed to provide insights into cancer prevalence, types, and interventions for dogs and cats, contributing to their well-being and offering valuable information to pet owners and veterinarians.

Common Types of Cancer in Domestic Animals in India:

Cancer in pets, much like in humans, exhibits

varying prevalence. Common types include breast, skin, bone, oral, sarcomas, and lymphomas. Leukaemia and lymphomas are blood-related cancers. Carcinomas affect epithelial cells in organs, while sarcomas involve mesenchymal cells, such as in bone cancer (Bronden *et al.*, 2010). As shown in Figure 3 mostly in domestic animals carcinogenic tumour site occur frequently on mammary glands, skin and soft tissues, and testicles.

The most frequently encountered types of cancer in domestic animals are of wide range

(Davis and Ostrander, 2014) such as:

(a) *Mammary Carcinoma*: Non-spayed female dogs carry a substantial risk of developing malignant mammary tumors. Complete surgical removal is advocated when metastasis is absent.

(b) *Malignant Histiocytosis*: Primarily affecting larger sporting breeds, this cancer materializes as localized lesions in various organs. Sadly, effective therapy remains elusive.

(c) *Hemangiosarcoma*: This incurable canine cancer originates from the endothelial cells lining blood vessels. Although it can affect dogs of any age and breed, it is more prevalent in middle-aged to elderly dogs

(d) *Mast Cell Tumors*: Immune cells known as mast cells, responsible for allergic reactions, can give rise to tumors, primarily manifesting on the skin in nearly 20 percent of the canine population. These tumors exhibit a broad spectrum of benign to highly aggressive behavior, with certain breeds, such as Boxers, being more predisposed.

(e) *Lymphoma*: Affecting dogs of all breeds and ages, lymphoma most commonly presents as visible or palpable swollen lymph nodes. Occasionally, it can affect lymph nodes concealed within the body, causing respiratory and digestive disturbances.

(f) *Osteosarcoma*: This primary bone cancer accounts for up to 85% of skeletal system tumors in dogs, predominantly affecting older large or giant breeds.

(g) *Testicular Cancer*: Prevalent in unneutered dogs or those with retained testes, this cancer is largely preventable through neutering and curable with early surgical intervention.

Thus, understanding of the various types of cancer afflicting domestic animals, coupled with early detection and appropriate treatment, can significantly enhance the prospects of managing and, in some cases, conquering these devastating diseases.

Prevalence of Cancer in Domestic Animals:

In India, as in many other parts of the world, the prevalence of cancer in domestic animals has been steadily increasing. This surge in cancer cases among pets has raised several questions and concerns, particularly regarding its causes, prevention, and treatment. Tumors originating from mesenchymal tissues were observed in 76.47% of domestic dogs, while tumors of epithelial origin accounted for 23.53%. Notably, a higher incidence of tumors was found in female domestic animals (encompassing both dogs and cats) compared to males.

Among domestic animals in India, there is a significant predisposition to cutaneous tumors, with Mast cell tumors being the most prevalent at 17.64%, followed by Hemangiosarcoma and Hepatoid gland carcinoma, each at 8.82%. Mammary gland tumors were also documented and categorized into Tubular (8.82%), Papillary (4.41%), Papillary cystic (5.88%), and carcinosarcoma (2.94%) (Neha and Chauhan, 2018).

Numerous studies have consistently highlighted cancer as a common and fatal disease, accounting for approximately 15-30% of dog deaths and 26% of cat fatalities in India. While studies on cancer incidence in domestic animals are not available in various geographical regions, there is a notable absence of data from cosmopolitan cities in India. (Bancroft and Gamble, 2015). Notably, veterinarians and pet owners have observed a higher incidence of cancer among aging pets. The precise correlation between advancing age and cancer development in animals remains enigmatic to animal researchers. One theory posits that age-related weakening of the immune system may facilitate the mutation of cells into precancerous states, although it is likely not the sole contributing factor (Karnik *et al.*, 2020). In India, the incidence and characteristics of neoplasms in domestic animals have been studied to provide valuable insights into this prevalent health concern as shown in Table 1. Notably, several research studies have delved into the frequency, types, and features of

Table 1: Studies and Their Findings on Animal Neoplasms in India

Reference	Findings
Neha and Chauhan (2018)	Neoplasms in pet animals in India.
Kumar <i>et al.</i> (2011)	Examined the incidence of mammary tumors in dogs in Chennai. - Investigated cytology, gross pathology, and histopathology of these tumors.
Karnik <i>et al.</i> (2020)	Incidence and histopathological studies on tumors of dogs in Bengaluru, India.
Meuten (2016)	Provides comprehensive insights into tumors in domestic animals as a reference.
Boerkamp <i>et al.</i> (2016)	Estimated incidence rate and distribution of tumors in 4,653 cases of archival submissions derived from the Dutch golden retriever population.
Gupta and Tiwari (2012)	Study on the incidence, histopathological features, and surgical management of neoplasms in canines.

neoplastic growths in animals, shedding light on the impact of these conditions.

Contributing Factors: Several factors contribute to the prevalence of cancer in domestic animals in India (Boerkamp *et al.*, 2014) :

(i) Family History and Genetic Factors: Statistics on animal malignancies imply that inherited risk factors have a role in the development of pet cancer. Breeds of dogs with higher cancer susceptibility include Golden Retrievers, Boxers, Bernese Mountain Dogs, and Rottweilers, which may be due to hereditary predispositions. However, comprehensive research is necessary to delineate the specific genetic factors at play.

(ii) Environmental Factors: A considerable majority of malignancies are caused by environmental or dietary risk factors, according to extensive human research. Given that pets and people share the same settings, it is very likely that these risk factors also play a significant role in pet malignancies. Long-term exposure to UV radiation from the sun, secondhand smoke, a variety of herbicides, insecticides, and pesticides used in agriculture, as well as smog and urban air pollution, are notable environmental carcinogens. Numerous everyday compounds have been linked to cancer, including asbestos, cadmium, vinyl chloride, radon, nickel, uranium, benzidine, and benzene. Similar to people, different pets react

differently to these risk factors, depending on the person.

(iii) Age: Cancer tends to manifest more frequently in older animals. While the precise causes of cancer remain elusive in both domains, advancing age may weaken the immune system's ability to control mutated cells, increasing the likelihood of malignancy. Additionally, prolonged exposure to environmental carcinogens over an animal's lifetime elevates the risk of genetic material damage and subsequent cancer development (Fig. 4).

(iv) Gender: Understanding this gender-based discrepancy in cancer incidence is crucial for veterinarians, pet owners, and researchers. It highlights the importance of tailored cancer prevention strategies and regular check-ups, particularly for female domestic animals. By addressing the specific risk factors and needs associated with each gender, we can strive to reduce the burden of cancer in our beloved pets and ensure they lead long and healthy lives (Fig. 4).

(v) Viruses, Carcinogens, and Known Causes: Certain tumours in pets have particular causes that have been pinpointed by researchers. For instance, squamous cell carcinoma, a cancer that affects superficial skin cells in several species, has been related to extended exposure to UV light from sunshine. White pets such as cats, dogs, and horses

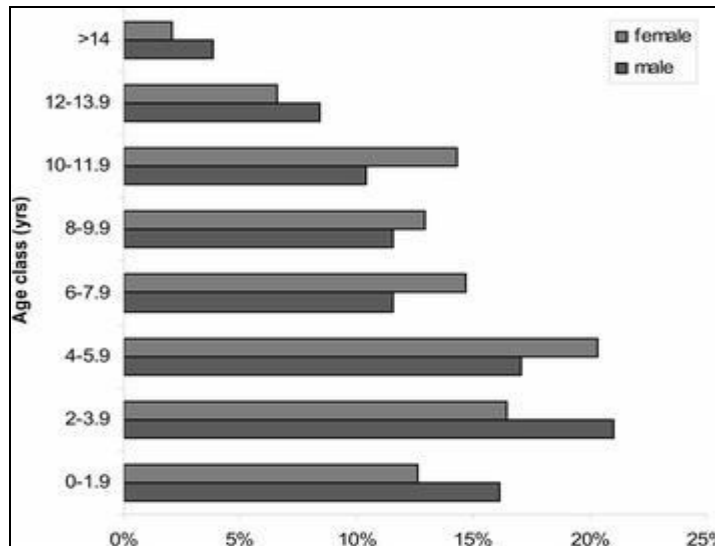


Fig. 4: Age and Gender Factor contribution of cancer in domestic animals (Boerkamp *et al.*, 2016).

with white markings are also more likely to develop squamous cell carcinoma. Oral squamous cell carcinoma in cats has occasionally been linked to environmental toxins like cigarette smoke.

Cancer Treatment for Domestic Animals in India-- Options and Considerations:

Veterinary oncology, a specialized field encompassing cancer prevention, diagnosis, and treatment in animals, plays a pivotal role. The pet may be treated by a dedicated veterinary oncologist or by regular veterinarian, often with the support of a veterinary clinic's staff. In the realm of veterinary oncology in India, treating cancer in domestic animals presents a variety of options, each tailored to the unique needs of the patient. When pet is diagnosed with neoplasia (the abnormal growth of tissue, commonly referred to as a tumor), the veterinarian will explore three primary treatment avenues: surgery, chemotherapy, and radiation therapy, also known as radiotherapy. These treatments can be utilized individually or in combination, contingent on the specific details of pet's condition.

The choice of treatment plan is a delicate balance determined by factors such as the type of cancer, its stage or grade (how aggressively it is spreading), and the tumor's location. The overarching goal of cancer treatment in pets is to

eradicate the cancer entirely. Unfortunately, complete cures are not always achievable, but the veterinary team can provide palliative care to alleviate pain and discomfort, enhancing pet's quality of life (Davis and Ostrander, 2014).

Surgery- The Cornerstone of Cancer Treatment:

Surgery holds a venerable position in cancer treatment for animals. It is one of the oldest and frequently the most effective methods. Surgery, when employed, generally aims to remove all cancerous cells from the pet's body. In some fortunate cases, early detection enables complete cancer eradication, dramatically improving the animal's prognosis and quality of life. Besides curing cancer, surgery can enhance an animal's comfort by removing an unsightly tumor or addressing a tumor that hinders normal bodily functions (Dodson, 2013). However, surgery's effectiveness diminishes when the cancer has metastasized (spread to multiple locations) or if the tumor is inaccessible due to its location or potential risks outweighing benefits, such as when removal might require sacrificing a vital organ (Dobson, 2013).

Radiation Therapy- Precision in Cancer Control:

Radiation therapy, or radiotherapy, is a common treatment modality in veterinary oncology, exploiting the fact that cancer cells typically divide

more rapidly than normal cells and have a reduced capacity for recovering from radiation damage. This therapy focuses intense energy on the cancerous area, effectively killing or impairing the cancer cells while minimizing damage to surrounding tissues. It can be administered externally using a machine or internally with implants, although the latter is less common in animals due to practical and safety considerations. Radiation therapy is often used in conjunction with surgery or chemotherapy, depending on the cancer type and location. It has proved particularly effective for head and neck tumors, spinal or pelvic cancers, and cases where tumor reduction is required before surgery (Goldschmidt *et al.*, 2011).

Chemotherapy- A Multifaceted Approach:

Chemotherapy, the administration of drugs to combat cancer, is another crucial tool in veterinary oncology. These drugs target rapidly dividing cancer cells and, while affecting some normal cells, are designed to inflict more harm on cancerous ones. Unlike in humans, pets generally tolerate chemotherapy well, with side effects being mild and infrequent. Potential side effects include nausea, vomiting, and temporary loss of appetite, which can be managed with medication. Regular monitoring ensures that treatment efficacy and pet well-being are maintained. Chemotherapy is often employed to manage cancer, control its spread, and improve the pet's quality of life, even if complete cure is not attainable. (Komazawa *et al.*, 2016).

Combination Therapy- A Comprehensive Approach:

Combination therapy, which integrates two or more treatment methods, is commonly used in veterinary cancer treatment. This approach offers several advantages, such as reducing the likelihood of drug resistance, targeting different cancer sites, and minimizing side effects compared to using a single drug. The selection of treatment modes depends on the cancer type, stage, and location, as well as the overall condition of the animal (Bancroft and Gamble, 2015).

Zoopharmacognosy Therapy:

Zoopharmacognosy, a fascinating field that

explores how animals self-medicate by selecting and using various plants and substances from their environment, is gaining attention for its potential applications in cancer treatment among domestic animals. Animals, when faced with health challenges, sometimes exhibit specific behaviors that involve seeking out certain plants, minerals, or other natural substances with potential therapeutic properties. In the context of cancer treatment among domestic animals, this self-medication behavior is particularly intriguing.

While the specific mechanisms and effectiveness of zoopharmacognosy in treating cancer are still being studied, there is a growing body of evidence that suggests some animals may be instinctively drawn to plants or substances that can aid in their recovery or alleviate the symptoms associated with cancer. These substances may contain compounds that have anti-cancer properties, boost the immune system, or alleviate discomfort, contributing to the overall well-being of the animal (Mezcua *et al.*, 2019).

For example, certain herbs and plants have been identified for their potential anticancer effects, such as enhancing the immune system, inhibiting cancer cell growth, or reducing inflammation. Animals might consume these plants when they are unwell, demonstrating a remarkable ability to self-medicate.

It is important to note that zoopharmacognosy in cancer treatment for domestic animals is an emerging field, and more research is needed to understand the extent of its effectiveness, identify the specific substances animals seek, and determine how these natural remedies can be integrated into veterinary care. The natural remedy (like zoopharmacognosy) may reduce the escalating spending budget continuously increasing from 2009 as shown in Fig. 5.

Nonetheless, the concept of animals self-medicating for cancer treatment opens up exciting possibilities for more holistic and natural approaches to supporting the health of our beloved pets. As our understanding of this phenomenon

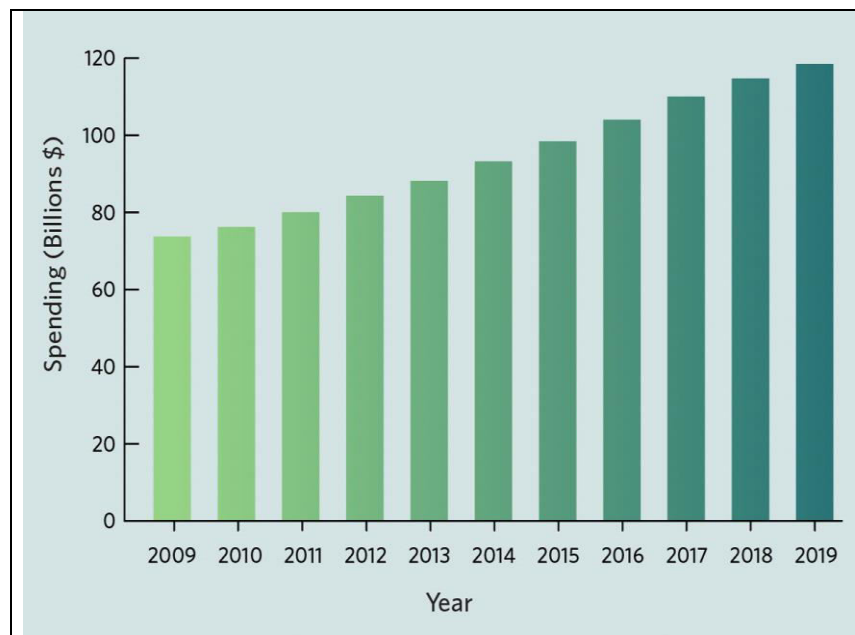


Fig. 5: India Healthcare industry growing in cancer research among domestic animals (Meuten, 2016).

deepens, it may lead to new avenues for improving cancer management and the overall well-being of domestic animals.

Prospects for a Cure and Ongoing Research:

While a definitive cure for cancer in pets remains elusive, significant progress has been made in managing and treating this disease. Veterinary medicine has achieved success in curing many animal cancers through surgery, chemotherapy, and radiation therapy. Research in this field continues, promising even better cancer treatments in the future.

The Role of Veterinary Oncology in India:

The global veterinary oncology market is growing, projected to reach \$369.2 million by 2026. Cancer is a leading cause of morbidity among veterinary patients. Advances in diagnosis and therapies like chemotherapy, radiology, surgery, and immunotherapy drive this market. The field of canine oncology has made significant progress in countries like the UK, India, Australia, and the US, although prognosis remains a subject of debate (Chandra *et al.*, 2018). The market segments include animal type (canine and feline), therapy

(chemotherapy, radiology, surgery, immunotherapy, and others), and cancer type (lymphoma, mast cell cancer, mammary and squamous cell cancer, and others). In this evolving landscape, researchers and veterinarians continue to fight against cancer in animals, aiming to improve the lives of our loyal companions while shedding light on the broader mysteries of this affliction. Veterinary oncologists in India play a pivotal role in addressing the increasing cancer incidence among domestic animals. These specialized veterinarians undergo extensive training in oncology, specializing in cancer diagnosis, staging, and treatment for animals. Within the realm of veterinary oncology in India, there are several key aspects. Firstly, early diagnosis is a primary focus, with veterinary oncologists utilizing advanced diagnostic techniques like imaging, biopsies, and laboratory tests to detect cancer at its nascent stages (Machado *et al.*, 2018). They also offer a wide range of treatment options, including tailored approaches like surgery, chemotherapy, radiation therapy, immunotherapy, and palliative care. Furthermore, education and awareness efforts target pet owners, educating them about cancer prevention, the

importance of regular check-ups, and recognizing early signs of cancer in their pets.

Ongoing research endeavours in the field aim to enhance the effectiveness of cancer treatment for animals, improving outcomes and advancing the field.

Lastly, collaboration with other veterinary specialists and institutions is fundamental, providing comprehensive care to ensure the best possible treatment for pets grappling with cancer. The reasons behind this surge in cancer cases, particularly in purebred dogs, remain elusive. Collaborative efforts with the Regional Cancer Centre (RCC) aim to explore potential links between animal and human health due to our close bonds with pets. Cancer in animals is on the rise, affecting not only exotic dog breeds but also cattle and wildlife (Ganguly *et al.*, 2016)

Limitation of the study:

This study, while providing valuable insights into the prevalence, causes, and treatment options for cancer in domestic animals in India, has certain limitations. The research primarily focuses on dogs and cats, potentially overlooking cancer trends in other domestic animal species however insufficient published data in the field of Indian veterinary oncology is available. Furthermore, the study is predominantly observational and does not delve into experimental aspects of cancer research. The data is sourced from available literature and existing studies, which may limit the comprehensiveness of the findings. Additionally, the study does not address socioeconomic factors, geographical variations, or the impact of diverse environmental conditions on cancer incidence among domestic animals in India. Further, it is essential to acknowledge that cancer research is an evolving field, and new discoveries and developments may emerge beyond the scope of this study.

Conclusion

Cancer, a genetic disease resulting from DNA alterations, is a leading cause of death in dogs and

cats, particularly in those aged around ten years. As we delve into the realm of cancer in domestic animals, we uncover a range of tumorous growths, including carcinomas affecting organs and glands, and sarcomas targeting supporting tissues. The concept of remission offers hope in managing cancer symptoms, and lymphoma, the most common cancer in dogs and cats, presents in various forms, influenced by factors like breed and environmental exposure. Notably, the rising incidence of cancer in India's domestic animals underscores the need for comprehensive research, education, and awareness in this area. This study aimed to shed light on the prevalence, types, and potential interventions for cancer in domestic animals, especially dogs and cats. By unraveling the underlying factors contributing to this epidemic, and by developing effective strategies for prevention and treatment, we aspire to enhance the well-being of our cherished pets while offering invaluable insights to pet owners and veterinarians.

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