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Cross sectional survey of the awareness, knowledge and perception of veterinarians about cancers in animals, their occurrence in Nigeria and associated risk factors

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Abstract

Animal cancers are under-reported in Nigeria. The present study was a cross-sectional survey of the awareness, knowledge and perceptions of Nigerian veterinarians about cancers of animals and risk factors associated with their occurrence. A mixed-sequential explanatory method, consisting of a cross-sectional survey (n=374) and qualitative interviews (n=30), was used to obtain information from veterinarians in the six geo-political zones of Nigeria. Of the 374 respondents, 71.9% were males, 95.5% were practising veterinarians, and 76.2% had an up-to-date practising licence with the veterinary practice regulatory body. 33.4% were between 35 – 44 years old, and 31.8% had 5 – 10 years of experience practising in Nigeria. Only 11% of the respondents were 'extremely familiar' with animal cancers; most others (43.6%) were only 'moderately familiar' with animal cancers. Also, only 9.9% were 'very confident' of their knowledge of animal cancers; more than half of the respondents (51.9%) admitted that they are 'fairly confident' of their knowledge of animal cancers. Only 13.4% of the respondents admitted to having participated in educational initiatives on animal cancers, while 83.7% were interested in collaborating with researchers in improving animal cancer knowledge and awareness. A large proportion (90.1%) of the respondents admitted that awareness of animal cancers was important. The top five identified risks associated with the prevalence of animal cancers were genetic predisposition, dietary habits, environmental pollution, lack of diagnostic facilities, poor knowledge and poor awareness. Late presentation (75.7%), lack of specialised equipment (70.9%), financial constraints of animal owners (69.8%) and limited treatment options (68.4%) were some challenges faced by veterinarians when dealing with animal cancers. It was concluded that there was a significant gap in awareness and knowledge of animal cancers among veterinarians, and that there was a lack of access to care, along with poor institutional infrastructure dedicated to the diagnosis and management of animal cancers in Nigeria.

Keywords: Cancers in animals; Veterinarians; Knowledge; Awareness; Perceived risk factors; Nigeria.

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Introduction

Cancers, also known as malignant neoplasms, are a class of disorders/diseases with the features of unrestrained cellular growth, proliferation, and invasiveness that serve no useful purpose. They are complex diseases with multi-stage pathways, where a set of genetic alterations are required for initiation, promotion, and metastasis (Vincze *et al.,* 2022). With the increased chance of each cell division producing mutations, it was earlier reported that body size and lifespan or longevity are risk factors for cancer development (Caulin and Carlo, 2011; Nunney *et al.,* 2018; Vincze *et al.,* 2022). Elevated cancer risk has also been linked to diet and reproductive biology (Munson and Moresco, 2007).

Cancer remains a challenge across various fields of medicine and the global community, and cancer burden significantly impacts on both human and animal populations. While considerable attention has been focussed on human cancers, there exists a dearth of studies on the prevalence of cancers in animals, especially in Nigeria. The intricate web of life on the planet is interconnected, with diseases often transcending species boundaries. An undeniable evidence of this interconnectedness is that over 75% of newly discovered human pathogens originate from animals (Jones *et al.,* 2008; Cui *et al.,* 2022), and 2.7 million deaths globally in humans were linked to zoonoses (Grace *et al.,* 2012; Gebreyes *et al.,* 2014). Cancer is the most common cause of disease-related death for old companion and working dogs in the developed world (Dobson, 2013). Researchers have long been investigating the origin of cancer, particularly in light of the shared genetic and physiological characteristics between species (Davis and Ostrander, 2014).

Gebreyes *et al.* (2014) illuminated fascinating parallels between certain types of animal cancers and their human counterparts, raising the prospect of a deeper connection between them. The One-Health approach emphasizes the interconnectedness of human, animal and environmental health. This holistic perspective urges us to recognize that diseases do not respect species boundaries. This phenomenon, known as human-animal or zoonotic transmission, underscores the intimate relationship between animal and human health. While much attention has been devoted to understanding human-animal infections, an equally pertinent question arises: could there be an association between animal and human cancers? It has become clear that understanding the prevalence, types, and potential shared risk factors of animal cancer could hold pivotal insights for veterinary medicine and human medicine; hence, this study intends to examine the knowledge of veterinarians on the occurrences of cancers in clinical veterinary practice in Nigeria.

Study of malignant neoplasms in animals could provide crucial reservoir of biomedical and clinical information (Kattner *et al.,* 2021). Research on animal cancers and their epidemiology, especially in Nigeria is underexplored, compared to what is obtained in humans. Meanwhile, understanding the level of awareness and knowledge about cancers in animals and their occurrence is vital, as it directly influences accurate diagnosis, treatment strategies and preventive measures (Rajmani *et al.,* 2012). The present study was a cross-sectional survey of the awareness, knowledge and perceptions of Nigerian veterinarians about cancers of animals and risk factors associated with their occurrence.

Materials and Methods

Study design: This study employed cross-sectional and mixed-sequential explanatory methods to extract information on veterinarians' knowledge of the occurrence

and prevalence of animal cancers and the associated risk factors.

Study area and Population: This study was carried out in Nigeria, which is made up of six geopolitical zones and 36 states, with a population of 230 million (Worldometer, 2025). The study population comprised veterinarians registered with the Veterinary Council of Nigeria, the national regulatory body with about 10,000 members (Ogwuche *et al.,* 2021). Only those who voluntarily consented to participate in the study were included. Veterinarians who have not resided in Nigeria in the last year were excluded.

Sample size determination and sampling technique: The study population was 10,000 and the sample size was determined with a 0.05 margin of error using (N/ {1+N (e)2}). A sample size of 385 respondents was estimated for the study using 95% precision (z=1.96) and 5% significance level. A snowball sampling technique was employed to ensure a representative sampling of veterinary doctors across the country (Nigeria). The total population of veterinary doctors in Nigeria was stratified based on their years of experience (junior: 0 – 5 years, mid-level: 6 – 15 years, senior: 16+ years). The participants were purposively selected based on their willingness to participate and their availability during the data collection period.

Study instruments and Data collection: Data was collected and collated using a mixed-method approach which involved quantitative and qualitative data collection methods. Quantitative data were acquired through structured and pre-tested questionnaires. The survey instrument was an electronic interviewer-administered structured questionnaire which had four sections (A – D). Section A obtained information on the socio-demographic characteristics, socio-economic background and work history of participants (age, sex, marital status, education level); Section B on the level of awareness, knowledge and confidence of veterinarians on animal cancers; Section C on veterinarians' perceptions of the factors responsible for animal cancer development; and Section D on the challenges of veterinarians in dealing with animal cancers. The qualitative tools; semi-structured in-depth interviews, key informant interviews, and focal group discussion guides with well-structured probes, were used to explore veterinarians' knowledge, the state of cancer research in Nigeria, prognosis, and challenges in the management of animal cancers. The moderator and an assistant led the discussion on veterinarians' knowledge of the types, symptoms, risk factors, regional variation, presentation time, state of research, trends in prevalence, challenges in management and prognosis of animal cancer and number of cases treated yearly.

Ethical considerations: The research adhered to ethical principles, ensured participant confidentiality, informed consent and respect for their autonomy. The study design was formally approved by the Animal Care and Use Research Ethics Committee, University of Ibadan, Nigeria, with approval reference number: UI-ACUREC/005-0124/12.

Statistical analysis: Quantitative data were cleaned, recoded, and composite variables were derived for some key variables. All descriptions were done using univariate analysis. For qualitative analysis, all interviews were audio-recorded and transcribed verbatim. Where interviews took place in local languages, the audio recordings were transcribed verbatim into the local language before translation to English. An inductive coding approach was adopted using the Atlas.ti software.

Results

Socio-demographic characteristics of veterinarians that participated in the study: The majority of veterinarians that participated in the study were males (71.9%), and those

who are practising veterinarians (95.5%) dominated (Table 1). Majority of the respondents (76.2%) were up-to-date in their Veterinary Council of Nigeria (VCN) registration (76.2%) (Table 1). Many of the respondents were between the age range of 35 – 44 years (33.4%), and the highest proportion of respondents were veterinarians that had 11 – 20 years of practice experience (Table 1).

Table 1. Socio-demographic characteristics of veterinarians that participated in the survey on awareness, knowledge and perception of animal cancers in Nigeria (N=374).

Profile	Category within profile	Number for each category	Percentage for each category
Practice status of the veterinarians (respondents).	Veterinarians in practice.	357	95.5%
	Non practicing veterinarians	13	3.5%
	Retired veterinarians	4	1.1%
VCN Registration status of the respondents.	Registration up to date.	285	76.2%
	Registration expired.	55	14.7%
	Not sure of Registration status.	34	9.1%
Gender of the respondents.	Female	105	28.1%
	Male	269	71.9%
Age of the respondents.	Less than 25 years of age.	11	2.9%
	25 – 34 years of age.	108	28.9%
	35 – 44 years of age.	125	33.4%
	45 – 54 years of age.	79	21.1%
	55 years of age and above	51	13.6%
Location of respondents.	Nigeria	371	99.2%
	Diaspora	3	0.8%
Location within Nigeria.	Urban area	340	90.9%
	Rural area	34	9.1%
Years of experience as a veterinarian.	Less than 5 years	84	22.5%
	5 – 10 years	69	18.4%
	11 – 20 years	119	31.8%
	21 – 30 years	73	19.5%
	More than 30 years	29	7.8%

VCN – Veterinary Council of Nigeria

Table 2. Further socio-demographic characteristics of veterinarians that participated in the survey on awareness, knowledge and perception of animal cancers in Nigeria (N=374).

Characteristics of the respondents	Category of the characteristic	Number for each category	Percentage for each category
Employer and/or Employment status of the respondents.	Government-employed.	181	48.4%
	Employed in the private sector.	78	20.9%
	Self-employed.	95	25.4%
	Unemployed	20	5.3%
Levels of education or qualification.	Doctor of Veterinary Medicine (DVM)	374	100%
	Master of Science (MSc) or MVSc).	154	41.2%
	Doctor of Philosophy (PhD).	65	17.4%
	Member, College of Veterinary Surgeons of Nigeria (MCVSN).	15	4.0%
	Fellow, College of Veterinary Surgeons of Nigeria (FCVSN).	67	17.9%
Areas of specialization	Small Animal Practice.	208	55.6%
	Large Animal Practice.	130	34.8%
	Exotic Animal Practice.	19	5.1%
	Wildlife and Aquatic Practice.	33	8.8%
	Poultry Practice.	126	33.7%
	Academia	82	21.7%
	Research	79	21.1%

About half (48.4%) of the respondents were government-employed veterinarians; others were employed in private organizations (20.9%), self-employed (25.4%) or unemployed (5.3%) [Table 2]. All the respondents (100%) had the Doctor of Veterinary Medicine (DVM) degree), 41.2% had a Master's degree, while 17.4% had a Doctor of Philosophy (PhD) degree (Table 2). Some additionally had further clinical qualifications: 4% had Member of the College of Veterinary Surgeons (MCVSN) while 17.9% had Fellow College of Veterinary Surgeons of Nigeria (FCVSN) certification (Table 2). Most of the respondents were specialists in Small Animal Practice (55.6%); others were into Large Animal Practice (34.8%), Poultry practice (33.7%), Exotic Animal Practice (5.1%), Wildlife and Aquatic (8.8%), Academia (21.9%) and Research (21.1%) [Table 2].

Knowledge, confidence and awareness of veterinarians on animal cancers: Only 11% of the veterinarians admitted that they were 'extremely familiar' with animal cancers; most others were only 'moderately familiar' (43.6%) with animal cancers. Also, only 9.9% were 'very confident' in their knowledge about animal cancers, but more than half of the respondents (51.9%) admitted that they are 'fairly confident' of their knowledge of animal cancers (Table 3). Only 13.4% of the respondents admitted having participated in educational initiatives on animal cancers, but a large proportion of the respondents (83.7%) were interested in collaborating with researchers in improving animal cancer knowledge and awareness (Table 3). Most respondents (90.1%) admitted that awareness of animal cancer was important, but their awareness on the prevalence of animal cancers varied (Table 3).

Table 3. Knowledge, confidence with knowledge and awareness of veterinarians of animal cancers in Nigeria (N=374).

Variables	Category of the variables	Number for each category	Percentage for each category
Familiarity with animal cancers	Slightly familiar.	78	20.9%
	Somewhat familiar.	78	20.9%
	Moderately familiar.	163	43.6%
	Extremely familiar.	41	11.0%
Confidence with knowledge on animal cancers	Surely not confident.	19	5.1%
	Fairly not confident.	31	8.3%
	Neutral	93	24.9%
	Fairly confident	194	51.9%
	Very confident.	37	9.9%
Participation in educational initiatives on animal cancers.	Participated	50	13.4%
	Not participated.	324	86.7%
Interested in collaboration with researchers to improve animal cancer knowledge.	Interested.	313	83.7%
	Not interested.	61	16.3%
Importance of awareness	Not important.	1	0.3%
	Somewhat important	36	9.6%
	Very important	337	90.1%
Occurrence of animal cancers.	Not aware.	85	22.7%
	Slightly aware.	96	25.7%
	Somewhat aware.	56	15.0%
	Moderately aware.	101	27.0%
	Extremely aware.	36	9.6%

Veterinarians' knowledge of risk factors for development of animal cancers: More than half of the respondents admitted that the following are factors affecting prevalence of animal cancers: genetic predisposition (74.6%), environmental pollution (62.3%), poor awareness of animal cancer (51.1%), dietary habits (63.6%), lack of diagnostic facilities (60.4%) and poor knowledge of animal cancer (57.0%) [Table 4]. Most of the respondents also mentioned that limited treatment options (68.4%), financial constraints of animal owners (69.8%), late presentation of cancer cases (75.7%), and lack of specialised equipment (70.9%) are the challenges militating the reduction of the burden of animal cancer in Nigeria (Table 4). Also, 45.5% of the respondents admitted that the behaviour of animal owners is a challenge in dealing with animal cancers. Though 73.8% of respondents stated that most human diseases were contracted from animals, only a small proportion of the respondents (15.5%) admitted that cancers are 'very likely' to be zoonotic (Table 4).

Table 4. Further on veterinarians' knowledge of animal cancers in Nigeria (N=374).

Variables	Category of the variables	Number for each category	Percentage for each category
Factor affecting the occurrence of animal cancers	Genetic predisposition.	279	74.6%
	Environmental pollution.	233	62.3%
	Dietary habits.	238	63.6%
	Poor awareness of animal cancer.	191	51.1%
	Lack of research into animal cancer.	176	47.1%
	Lack of diagnostic facilities.	226	60.4%
	Lack of cancer experts.	128	34.2%
	Poor knowledge of animal cancer.	213	57.0%
Challenges when dealing with animal cancers.	Limited treatment options.	256	68.4%
	Financial constraints of animal owners.	261	69.8%
	Late presentation of cases.	283	75.7%
	Lack of specialized equipment.	265	70.9%
	Poor attitude of animal owners.	170	45.5%
Awareness that most human diseases are gotten from animals.	Yes.	276	73.8%
	No.	98	26.2%
Likelihood of cancer being transferred between humans and animals	Very unlikely.	107	28.6%
	Somewhat unlikely.	89	23.8%
	Neutral.	41	11.0%
	Somewhat likely.	79	21.1%
	Very likely.	58	15.5%

The interviews and qualitative instruments revealed that veterinarians believe that unhealthy lifestyles of animal owners, such as smoking, alcohol intake, and unhealthy intake of diet affect the prevalence of animal cancers (Table 5). The respondents testified seeing animal owners or that animal owners admitted giving alcohol to their pets in the form of fun and allowing the pets to take alcohol at home. Unhealthy diet was another risk factor mentioned by the respondents. Some of those interviewed stated that some diets usually given to dogs which include unhealthy domestic and industrial wastes, especially the popular ‘‘indomie’ waste may contribute to the prevalence of animal cancers. Also, indiscriminate mating among dogs was mentioned as a risk factor responsible for transmissible venereal tumours (Table 5).

Table 5: Responses from veterinarians who participated in focus group discussion on animal cancers in Nigeria (N=30).

Themes	Emerging sub-themes	Examples of Responses
Types of animal cancer.	Transmissible venereal tumour (TVT) and some sarcomas and carcinomas.	**Respondent 11:** I have seen many cancer types and the most common around here is the transmissible venereal tumour (TVT). I have seen it in male dogs but more in female dogs. I have seen osteosarcoma, lymphoma, and melanoma a couple of times.
Symptoms of animal cancer.	Swelling, discharge and loss of appetite	**Respondent 14:** Most times the dog is not eating well, it's just losing condition, you will find that there is a mass somewhere, the dog is just not thriving, it's not able to eat.
Risk factors of animal cancer.	Unhealthy lifestyle of animal owners.	**Respondent 20:** I know some people that drink a lot, I'm talking about alcohol, so when they want to celebrate anything, maybe their birthday or dog’s birthday, they give the dog alcohol.
	Mating	**Respondent 10:** TVT is sexually transmitted between dogs and very rampant during the cold seasons, especially around December to February in Nigeria.
	Diet	**Respondent 5:** Some clients have large dogs that need a large amount of food to be fed so people like that are looking for alternative means, and outlets and that is where we hear things like industrial rice and ‘indomie’ waste.
Presentation time.	Lateness in animal cancer presentation.	**Respondent 10:** Cancer case presentation is usually late, when the symptoms become unbearable and burdensome for them, and when the dog is not looking presentable again.
Distribution or regional variation of animal cancer occurrence in Nigeria.	Lack of concrete data on prevalence of animal cancer.	**Respondent 18:** There is no regional prevalence, now the problem is this; there is no registry for cancer documentation.

Environment polluted with industrial wastes and toxic air pollutants was another identified risk factor for animal cancer. Other risk factors mentioned were genetic predisposition, poor economic and financial status of animal owners, poor attitudes to vaccination, opportunistic diseases, and age. Also, those interviewed admitted that animals with cancer are usually presented late to clinics; when symptoms of illness become visible and unbearable to animals (Table 5).

Further, those interviewed posited that trends in types and prevalence of animal cancer were due to new trends of risk factors. For example, a respondent mentioned how cancer conditions become more prevalent in younger patients than in older patients due to the use of chemicals and drugs (Table 6). Lower rates of cancer prevalence were also believed to be due to the underreporting of cases, especially in food animals, which are reared to be slaughtered for consumption.

Table 6: Further on responses from veterinarians who participated in focus group discussion on animal cancers in Nigeria (N=30).

Themes	**Emerging sub-themes**	**Examples of** Responses
Trend in types, prevalence and risk factors for animal cancers.	There are trends in types, prevalence and risk factors.	**Respondent 3:** Over the past five years, a lot of cancer cases were reported, particularly in exotic breeds, who suffer from hemangiosarcoma and hepatocellular carcinoma. **Respondent 7:** Dogs above 5 years old are at high risk of cancer. But recently, I managed a case of osteosarcoma in a dog of around two years; I wasn't expecting that. So now you have cancer conditions in younger patients than in older patients.
State of animal cancer research.	Poor state.	**Respondent 4:** Research in cancer is very low, it's not there. We're not doing much. I know.
Reasons for poor prognosis.	Inefficient health system.	**Respondent 20:** We do not have functional cancer diagnostic centres in this place.
Challenges in dealing with animal cancer.	Lack of expertise and facilities.	**Respondent 1:** You need facilities and the cost, except you have a grant. **Respondent 7:** Well, key challenges in cancer management, I think skills, access to drugs, and facilities for diagnosis.
Ways to reduce challenges in dealing with animal cancer and improve prognosis.	Strengthening of health system and animal cancer awareness.	**Respondent 10:** Government support. **Respondent 3:** International collaboration and funding for research. **Respondent 5:** More education and awareness are needed. **Respondent 25:** Training and re-training of veterinarians. **Respondent 6:** Provision of cancer registry.

Most of those interviewed or who participated in focus group discussions mentioned they have only seen a few cases of animal cancers and some felt that the level of research on animal cancers in Nigeria was low. Lack of diagnostic facilities, self-medication, high cost of treatment, poor financial situation, late presentation of cases to veterinarians and poor knowledge of animal cancer among veterinarians and animal owners were said to be responsible for poor prognosis of animal cancers. It was posited that prognosis could be improved with continued professional education of veterinarians and awareness creation of cancer occurrence in animals among animal owners (Table 6).

Participants in the focus group discussion identified some challenges faced by veterinarians while dealing with animal cancers: these included a lack of animal cancer experts, unavailability of diagnostic facilities, lack of access and drug affordability, unstable electricity and water supply, and poor working environment for practitioners (Table 6). The participants further listed public awareness, adequate funding via internationalization and collaboration and provision of well-equipped diagnostic centres as ways to reduce animal cancer burden (Table 6).

Veterinarians' knowledge of occurrence of specific animal cancers: Respondents admitted that the five most commonly seen and/or occurring neoplasms of animals in Nigeria were: transmissible venereal tumour (TVT) (47.1%), skin tumours/cancers (unclassified) (20.3%), mammary gland tumour (18.2%), lymphoma/lymphosarcoma (16.3%) and osteosarcoma (13.6%) (Table 7).

Table 7. Neoplasms that veterinarians that responded to the survey on animal cancers reported that they have seen in animals in Nigeria.

S/N	**Benign** and **malignant tumour types**	Frequency	Percentage
1.	Transmissible venereal tumour (TVT)	176	47.1%
2.	Skin tumour/cancer (unclassified)	76	20.3%
3.	Mammary gland tumour	68	18.2%
4.	Lymphoma/lymphosarcoma	61	16.3%
5.	Osteosarcoma	51	13.6%
6.	Papillomas	28	10.1%
7.	Squamous cell carcinoma	28	10.1%
8.	Leukaemia	24	6.4%
9.	Liver cancer	20	5.3%
10.	Marek (T-cell lymphoma)	17	4.5%
11.	Avian leukosis	15	4.0%
12.	Ovarian cancer	11	2.9%
13.	Sertoli cell tumour	11	2.9%
14.	Lung cancer	10	2.7%
15.	Ocular tumour/cancer	10	2.7%
16.	Mast cell tumour	10	2.7%
17.	Leiomyomas	10	2.7%
18.	Colorectal cancer	8	2.1%
19.	Lipoma	7	1.9%
20.	Haemangiosarcoma	7	1.9%

Discussion

Understanding veterinarians' level of awareness and knowledge of animal cancers is vital, as it directly influences cancer management and prevention. Findings in the present study showed that the level of awareness, knowledge, and confidence in the knowledge of animal cancers was relatively poor among the veterinarians studied. Only a small proportion of veterinarians had participated in educational initiatives on animal cancers, although the majority were interested in educational initiatives and collaboration with researchers on animal cancers. This observed poor knowledge and low confidence in their knowledge of cancers could be due to the poor participation in cancer educational initiatives. A similar earlier finding on veterinarians' knowledge of animal cancers was reported by Engiles and Sozanski, (2020). According to the authors, veterinarians know less about specific animal cancers, and they attribute this to little research on animal malignancies. These findings highlight a critical need to enhance veterinarians' education on animal cancer. Poor awareness and confidence can lead to misdiagnosis or suboptimal treatment. To address this, veterinary schools or colleges should put more emphases on oncology training, while professional bodies should offer accessible continuing education programmes on oncology and animal cancers. Collaborative initiatives with clinicians and researchers can bridge knowledge gaps and improve care. Additionally, integrating online courses and workshops on animal cancers into professional development programmes for veterinarians can ensure that veterinarians are up to date on advancements in cancer research and cancer-related issues, including treatment.

In the present study, those interviewed posited that the level of research on animal cancers in Nigeria was low. This finding is consistent with an earlier reported study by Kattner *et al.* (2021) which showed that animal tumours have, so far, not been duly researched and efficiently used as a potent research tool. The poor state of research on animal cancers in Nigeria implies a limited understanding of cancer prevalence, diagnosis and treatment in animals, potentially affecting animal health, veterinary practice and related industries. This gap may hinder advancements in veterinary oncology, disease prevention and public health, especially considering zoonotic (human-animal) transmission risks. To address this, recommendations include increased funding for veterinary research, specific oncology training programs for veterinarians, collaboration with research bodies, and government initiatives to support animal health and cancer research infrastructure in Nigeria.

The recorded risk factors affecting animal cancers in this study are consistent with earlier research reports on cancers of animals (Peto, 1975; Engiles and Sozanski, 2020; City of Hope, 2021). These earlier researchers reported that animals develop cancer more frequently during the late stages of life, with speculations that it could be due to a weaker immune system caused by an advanced age. Also, it was reported by Engiles and Sozanski, (2020) that cancer development could be triggered by hereditary, environmental and nutritional factors. Sex and age have been identified as risk factors for some cancer types (Corvera *et al.,* 2024). Similarly, some cancers result from transmission via sex, non-compliance to vaccination and genetic changes to DNA that could lead to uncontrollable division of cells and tumour formation (Cranage, 2019; Kattner *et al.,* 2021).

The response from veterinarians who participated in the study that early detection of cancer in animals produces a better prognosis is consistent with previous findings (Engiles and Sozanski, 2020). The earlier cancer is detected and diagnosed, the easier it may be to treat, and the better the outcome (Kikuyama *et al.,* 2018). The present study has

provided additional information on items such as financial constraints and poor knowledge of veterinarians in addition to earlier reported factors, such as the functional status of the cancer diagnostics and molecular characteristics that influence cancer prognosis in animals (Martin and Widera, 2020). This present study also suggests the need to improve awareness and education and also provision of resources for cancer diagnosis and management in animals in Nigeria. It is believed that strengthening environmental protection regulations and promoting proper animal care, including nutrition and vaccination, could help reduce cancer incidence and improve animal health outcomes.

The findings of the present study show that the lack of animal cancer experts, unavailability of specialized diagnostic facilities and anti-cancer preparations for animals, were some of the challenges faced by veterinarians while managing animal cancers. The challenges faced by veterinarians while dealing with animal diseases, including cancers are similar to previous findings on pet owners' perspectives on animal diseases (Onwubiko *et al.,* 2020; Carrozza, 2021). In an earlier study by Carrozza's (2021), two-thirds of pet owners believed that cancer treatment is cost-prohibitive leading to suboptimal care. These challenges limit treatment of animal cancers, leading to increased animal mortality and reduced productivity. Additionally, it undermines veterinarians' capacity to provide effective animal care services. Further, the present study showed that these veterinarians' challenges can be minimized by creating public awareness of animal cancers, raising funds via internationalization and collaboration and providing a good diagnostic centre with extensive facilities. This is consistent with earlier reports by Carrozza (2021) which showed that fundraising through international collaboration would reduce veterinarian challenges in addressing animal cancers. Similarly, there are reports that established, well-equipped diagnostic centres with necessary facilities are essential to improve cancer management and outcomes in care (Gospodarowicz *et al,* 2015; Stefan and Tang, 2023).

From the present study, transmissible venereal tumour is the most commonly seen neoplasm of animals in Nigeria. This is consistent with the report of Engiles and Sozanski, (2020) and a study by the City of Hope, (2021), which found that almost all dogs develop a canine transmissible venereal tumour and squamous cell carcinoma. This genital cancer of dogs known as the canine transmissible venereal tumour is transmitted during sexual intercourse. The cancerous cells are transferred during contact between a healthy animal and an infected animal (Sindzinski, 2016). In contrast, mammary gland and mast cell tumours have been reported as the first and second frequently encountered neoplasms in dogs in Brazil (de Nardi *et al.,* 2022). Also, Adams (2016) reported that lymphomas are the most encountered death-related cancer in dogs, accounting for up to one-fifth of all malignant tumours.

The strength of this study is that it appears to be a pioneer research that would provide valuable insight into veterinarians' awareness, knowledge and confidence in managing animal cancers in Nigeria, and it also highlights a crucial gap in veterinary healthcare. It also identifies socio-economic, environmental and lifestyle factors as perceived risk contributors. The focus on possible zoonotic potentials of animal cancers enhances its relevance to animal and human health. However, there were some limitations. The study may be limited by a small sample size or geographic focus, potentially affecting generalizability across Nigeria. Self-reported data could also introduce bias (Althubaiti, 2016). The impact of this limitation was, however, reduced as we used diverse or stratified sampling,

triangulation, data verification, and statistical techniques. These methods improved representativeness, reduced self-report bias, and enhanced the accuracy and generalizability of findings.

Conclusion: This study highlighted the significant gaps in levels of awareness and knowledge among veterinarians and the infrastructural deficit related to treatment and management of animal cancers in Nigeria. The findings emphasize the need for enhanced education and specialized training in veterinary oncology, as poor awareness and limited resources affect cancer diagnosis, treatment and overall animal health. Key risk factors, including unhealthy lifestyles of animal owners, environmental pollution and socio-economic challenges that further complicate cancer management were highlighted. The lack of cancer diagnostic centres, poor working conditions and insufficient research infrastructure compound these challenges, contributing to late diagnosis and suboptimal care. Addressing these issues requires a multi-faceted approach, including increased funding, collaboration, public awareness campaigns, and establishing well-equipped diagnostic centres. By addressing these gaps, the prognosis for animal cancers could improve, benefiting both animal welfare and the veterinary profession. This study offers a crucial first step in understanding and enhancing animal cancer knowledge and care in the veterinary sector in Nigeria.

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Conflict of interests

All authors have no competing interests to declare.

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