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Sycamore, Illinois

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Editor in Chief

EDITOR'S LETTER

Embracing the Beauty of Change

Autumn is a great time to open our minds to learning as we do for the changing season. With the fall season upon us, we can take the opportunity to curl up in a favorite blanket with our cat, dog, bird, or iguana and read the *Today's Veterinary Nurse* Fall issue to learn a new technique for a skill or revisit one that we have not performed in a while! This issue covers the latest information veterinary nurses need to know about the ongoing **avian influenza outbreak** (p. 10) and the risk of ***MDR1* mutations in our feline patients** (p. 70). There is also a much-needed discussion on how **exercise is crucial to managing weight** in our patients (p. 38). Embrace the beauty that is autumn. Your knowledge and skill set will be better for it, and your patients will benefit. Change, like the autumn leaves, can be glorious!

WHAT WE'RE READING *A member of our Editorial Advisory Board shares a recent open-access publication, including their key takeaways and its practical conclusion.*

Efficacy, Safety, and Vaccine Response in Dogs Treated with Ilunocitinib (Zenrelia)

Forster S, Trout CM, Despa S, Boegel A, Berger D, King S. *Vet Dermatol.* https://doi.org/10.1111/vde.13344

Fent GM, Jacela J, Plazola-Ortiz R, et al. *BMC Vet Res.* https://doi.org/10.1186/s12917-025-04929-z

Fent GM, Despa S, Gabor L, et al. *BMC Vet Res.* https://doi.org/10.1186/s12917-025-04896-5

WHAT WAS INVESTIGATED? In follow-up to an initial safety trial, 2 studies evaluated ilunocitinib, a Janus kinase (JAK) inhibitor, for its ability to control pruritus and skin lesions in client-owned dogs with canine atopic dermatitis (CAD) and its effect on immune response to core booster vaccinations when given at up to 3 times the recommended dose.

WHAT WAS DISCUSSED?

- **Efficacy in CAD:** In a 112-day, multicenter, placebo-controlled trial, 83% of ilunocitinib-treated dogs achieved ≥ 50% improvement in pruritus or lesion scores by day 28 versus 31% of placebo dogs. Rapid improvement in pruritus was seen as early as day 2, and clinical remission occurred in approximately 67% of treated dogs by day 112.
- **Safety:** Ilunocitinib was generally well tolerated. Most adverse events were mild and involved skin or gastrointestinal signs; laboratory changes were small and clinically insignificant. Serious adverse events were rare and unrelated to treatment.
- **Vaccination response:** In a prospective, noninferiority trial, dogs received ilunocitinib at 1 times or 3 times the label dose for 56 days, with core booster vaccinations (CDV [distemper], CPV [parvovirus], CAV-2 [adenovirus type 2], and rabies) administered 28 days after treatment initiation. Antibody titers measured at 15 and 28 days postvaccination showed no significant differences between treated and untreated controls. All dogs maintained titers above protective thresholds for rabies, CAV-2, and CPV throughout the study; CDV titers remained comparable to controls at all time points. Mild gastrointestinal or skin abnormalities were observed, consistent with expected background findings for JAK inhibitor therapy, and all dogs remained clinically healthy.
- **Clinical context:** These results help address concerns about using immune-modulating drugs like JAK inhibitors in dogs requiring routine vaccinations, supporting their safety even at doses up to triple the therapeutic level.

TAKE-HOME POINTS

- Ilunocitinib provides rapid, sustained control of CAD signs with a favorable safety profile.
- Treatment at up to 3 times the label dose did not impair protective antibody responses to core booster vaccines.
- For veterinary teams, this supports the continued use of ilunocitinib in appropriately vaccinated dogs, with routine monitoring for mild skin or gastrointestinal effects.

— *Jennie Tait, AHT, RVT, VTS (Dermatology) Charter Member*

NAVTA's Approved Veterinary Assistant Program Celebrates 15 Years



Beckie Mossor, RVT
President, NAVTA

Veterinarians and veterinary nurses/technicians work more efficiently and provide better patient care when supported in their endeavors by well-trained veterinary assistants. While veterinary nursing/technology training programs and colleges have been accredited for decades by the AVMA's Committee on Veterinary Technician Education and Activities (CVTEA), there was no formal program reviewing veterinary assistant training programs prior to 2010.

However, much to the dismay of credentialed veterinary technicians, certain veterinary assistant educational programs were training veterinary assistant students in skills considered within the scope of practice for credentialed veterinary technicians and out of scope for the noncredentialed veterinary assistant. Unfortunately, a few states supported this practice, and these states continue to provide no delineation between the positions of veterinary nurses/technicians and veterinary assistants.

These issues provided the impetus for NAVTA to convene a meeting of veterinary nursing educators in 2010 for the purpose of developing a program to review and recognize high-quality veterinary assistant training programs. NAVTA's Approved Veterinary Assistant (AVA) program came into fruition in 2011.

> "The year 2025 marks the 15th year of operation for NAVTA's AVA program."

The year 2025 marks the 15th year of operation for NAVTA's AVA program. The founding committee members worked diligently throughout 2010 and 2011 to prepare guidelines for recognizing high-quality veterinary assistant training programs (navta.net/ava-program-guidelines). These guidelines included:

- Faculty standards requiring instruction by a licensed veterinarian and/or credentialed veterinary technician
- Required course/module and curriculum topics, including front office work and restraint of domestic species
- A review of facilities and supplies necessary for training the veterinary assistant
- Skills to demonstrate assistance in pharmacy, laboratory, surgical, and imaging procedures

NAVTA believes a specific set of skills is necessary for the veterinary assistant position. These skills are classified into 8 primary categories:

1. Office and hospital procedures
2. Communication and client relations
3. Pharmacy and pharmacology skills
4. Examination room procedures

5. Basic small animal nursing
6. Surgical preparation and assisting
7. Laboratory procedures
8. Radiography and ultrasonongraphy

Other basic tasks may be added to the skills list but must not encroach on essential areas of study for veterinary nurses/technicians. Veterinary assistant training programs must emphasize the role of all members of the veterinary team and are responsible for educating both students and their potential employers on proper delegation to the veterinary assistant.

NAVTA's AVA program requires all veterinary assistant training programs to have 150 hours of classroom/lab education and an additional minimum of 100 hours' externship/clinical experience. AVA training programs must also have a letter of support from an AVMA CVTEA–accredited veterinary nursing/technology program.

> "Veterinary assistant training programs must emphasize the role of all members of the veterinary team and are responsible for educating both students and their potential employers on proper delegation to the veterinary assistant."

The NAVTA AVA program currently recognizes more than 70 veterinary assistant training programs throughout the United States and Canada (see the full list at navta.net/veterinary-assistants-program/ava-programs). Half of these programs are high school programs at career and technical academies, representing some of the best vocational medical training offered at the secondary level. The remaining approved programs are offered through community colleges and postsecondary institutions, with 6 of these programs offered online or as hybrid. In all, 24 states and 1 Canadian province offer NAVTA AVA programs.

Thousands of students have completed these programs in the past 15 years and more than 2500 students have passed the NAVTA AVA Examination, which is administered by NAVTA's partner VetMedTeam. These graduates carry the designation of "NAVTA Approved Veterinary Assistant." (NAVTA is careful not to use the word "certified" to avoid confusion with states that credential veterinary technicians as "certified veterinary technicians.") NAVTA AVAs may renew their designation every 2 years by completing 10 hours of continuing education.

Beware of Veterinary Assistant Review Courses

NAVTA is aware of the existence of several online testing review courses and practice tests identified as review for the "Approved Veterinary Assistant Exam." NAVTA neither approves of nor endorses any of these courses, practice tests, or online review questions purporting to prepare the test taker for the NAVTA AVA exam. The NAVTA AVA exam is a proprietary product, is owned by NAVTA, and has no sanctioned or approved study course other than the program itself. NAVTA firmly believes that graduates of approved programs are sufficiently prepared for success on the NAVTA AVA exam with proper studying and preparation.

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NAVTA AVAs have a strong advantage when seeking employment and a high number are hired from their externship/clinical experience. Many of these NAVTA AVAs have furthered their education and become credentialed veterinary technicians. These NAVTA AVA graduates have cited the basic training received in their programs as instrumental in providing a foundation for their skills and confidence. Several NAVTA AVAs have also gone on to veterinary colleges to join the ranks of practicing veterinarians.

In May of 2023, NAVTA began a program of recognition and celebration of NAVTA AVAs with the first annual NAVTA AVA Day. In 2024, the day was expanded to a full week of celebration. In 2025, 8 distinguished NAVTA AVA program graduates were recognized by NAVTA with articles in NAVTA publications and on the NAVTA website and social media pages.

The NAVTA AVA program continues to expand and explore ways of recognizing the vital support position of veterinary assistant. The NAVTA AVA program will help provide well-trained veterinary assistants ready for employment and help to establish the increasing need for all levels of veterinary support personnel.

NAVTA thanks and recognizes the dedication and contributions of Dennis Lopez, MEd, LVT, FVTE, who has led the AVA Committee for years. Current members of the AVA Committee are Helen DeWitt (vice chair), Megan Chadwick, Betsy Hensley, Christina Melvin, Heather Milharcic, Lynn Roland, Oreta Samples, Erin Spencer, Stephanie Vuckovich, and Mandy Zachgo.

For more information about how to enroll in the NAVTA AVA program or how to become a NAVTA AVA program, visit navta.net/veterinary-assistants. TVN





TRENDS IN VETERINARY MEDICINE

What Veterinary Nurses Need to Know About Avian Influenza

***Sarah Kolb**, JD, BAS, CVT, LAT, VTS Clinical Practice (Exotic Companion Animals)*
VCA Veterinary Emergency Service & Veterinary Specialty Center, Middleton, Wisconsin

Avian influenza has become an increasingly urgent concern in veterinary medicine, especially with the ongoing spread of the highly pathogenic H5N1 strain across North America. While this virus has long been recognized as a threat to poultry, it now poses risks to a broader range of species—including wild birds; domestic mammals; and, in rare cases, humans. It is critical for veterinary nurses to stay informed about this evolving disease.

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Not only are veterinary nurses often the first to recognize clinical signs or potential exposures in patients, but they are also key players in educating clients and supporting biosecurity protocols in clinical and farm settings. As avian influenza continues to shift in scope and behavior, veterinary nurses must be equipped with current information on how it spreads, which patients are most at risk, what precautions to take, and how to communicate these issues effectively with the public.

UNDERSTANDING AVIAN INFLUENZA

Avian influenza, commonly known as "bird flu," is caused by influenza A viruses that primarily infect birds.[1] These viruses are classified based on 2 surface proteins: hemagglutinin (H) and neuraminidase (N).[1] In birds, 16 H subtypes (H1 through H16) and 9 N subtypes (N1 through N9) have been identified, resulting in various combinations such as H5N1 or H7N9.[1] These combinations are used to identify the specific strain of the virus.

Avian influenza viruses are further categorized by their pathogenicity in poultry, which refers to the severity of disease—highly pathogenic avian influenza (HPAI) or low pathogenic avian influenza—they cause in chickens (**TABLE 1**).[1]

Of particular concern is the HPAI H5N1 strain, which has evolved over the past few decades and is now considered enzootic in some bird populations.[2] The current virus affecting North America belongs to clade 2.3.4.4b, a genetic subgroup of this H5N1 strain. This clade has demonstrated the ability to[3]:

- Spread rapidly among wild and domestic birds
- Cause mass mortality in poultry flocks
- Spill over into mammals (including humans, seals, foxes, cats, and cattle)
- Persist in the environment, particularly in water and organic material like feces and litter

Because wild birds often carry the virus without obvious illness, they play a key role in its long-distance spread.[1] In contrast, domestic poultry and mammals are highly susceptible and may suffer devastating losses—whether from sudden mortality, production decline, or mass depopulation.[4] Understanding how this virus has emerged, spread, and adapted across species and regions is essential context for the role veterinary nurses play in biosecurity and disease prevention.

EPIDEMIOLOGY OF HPAI H5N1 IN NORTH AMERICA

Since the emergence of clade 2.3.4.4b HPAI in Africa, Asia, and Europe during 2020, the virus has become firmly established across North America.[5] In late 2021, clade 2.3.4.4b A(H5N1) viruses were first detected in Canada, where the virus has since caused a significant epizootic.

Transmission of HPAI H5N1 from birds occurs primarily through direct contact with secretions from infected birds (e.g., saliva, nasal discharge, and feces) as well as exposure to virus-contaminated environments, equipment, feed, or animal by-products. The virus can also spread via aerosolized particles, including respiratory droplets and fine dust, which are especially problematic in enclosed poultry facilities where ventilation systems may circulate virus-laden air between barns. In open-air settings, migratory birds can shed virus midflight, contaminating feed, water sources, or surfaces via droppings or aerosolized

TABLE 1 Key Differences Between LPAI and HPAI

FEATURE	LPAI	HPAI
Severity in poultry	Mild or no illness	Severe illness and high mortality
Common subtypes	H5, H7 (initially low pathogenic)	H5, H7 (after mutation to high pathogenicity)
Reservoir species	Wild waterfowl	Wild waterfowl, but highly fatal in poultry
Transmission speed	Slower	Rapid within flocks
Clinical signs in birds	Often subclinical	Sudden death, neurologic signs, hemorrhage
Zoonotic potential	Low	Moderate (especially H5N1 and H7N9)
Reportable disease?	Not always	Always reportable to World Organisation for Animal Health and USDA

HPAI=highly pathogenic avian influenza; LPAI=low pathogenic avian influenza

particles. Combined with the virus's environmental stability in cool, moist conditions, this creates ample opportunity for indirect transmission—even without bird-to-bird contact. Waterfowl, especially migratory species, are therefore key vectors for long-distance spread, while localized outbreaks are frequently driven by contaminated fomites and human activity.[6]

The virus then spread rapidly southward. In the United States alone, between January 2022 and June 2025, HPAI H5N1 was confirmed in more than 13 200 wild birds and over 1700 commercial or backyard poultry flocks.[7] These outbreaks have resulted in the loss of over 174 million domestic birds across all 50 states.[7] Seasonal spikes in virus detection have aligned with spring and autumn waterfowl migrations, highlighting how important these birds are in spreading the virus over long distances.

Spillover of HPAI H5N1 into mammals has also become increasingly common, including in a wide range of mammals such as seals, skunks, foxes, raccoons, cats, and dogs.[8,9] These cases are typically linked to scavenging infected birds or consuming contaminated poultry waste, which increases opportunities for cross-species transmission.[6]

A major epidemiologic turning point occurred in March 2024 with the first detection of H5N1 in U.S. dairy cattle.[10] By May 2025, the virus had been confirmed in over 760 herds across 17 states, characterized by extraordinarily high viral loads in raw milk but relatively minimal clinical illness in the cows themselves.[10] However, the virus's adaptation to a new livestock host has increased both the number of exposed workers and the geographic spread of the outbreak.[10] Detection of H5N1 in mammary tissue and raw milk is particularly concerning due to the potential for mucosal or oral exposure among farm workers and the theoretical risk of further mammalian adaptation.[11,12] While pasteurization eliminates this risk in commercial milk supplies, the presence of virus in a widely consumed livestock product has prompted new biosecurity and surveillance measures.[11,12]

Human infections remain rare and mild but are now directly linked to exposures from both cattle and poultry. The first U.S. cow-associated H5N1 case—a dairy worker in Texas who developed conjunctivitis—was reported on April 1, 2024, followed by sporadic cases in Michigan and Colorado.[12] To date, no human-to-human transmission has been documented.[11,12] According to the CDC, the risk to the general public remains low; however, this unprecedented spillover from cattle has expanded the occupational health risks that veterinary nurses and other animal workers must anticipate.[11,12]

With an understanding of where and how HPAI H5N1 is spreading, veterinary nurses can better anticipate what to look for across different species in clinical settings (**BOX 1**).

BOX 1

Stay Informed: Trusted Resources for Avian Influenza Information

Bookmark and regularly check these sources for real-time updates and accurate information about avian influenza:

United States

- **CDC** H5 Bird Flu: Current Situation. Updates on U.S. human cases, animal outbreaks, and public health risk assessments. go.navc.com/3UXonjJ
- **USDA** Animal and Plant Health Inspection Service (APHIS) H5N1 Influenza. Central hub for official HPAI updates in poultry, mammals, and cattle. go.navc.com/46Wt58G
- **USDA** APHIS Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks. Ongoing reporting of confirmed HPAI cases and response actions. go.navc.com/4lks7qd

International

- **World Health Organization** Avian Influenza Situation Reports. Weekly global summaries, including zoonotic cases and risks. go.navc.com/417Qfp0
- **Food and Agriculture Organization of the United Nations** Global Avian Influenza Viruses With Zoonotic Potential Situation Update. Global situation updates on avian influenza viruses that can infect humans. go.navc.com/4ouF1EV

HPAI = highly pathogenic avian influenza

CLINICAL SIGNS

Avian influenza can cause a wide range of clinical signs that vary by species, viral strain, and pathogenicity.

In poultry, highly pathogenic strains like H5N1 frequently cause[13-15]:

- Sudden death with no premonitory signs
- Neurologic signs such as head tilt, tremors, and incoordination
- Respiratory distress, including coughing, sneezing, and nasal discharge
- Cyanosis (bluish discoloration) of the combs and wattles
- Greenish diarrhea
- Drop in egg production or misshapen, soft-shelled eggs

In wild birds, signs can vary widely. Some infected birds—particularly waterfowl—may show no outward signs while actively shedding virus, while many species are often asymptomatic. Others may develop severe disease, including[15,16]:

- Weakness, circling, head tremors, or swimming in circles
- Inability to fly or stand
- Neurologic signs (most common in affected raptors and scavengers)

In mammals (e.g., cats, foxes, seals, cattle), clinical signs depend on species and route of exposure.[13,15]

- Neurologic signs, such as stumbling, seizures, or disorientation
- Respiratory signs in some species, most notably in seals and cattle
- Fever, lethargy, and anorexia
- In dairy cattle, illness may be subtle but can include:
  - Decreased milk production
  - Thickened, discolored, or colostrum-like milk
  - Mild fever, with otherwise minimal clinical signs

DIAGNOSIS

Because HPAI is a reportable disease, any confirmed or suspected case must be reported to appropriate regulatory authorities.[13] While some veterinary clinics may conduct or submit initial testing, confirmation and official response involve state, provincial, or federal animal health agencies.

Several diagnostic tools may be used depending on the species, the clinical presentation, and whether an outbreak is ongoing. Testing methods include rapid antigen tests (antigen capture immunoassay) for initial screening, which are highly specific but require confirmation by molecular tests; real-time PCR, the primary and sensitive test used by official labs to detect and subtype the virus with results in hours; and virus isolation, a slower, more complex confirmatory method involving growing the virus for detailed analysis.[13]

> Spillover of HPAI H5N1 into mammals has also become increasingly common, including in a wide range of mammals such as seals, skunks, foxes, raccoons, cats, and dogs.[8,9]

Testing protocols vary depending on whether you're sampling poultry, wild birds, or mammals and on the specific signs observed. For poultry, samples might include oropharyngeal and cloacal swabs. In mammals, nasal, oral, or milk samples may be needed. In suspected flock outbreaks, necropsy—conducted at an approved lab—is often recommended to guide diagnosis and control efforts.[13]

Even though diagnostic confirmation typically happens off-site, veterinary nurses play a key role in recognizing clinical signs, assisting with sample collection, and supporting biosecurity measures throughout the diagnostic process.

TREATMENT AND CONTROL

There is no specific treatment for HPAI in animals.[13] Recovery in poultry is extremely rare; infected birds are typically euthanized and their products destroyed to prevent further spread.[13] The AVMA Guidelines for the Depopulation of Animals provide valuable resources to assist with difficult culling decisions.[13,17] If HPAI is suspected in any animal, contact federal and state authorities before initiating treatment.[13] For commercial poultry flocks, quarantine the premises immediately and limit exposure until you receive official guidance.[13] When supportive care is appropriate—for example, in companion animals or livestock—it may include fluids and anti-inflammatory medications, but strict isolation and infection control measures are essential.[13,15] Note that the FDA prohibits extra-label use of certain antiviral drugs (adamantine and neuraminidase inhibitors) in poultry species.[13,15]

Staying informed about the latest developments and communicating them clearly to clients are critical components of the job.

Veterinary nurses can help control infection by[16]:

- Using appropriate personal protective equipment (e.g., gloves, gowns, face shields or goggles, N95 respirators) when handling suspect cases or cleaning contaminated areas
- Following strict cleaning protocols—disinfect exam areas, carriers, floors, and tools with EPA-approved disinfectants effective against influenza viruses
- Designating avian-only zones and equipment to reduce cross-contamination
- Practicing excellent hand hygiene, washing thoroughly before and after handling birds or contaminated surfaces
- Controlling clinic traffic flow to limit movement between isolation and other areas, and using footbaths or changing footwear as needed
- Educating staff and clients about avian influenza risks and clinic protocols

Having a clear plan protects your team, clients, and animals—and supports One Health by helping prevent spread during outbreaks.

CLIENT COMMUNICATION: TALKING ABOUT AVIAN INFLUENZA

During outbreaks of avian influenza—especially when it affects backyard poultry, wild birds, or even dairy cattle—clients are likely to have concerns (see **CLINIC RESOURCE**). For the veterinary nurse, the ability to provide calm, fact-based guidance helps maintain trust and prevent panic. Communication should be:

- **Clear:** Avoid technical jargon unless the client is knowledgeable.
- **Accurate:** Stay up to date with CDC, USDA, or Canadian Food Inspection Agency updates.
- **Balanced:** Acknowledge the risks but emphasize prevention and perspective.
- **Empathetic:** Many clients see their birds as family; others may be worried about zoonotic transmission or food safety.

CLINIC RESOURCE
Download this resource on client FAQs and answers related to avian influenza for easy clinic use.

SUMMARY

The ongoing HPAI H5N1 outbreak presents significant challenges to both animal and public health, and veterinary nurses are at the heart of the response. The veterinary nurse's role extends beyond the exam room—encompassing disease surveillance, infection control, client education, and everyday biosecurity. Staying informed about the latest developments and communicating them clearly to clients are critical components of the job. This outbreak is a clear reminder that One Health is not just a theory but a practical, daily responsibility—linking animal, human, and environmental health. Through vigilance, education, and teamwork, veterinary nurses are an essential line of defense in protecting patients and the community. TVN

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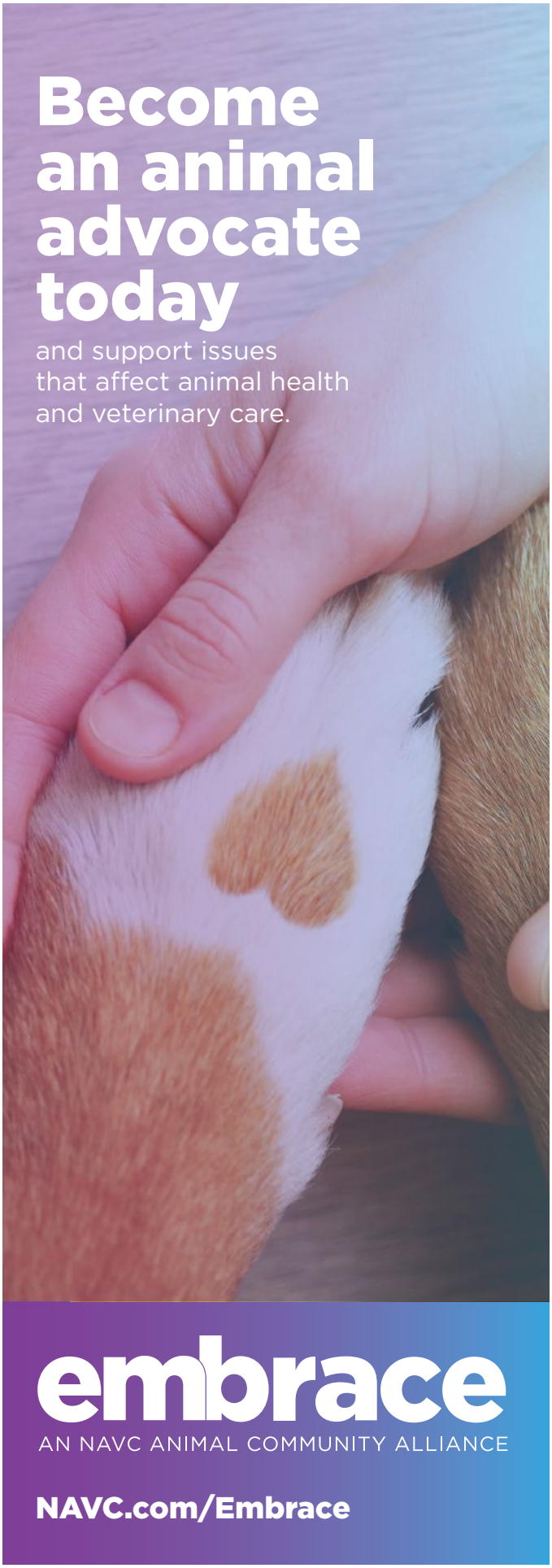
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Sarah Kolb



Sarah is a VTS in exotic companion animal medicine. With over 20 years of clinical experience, Sarah has dedicated her career to the care of exotic pets and wildlife. She spent 14 years at Iowa State University's Lloyd Veterinary Medical Center before joining the University of Wisconsin–Madison's National Primate Research Center, where she gained extensive experience in primate medicine, research support, and specialized husbandry. She now serves as a specialty supervisor with VCA, overseeing clinical teams, implementing best practices, and supporting the growth of specialty services. Sarah has served as the 2022-2023 Academy of Veterinary Technicians in Clinical Practice president. A Veterinary Support Personnel Network instructor, national conference speaker, and published author, she is committed to advancing exotic animal medicine and technician education through teaching, writing, and professional leadership.




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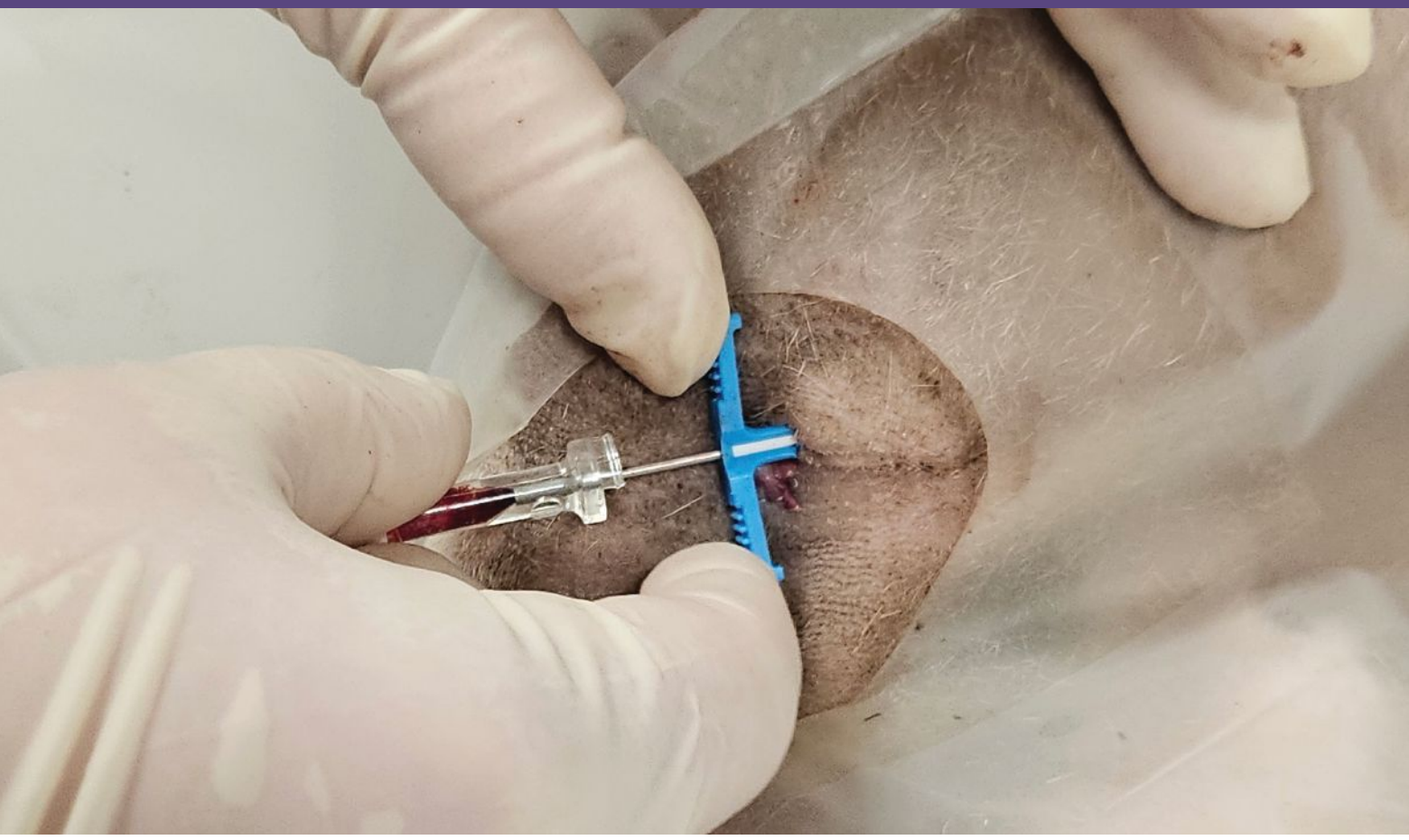
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SKILLS CHECK

Placing Central and Peripherally Inserted Central Catheter (PICC) Lines

***Laura Waller**, RVT*
Southwest Veterinary Training, Apple Valley, California

Abstract

Central venous catheters (central lines and peripherally inserted central catheters) play a vital role in the management of critically ill veterinary patients. Either the modified Seldinger or the peel-away technique can be used for placing central venous catheters; with training and practice, veterinary nurses and technicians can use them to enhance patient care in emergency and intensive care settings.

Opposite: Alexander_P/shutterstock

Take-Home Points

- Central and peripherally inserted central catheter (PICC) lines can enhance the care of patients who need frequent venous blood sampling, hyperosmolar or multiple incompatible medications, central venous pressure measurements, or parenteral nutrition.
- Aseptic technique when placing and handling central and PICC lines is crucial because they are typically left in place much longer than peripheral intravenous catheters.
- A solid understanding of anatomy and placement techniques can reduce anxiety around central and PICC line use.

A central line is a long-line catheter placed in a central vein, such as the jugular vein, and fed into the central circulation via the cranial vena cava. A peripherally inserted central catheter (PICC) line is placed in a peripheral vein, such as the saphenous vein, and fed into the central circulation via the caudal vena cava (**FIGURE 1**).

INDICATIONS

Central and PICC lines are indicated for administration of medications with osmolarity of > 600 mOsm/L, such as dextrose > 10% (maximum through a peripheral vein is 10%), or medications with a high risk of causing phlebitis/thrombophlebitis should they be extravasated,[1] such as vasopressors. Many lines have multiple lumens for delivery of several or incompatible medications. They are ideal for patients that require frequent blood sampling (e.g., patients with diabetic ketoacidosis, parvovirus infection, or hypoglycemia). Central lines inserted into the jugular vein also enable measurement of central venous pressure and administration of parenteral nutrition.[2]

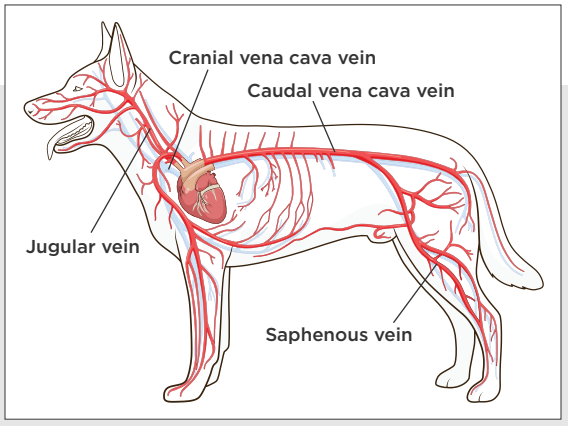


FIGURE 1. Venous circulation in a dog.

CONTRAINDICATIONS AND COMPLICATIONS

Contraindications and complications of central and PICC lines are similar in many respects but differ in others.

Contraindications

Central line contraindications include skin infection over the desired insertion site, increased intracranial pressure, or suspected or confirmed bleeding disorder. PICC line contraindications include skin infection over the desired insertion site, edema, mobility at the site, frequent urination, or diarrhea.[3]

Complications

Central line complications include arrhythmias secondary to placement, phlebitis, embolism, bleeding, and/or infection. PICC line complications include phlebitis, embolism, bleeding, and/or infection.[4]

TECHNIQUES

Many techniques can be used for inserting central and PICC lines. This article discusses the modified Seldinger and peel-away techniques. The modified Seldinger technique uses catheterization, guidewire placement, vessel dilation, and line insertion. The peel-away technique involves placing an introducer catheter, inserting the line, then "peeling away" the introducer.

Although both techniques can be used for central and PICC lines, for clarity the author describes the modified Seldinger technique for central lines and the peel-away technique for PICC lines. Both techniques begin with the same first 7 steps.

Shared Foundational Steps

STEP 1: Initiate sedation and monitoring as appropriate for the patient (i.e., have staff/multiparameter monitor available).

STEP 2: Position the patient in lateral recumbency.

STEP 3: Shave over the desired vein to be used.

- Central lines
  - **Dogs and cats:** From mandible to thoracic inlet
- PICC lines
  - **Dogs:** Lateral saphenous vein
  - **Cats:** Medial saphenous vein

VIDEO 1
Central line placement using the modified Seldinger technique. The video starts immediately after the intravenous catheter has been placed.

VIDEO 2
Bleeding each line after central line placement.

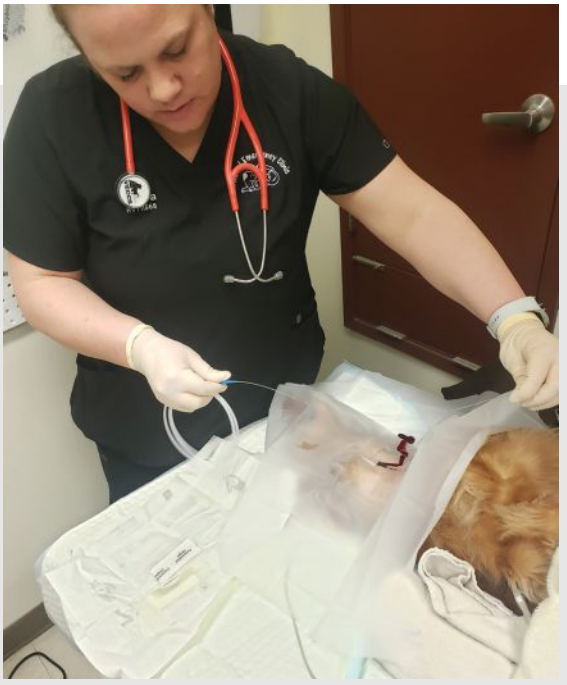


FIGURE 2. Measuring the guidewire for the modified Seldinger technique.

STEP 4: To determine the correct location, don examination gloves, hold off the vein, and palpate/visualize the site of insertion (which if too high or low may cause problems with insertion), securing the site and patient comfort.

STEP 5: Still wearing the examination gloves, use aseptic technique to prepare the insertion site.

STEP 6: Open the kit and verify that all needed parts are present.

STEP 7: The person placing the catheter should don sterile gloves, and the assistant, wearing examination gloves, holds off the vein far above the venipuncture site.

Secondary Steps Specific to the Modified Seldinger Technique

The modified Seldinger technique is used for placement of a central line in the jugular vein. Follow the first 7 steps under **TECHNIQUES** and then the steps below. See also **VIDEOS 1 AND 2**.

STEP 8: Measure the guidewire (keeping it sterile) from the planned entry site to the 3rd to 4th intercostal space, and visually note the location on the guidewire. Lines are marked on the guidewire to help track the length inserted (**FIGURE 2**).[5]

STEP 9: Keeping it sterile, measure the central line from the planned entry site to the 3rd to 4th intercostal space (to the right atrium), and visually note the centimeter mark on the central line, or use a tape measure if available in the kit.



FIGURE 3. Cutdown in the modified Seldinger technique.

STEP 10: Remove the drape window, if needed, and place the drape on the patient, putting the desired entry point in the center of the fenestration. **Note:** Visualization can be difficult after draping—be diligent in selecting a spot.

STEP 11: To facilitate initial catheter placement, perform a cutdown over the desired entry point (**FIGURE 3**). **Note:** A larger cutdown can be performed if needed for visualization.

STEP 12: Have the assistant hold off the vein at the jugular furrow with a sterile-gloved hand under the drape (**FIGURE 4**).



FIGURE 4. Holding off at the jugular furrow to visualize the jugular vein during the modified Seldinger technique.



FIGURE 5. Inserting the intravenous catheter during the modified Seldinger technique.

STEP 13: Insert the catheter at the desired location; when blood appears, advance the catheter and remove the stylet. The restraining assistant can then stop holding off the vein at the jugular furrow (**FIGURE 5**).

STEP 14: Straighten out the J hook (**FIGURE 6**) and plug the guidewire housing set into the catheter (**FIGURE 7**). Advance the wire to the predetermined estimated mark (guidewires have single or double line marks to help notate desired insertion site). To avoid inadvertently losing the wire inside the patient, do not advance more than two-thirds of the wire into the patient. Do not at any point let go of the guidewire (a case of a guidewire accidentally lost in a patient led to it being surgically retrieved[6]).

STEP 15: Remove the guidewire housing, leaving the guidewire in place (**FIGURE 8**). **Note:** Be cautious to keep the wire sterile and not let go of it.[7]

STEP 16: Remove the catheter, leaving only the guidewire in place (**FIGURE 9**).

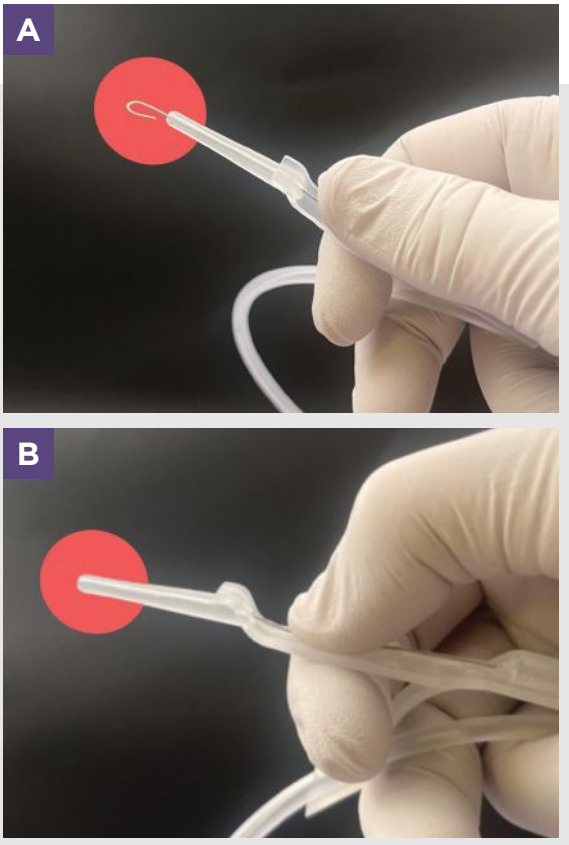


FIGURE 6. J hook **(A)** outside of the housing and **(B)** pulled back into the housing for the modified Seldinger technique.

Figure 6 (A and B): courtesy Alli Butler, MILA International



FIGURE 7. Connecting the guidewire housing to the intravenous catheter during the modified Seldinger technique.

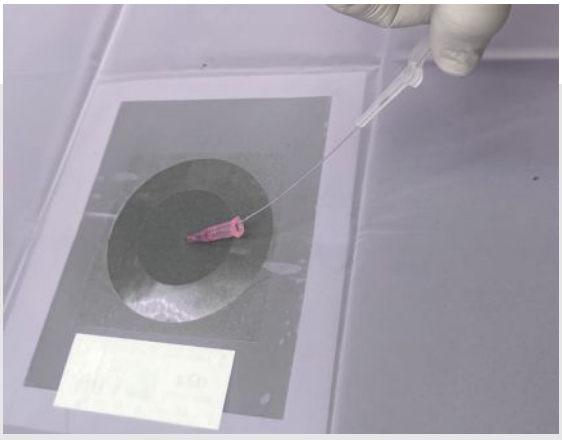


FIGURE 8. Removing the guidewire housing, leaving the guidewire in place, during the modified Seldinger technique.

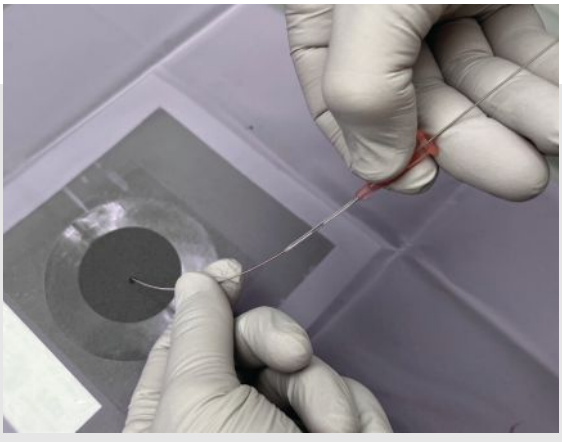


FIGURE 9. Removing the intravenous catheter, leaving the guidewire in place, during the modified Seldinger technique.

STEP 17: Fully feed the dilator into the vessel with a slight twisting motion, until the hub has reached the skin, and then remove the dilator (**FIGURE 10**). It will take more force than you might expect. For ease of insertion, hold the dilator close to the skin.

STEP 18: After removing the dilator, hold gauze over the site to stop bleeding.

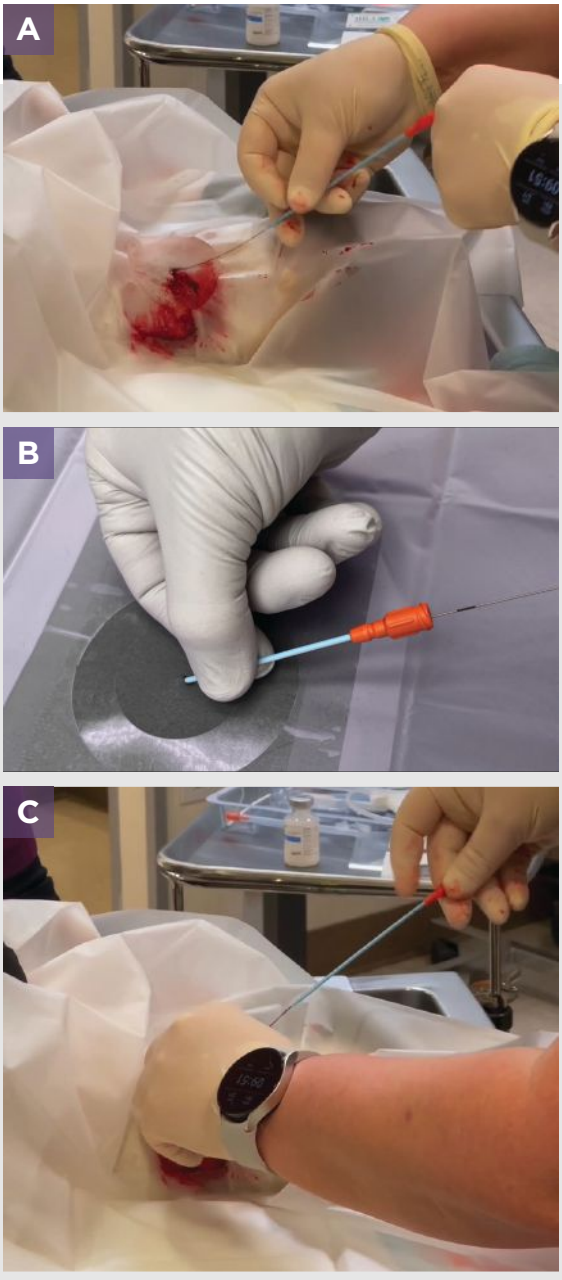


FIGURE 10. Feeding the dilator **(A)** over the guidewire and **(B)** into the vessel, and **(C)** removing the dilator from the vessel during the modified Seldinger technique.

Figure 8, 9, 10 (B): courtesy Alli Butler, MILA International

STEP 19: Feed the central line over the wire to the desired location. The wire will come out of the brown distal port. The assistant should watch for the wire to unclamp it and reclamp it as soon as it has passed (**FIGURE 11**).

STEP 20: To avoid air embolism, bleed each line, then flush with saline from the patient's dedicated bag (**FIGURE 12, VIDEO 2**). **Note:** Consider blood loss and the size of the patient.

STEP 21: Place 2 caps on each line, each of which should have a Luer lock port and a cap on top of it.



FIGURE 11. Feeding the central line over the wire during the modified Seldinger technique.



FIGURE 12. Bleeding each line during the modified Seldinger technique.

STEP 22: Place a temporary securing bandage over the line and transport the patient to radiology.
Note: Placing central lines while in the radiology suite (instead of before) decreases the risk for inadvertent line removal.

STEP 23: Take lateral (**FIGURE 13**) and ventral/dorsal views from the neck to the xiphoid process. Radiographs are recommended to confirm placement in front of the right atrium. If the line is too far in, back it out slowly, taking additional radiographs. Pull the line out in increments. Do not insert the line after it has been pulled out as it would no longer be sterile.

STEP 24: It is best to unwrap the bandage manually before suturing in place. If cutting the bandage, be careful not to cut any lines.

STEP 25: After catheter positioning is correct, suture each butterfly wing in place with a single interrupted pattern and tightly around both indentations of the hub to secure the line in place (**FIGURE 14**).

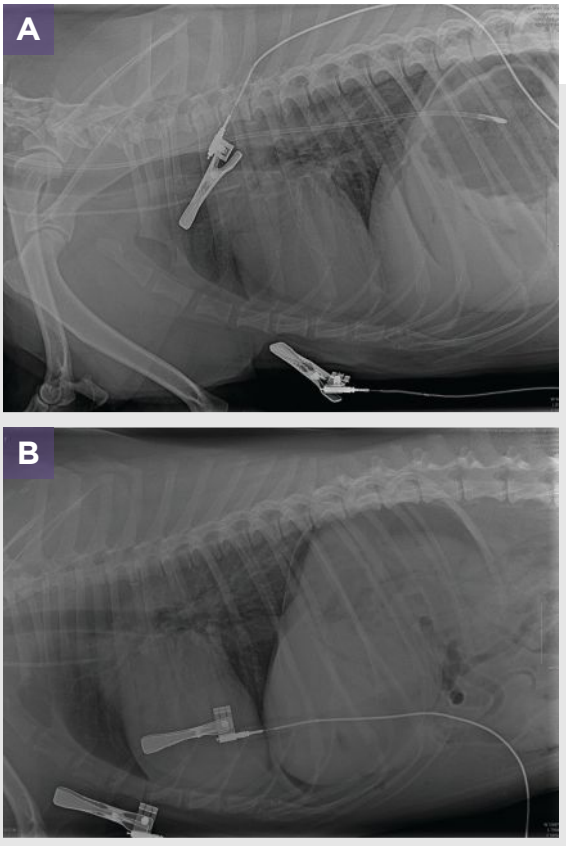


FIGURE 13. Central line **(A)** incorrect position and **(B)** correct position during the modified Seldinger technique.

Note: Depending on the length, you may need to use butterfly extenders and secure 1 or both ports.

STEP 26: Place a Tegaderm dressing or Telfa pad over the insertion site and bandage with rolled cotton and elastic wrap. Leave the ports out and tape them to the elastic wrap to create a secondary source of tension (**FIGURE 15**).

STEP 27: Label ports with tape (e.g., IVF [intravenous fluids], FLK [fentanyl, lidocaine, ketamine constant-rate infusion], insulin, sampling, alfaxalone).

Secondary Steps Specific to the Peel-Away Technique

The peel-away technique is used for PICC line placement in a peripheral vein. Follow the first 7 steps under **TECHNIQUES** and then the steps below.

STEP 8: Measure the PICC line (keeping it sterile) from the planned entry point to just past the femoral head (to the caudal vena cava). Visually note the cm mark on the PICC line or use the provided tape measure.

STEP 9: Clamp each line to avoid air embolism.

STEP 10: Remove the drape window, if needed, and place the drape on the patient, putting the desired entry point in the center of the fenestration (**FIGURE 16**).

STEP 11: Perform a stab incision over the desired entry point with the blade facing toward the ceiling (optional).

STEP 12: Have the assistant, wearing examination gloves, hold off the vein above the stifle.

STEP 13: Insert the catheter at the desired location; when blood appears, advance the catheter and remove the stylet (**FIGURE 17**). The assistant then stops holding off above the stifle.

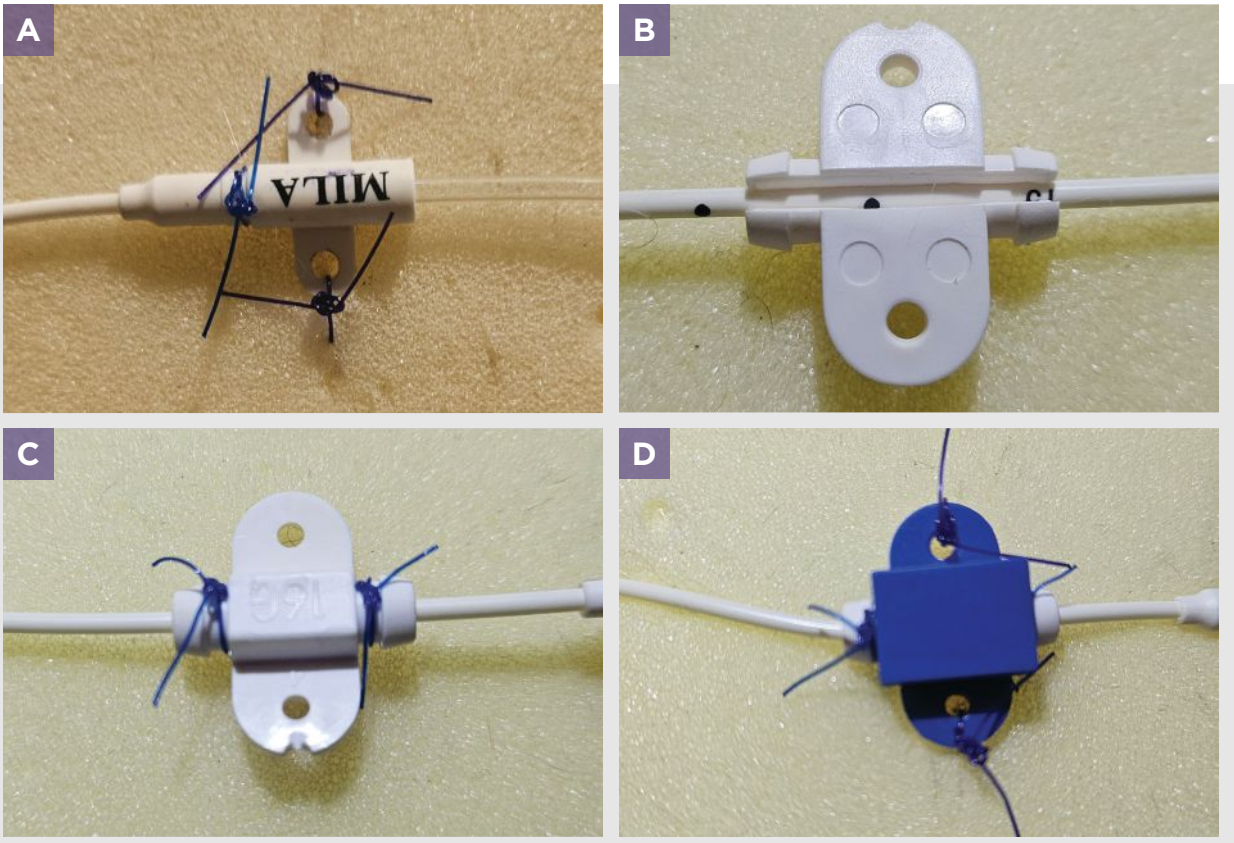


FIGURE 14. Suturing the central line after placement using the modified Seldinger technique.

STEP 14: Feed the PICC line into the catheter to the measured location (**FIGURE 18**).

STEP 15: Place 2 caps on each line. Each line should have a Luer lock port and a cap on top of it.

STEP 16: "Peel away" the catheter and remove it (**FIGURE 19**).

STEP 17: After the line is secured (with a single interrupted pattern, tightened around both indentations of the hub), place a Tegaderm dressing or Telfa pad over the insertion site and bandage with rolled cotton and elastic wrap. Leave the ports out and tape them to the elastic wrap to create a secondary source of tension (**FIGURE 20**).



FIGURE 15. Bandage over the central line site, leaving the ports out, after placement using the modified Seldinger technique.



FIGURE 16. Drape placed over the lateral saphenous vein in a dog, preparing for the peel-away technique.

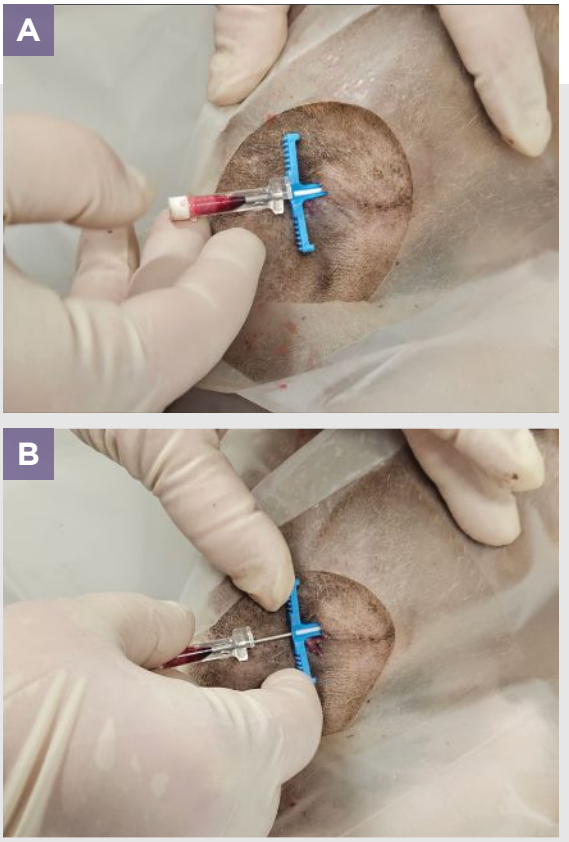


FIGURE 17. The introducer catheter is **(A)** placed and then **(B)** the stylet is removed during the peel-away technique.



FIGURE 18. Feeding the PICC (peripherally inserted central catheter) line into the introducer catheter during the peel-away technique.

Flushing should be performed every 4 hours, with at least the priming volume of the central line (approximately 0.5 to 2 mL, depending on catheter size/manufacturer).[10]

STEP 18: Label ports with tape (e.g., IVF, FLK, insulin, alfaxalone, sampling).

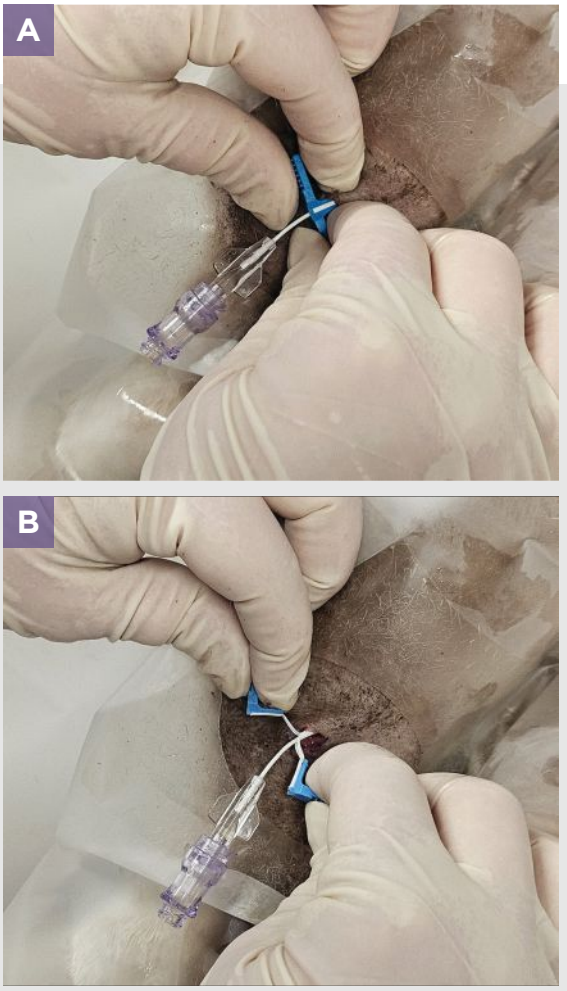


FIGURE 19. Peeling away the introducer catheter during the peel-away technique.

SAMPLING FROM CENTRAL AND PICC LINES

Multilumen central lines ideally have a dedicated port for blood sampling. The distal (brown) port is ideal because it is the farthest from the insertion site and closest to the vena cava, but any port can be used.

Sample Collection

STEP 1: Stop any fluids running through any ports.

STEP 2: Don gloves.

STEP 3: Remove the cap, keeping it sterile.

STEP 4: Clean the port with alcohol for at least 5 seconds and let it air dry.

STEP 5: Use the push/pull method.

- Attach a 10-mL syringe with 1 mL of saline and flush the line.
- Pull 3 mL of blood and push it back into the line 3 times, then draw the sample.
- Flush the line with saline, being mindful of the volume used, using a positive-pressure pulsating technique. Flushing with heparinized saline has not



FIGURE 20. Bandage, leaving the ports out, following the peel-away technique.

been demonstrated to be superior to saline, and excessive flushing with heparinized saline could lead to coagulation disorders, although this has not been proven.[8,9]

- **Troubleshooting:** Flushing with saline may help if you cannot get a sample. Adjusting the patient's head or leg position may help. If you still cannot get a sample, unwrap the bandage to verify that the line is still in place.

MAINTAINING CENTRAL AND PICC LINES

To maintain catheter patency, the line should be routinely flushed, especially when a port is not in use. Flushing should be performed every 4 hours, with at least the priming volume of the central line (approximately 0.5 to 2 mL, depending on catheter size/manufacturer).[10] Consider the size of the patient and concerns for fluid overload. When flushing, use a saline bag dedicated for that patient, wear gloves, maintain pulsating positive pressure as you flush, and clamp the line before disconnecting the syringe.

Bandages should be unwrapped by hand once daily and the insertion site inspected for erythema, swelling, or discharge. The insertion site should be gently cleaned with chlorhexidine scrub and dried, and all ports and the line should be wiped down for at least 5 seconds with alcohol and allowed to air dry. The bandage can then be replaced.

Note that when parenteral nutrition is to be administered, unnecessary disconnection of the central line port from parenteral nutrition administration lines should be avoided to prevent contamination. If disconnection is necessary, strict aseptic technique should be followed.

SUMMARY

Although central catheter placement requires advanced technical skills and comes with potential risks, being able to correctly place catheters is invaluable for management of critical-care patients. With training and practice, the skill can enhance patient care in emergency and intensive care settings. **TVN**

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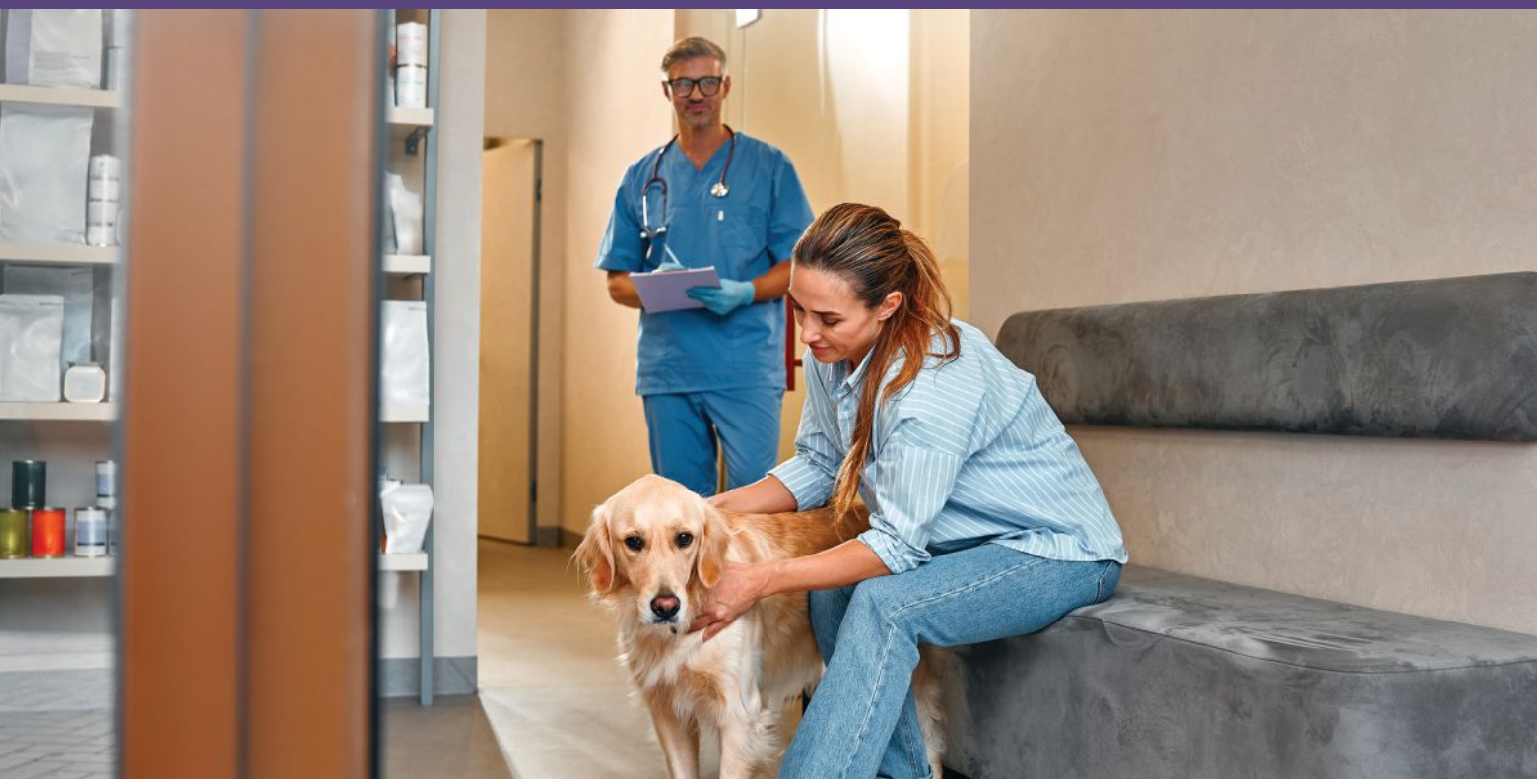
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CASE REPORT: BEHAVIOR

Addressing the Most Common Veterinary Visit–Associated Canine Behavior Concerns

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Abstract

Canine behavior concerns, including fear, anxiety, and aggression, are frequent challenges for patients and staff in veterinary clinics, often resulting from learning, genetics, and the environment. These behaviors can complicate veterinary care procedures, increase the risk of injury to staff and owners, have an emotional impact on clients, and negatively impact canine welfare. Research shows that fear-related behaviors are common during veterinary visits, with contributing factors such as age, previous experiences, handling techniques, and owner-related stress. While pharmacologic interventions can aid in some cases, addressing the underlying causes of these behaviors requires a holistic approach. The 5 Domains Model provides a structured framework to assess and modify factors contributing to fear and aggression that can be implemented in clinical settings. This case report illustrates the application of environmental modifications, low-stress handling techniques, and behavioral interventions in a dog with severe veterinary-related aggression.

Take-Home Points

- Environmental modifications, such as reducing sensory overload, creating safe and comfortable spaces, and structuring clinic flow, can minimize fear-based responses.
- Low-stress handling techniques reduce restraint, allowing for more cooperative veterinary visits.
- Positive reinforcement (e.g., treats, verbal praise) helps condition positive associations with handling.
- Owner involvement and happy visits improve patient confidence and reduce anticipatory stress.
- A structured, welfare-based approach improves long-term behavior and patient outcomes.

Fear, anxiety, and aggression are among the most common behavioral issues encountered in veterinary clinics, significantly affecting patient welfare, clinical efficiency, and staff safety.[1,2] Studies indicate that up to 78.5% of dogs display fear-related behaviors, ranging from avoidance to defensive aggression, during veterinary visits.[1,2]

Veterinary-related fear can be triggered by several factors, including genetics, unfamiliar environments, previous negative or lack of experiences, and outdated or improper handling techniques. Fearful dogs are more likely to freeze, resist restraint, vocalize, and engage in defensive aggression, increasing the risk of injury to veterinary staff and leading to potential complications in medical care. In severe cases, prolonged fear responses may contribute to chronic stress, which can negatively impact both physical and emotional wellbeing.[3]

A 2021 survey by Stellato et al identified several risk factors influencing veterinary-related fear and aggression, including[4]:

- Dog-specific factors (general fearfulness, prior experiences with handling)
- Owner-related factors (stress levels, handling confidence)
- Clinic-related variables (restraint techniques, environmental triggers)

Physiologic stress markers, such as elevated heart rate, blood pressure, and cortisol levels, occur frequently in cats during veterinary visits and have been found to affect dogs as well, a phenomenon often referred to as the "white-coat effect."[5] Stress during clinical visits not only affects behavior but can also impact diagnostic accuracy by altering physiologic parameters.[6] Dogs that associate veterinary visits with fear and anxiety are more likely to have their owners avoid routine care, leading to delayed medical interventions and poorer health outcomes.[7] Additionally, dogs that struggle with handling in clinical environments often have underlying pain conditions, sensory sensitivities, or generalized anxiety disorders that exacerbate stress responses.[8] Identifying and addressing these underlying factors are essential for managing veterinary-related aggression.

This case report details the assessment and veterinarian-developed treatment plan of Bernie, a 4-year-old mixed-breed dog, who presented with severe fear aggression during veterinary visits. The report outlines the impact of environmental modifications, structured behavior modification, and veterinary nurse–led interventions in improving Bernie's ability to tolerate handling in a clinical setting.

THE 5 DOMAINS MODEL

A comprehensive, multifaceted approach is needed to improve patient cooperation while maintaining staff safety and clinical efficiency. This case used the 5 Domains Model as a guiding framework (**FIGURE 1**), implemented through the following interventions:

1. **Environment**—Modified the clinical setting to reduce sensory overload, including visual barriers, scent masking, and reduced noise stimuli.
2. **Behavior**—Applied low-stress handling and counterconditioning, reinforcing calm behaviors with high-value rewards.
3. **Health**—Addressed underlying medical contributors to stress (e.g., pain) through pre-exam assessments.
4. **Nutrition**—Incorporated strategic use of food rewards as part of desensitization and positive reinforcement training.
5. **Mental state**—Supported emotional resilience by promoting predictability, allowing choice where feasible, and involving owners in previsit training.

The 5 Domains Model provides a structured framework for addressing these challenges, allowing veterinary professionals to develop targeted strategies that enhance patient welfare, improve clinical outcomes, and build long-term positive associations with veterinary visits.

SIGNALMENT, HISTORY, AND PRESENTATION

Bernie, a 4-year-old neutered, 26-kg (57-lb) mixed-breed dog with a moderate exercise routine, presented with a history of severe fear-related aggression during veterinary visits, at home, and in public spaces. His owner reported:

- Lunging, growling, and snapping when being approached by veterinary staff and strangers
- Escalating stress levels (e.g., diverting gaze, pacing, panting, tense body) upon arrival at the clinic, often requiring premedication that had limited efficacy due to physiological arousal
- Charging at unfamiliar people in enclosed spaces (such as exam rooms)

The owner noted that Bernie's first negative experience at a veterinary clinic occurred at 6 months old when he was restrained during a procedure. This experience contributed to the escalation of fear-based responses over subsequent years, culminating in conditioned avoidance and anticipatory anxiety. These responses—rooted in self-preservation—manifested as aggressive behaviors during veterinary visits, reflecting the dog's impaired ability to cope with perceived threats.

HEALTH	NUTRITION	PHYSICAL ENVIRONMENT	BEHAVIOR INTERACTIONS	MENTAL STATE
Pain and discomfort Increase fear/ defensive behaviors	**Hunger and dehydration** Increase stress and irritability	**Clinic stressors** Noise, lights, slippery floors, strong smells	**Human–dog interaction** Handling affects stress.	**Fear and anxiety management** Addressing environmental and handling factors
Previsit medication Pain relief or anxiolytics may help.	**Fasting before procedures** Can heighten reactions	**Reducing sensory overload** Soundproofing, pheromones, visual barriers	**Low-stress handling techniques** Least restrictive, consent-based	**Stress reduction techniques** Predictability, positive interactions, controlled exposure
Comprehensive exams Rule out medical causes of behavior changes.		**Creating safe spaces** Quiet waiting areas, nonslip mats, familiar items	**Recognizing canine body language** Stress signals like yawning and whale eyes	
		Structured clinic flow Scheduling, minimizing transitions	**Positive reinforcement** Treats and praise create positive associations	
		Environmental predictability Routine handling sequences	**Role of owners** Owners help reduce fear and improve cooperation.	
			Consistency in handling Standardized protocols across staff	

FIGURE 1. The 5 Domains Model. A holistic approach to canine behavior management in veterinary clinics.

INITIAL ASSESSMENT

Physical Findings

- Body condition score of 5/9 (ideal)
- Elevated heart rate (150 beats per minute) and respiratory rate (panting) on arrival
- Dilated pupils, tense body posture, ears pinned back
- Hypersensitivity to handling, particularly around the neck and legs, evidenced by flinching, muscle tensing, and withdrawal behaviors, even in response to light or gentle touch

Diagnostic Tests and Results

- **Orthopedic exam:** No significant findings
- **Pain assessment:** No overt signs of pain, ruling out pain-induced aggression
- **Blood work:** Unremarkable

Differential Diagnosis

- Fear aggression likely associated with previous negative veterinary experiences
- Generalized anxiety disorder leading to heightened stress responses in clinical environments
- Lack of socialization and exposure to positive handling experiences in a veterinary setting

TREATMENT PLAN AND ROLE OF THE VETERINARY NURSE

A multidisciplinary approach was implemented to address Bernie's fear aggression during veterinary visits. Treatment followed the doctor's orders and focused on modifying the clinical environment (**CLINIC RESOURCE 1**), employing low-stress handling techniques (**CLINIC RESOURCE 2**), implementing a structured behavior modification plan, and educating the owner on stress management strategies.

1. Environmental Modifications and Antecedent Management

Environmental modification was a primary focus to reduce previsit anxiety and in-clinic stressors. Veterinary nurses played a key role in implementing the following:

- **Alternative waiting arrangements**—Bernie remained in the car upon arrival and was escorted directly into a quiet, low-traffic examination room, minimizing exposure to anxiety-triggering stimuli.
- **Sensory adjustments**—The examination room was prepared with dim lighting, nonslip mats, and pheromone diffusers such as Adaptil (Ceva, adaptil.com/us) to promote relaxation.
- **Handling area adaptations**—Bernie was examined on the floor rather than on an examination table to prevent forced handling and provide him with a sense of control.

CLINIC RESOURCE 1
Creating a Calm Environment for Canine Patients

CLINIC RESOURCE 2
Positive Human–Dog Interactions in Veterinary Clinics

CLINIC RESOURCE 3
Making Veterinary Clinics a Positive Experience for Dogs

2. Low-Stress Handling Techniques

Veterinary nurses followed a low-stress, agency-based handling protocol to prevent escalation of stress-related behaviors, including:

- Bernie was given time to voluntarily approach the veterinarian, avoiding direct confrontation.
- High-value treats (e.g., chicken, cheese) were used to reinforce (through operant conditioning) calm behavior (e.g., relaxed body, soft eyes, loose body) throughout handling.
- Handling was paused immediately when early stress indicators (e.g., tense body, tense muzzle, lip licking, whale eyes [showing whites of the eyes]) were observed.
- Staff maintained a neutral body posture (nonthreatening, relaxed stance); avoided direct eye contact; and used calm, low-pitched verbal cues to reduce perceived threats.

3. Behavior Modification and Desensitization

A structured behavior modification plan was introduced to improve Bernie's tolerance to the clinic environment, comprising:

- **Happy visits (FIGURE 2, CLINIC RESOURCE 3)**—

Bernie attended weekly nonprocedure visits, allowing him to explore the clinic without undergoing medical handling.

- **Systematic desensitization**—Exposure to clinic-related stimuli while remaining under emotional threshold, which was then gradually increased, starting with brief waiting room visits and progressing to short, hands-off exams.
- **Counterconditioning**—Used to pair each interaction with veterinary staff, including proximity and light handling, with positive experiences such as food, praise, and gentle petting, regardless of behavior. As Bernie's comfort increased, positive reinforcement was contingent on voluntary participation in handling exercises.

4. Owner Education and Home Strategies

Owner compliance was essential to ensuring long-term behavioral improvement. Veterinary nurses provided tailored education and support to the owner on:

- Recognizing early stress signals to intervene (e.g., removal from situations) before escalation
- Previsit training techniques, including car desensitization, short exposure trips to the clinic, and reinforcing calm behaviors at home
- Encouraging displacement behaviors (e.g., sniffing, shaking off) as self-soothing mechanisms

OUTCOME

Over 3 structured appointments, Bernie's responses improved significantly, exhibiting:

- Reduced previsit anxiety, which meant Bernie walked into the clinic voluntarily
- Decreased avoidance and defensive aggression, allowing for a full physical exam
- Cooperative low-restraint handling, enabling vaccinations without sedation

The owner reported reduced anticipatory stress and increased confidence in handling Bernie during clinic visits.

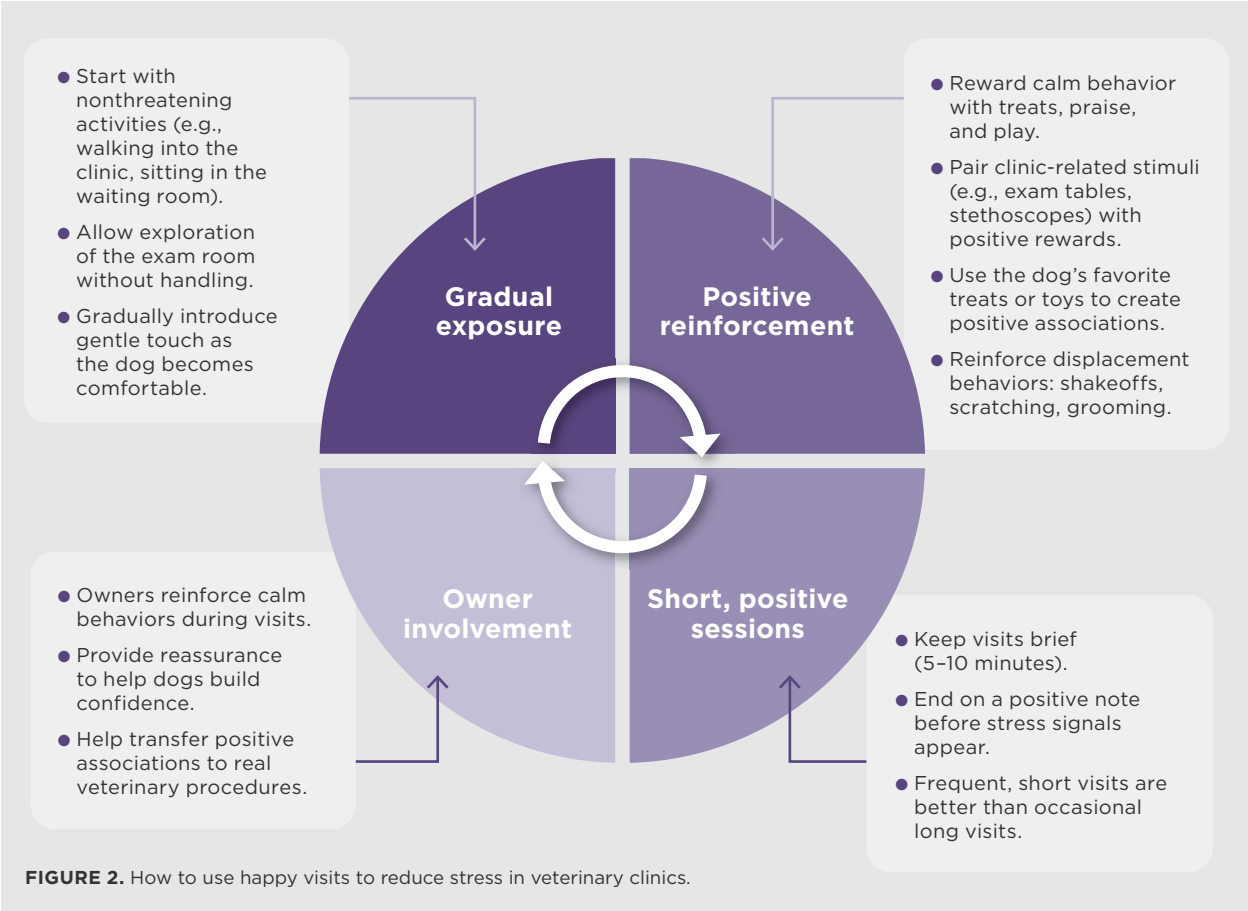


FIGURE 2. How to use happy visits to reduce stress in veterinary clinics.

DISCUSSION

Fear, anxiety, and aggression are common canine behaviors in veterinary settings but can be successfully managed using a structured, welfare-focused approach.[1,2]

A key takeaway from this case is the importance of environmental control. Simple modifications, such as reducing sensory overload, creating quiet waiting areas, and using low-stress handling techniques, significantly lowered Bernie's stress levels. Research shows that veterinary hospital–induced stress can alter physiologic parameters, leading to elevated heart rates and increased cortisol levels, further exacerbating fear-based behaviors.[6] These environmental changes can be easily applied in most veterinary clinics to improve patient comfort and compliance.[7]

Another major factor in Bernie's success was the use of positive reinforcement and counterconditioning. By pairing handling experiences with rewards, Bernie learned to associate veterinary visits with positive outcomes rather than fear. Studies indicate that counterconditioning techniques, such as food reinforcement, can significantly reduce stress and increase long-term behavioral resilience in fearful dogs.[9] Additionally, structured happy visits—short, stress-free trips to the clinic with positive interactions—have been shown to desensitize dogs to clinical environments and improve handling tolerance over time.[10]

Finally, this case highlights the essential role of owner involvement. Veterinary nurses should[11]:

- Educate owners on recognizing stress signals and responding appropriately
- Encourage previsit acclimation (e.g., happy visits)
- Support cooperative, low-restraint handling training
- Promote positive handling experiences at home to enhance long-term behavioral success

Research has demonstrated that owner presence during veterinary visits can act as a buffer against stress, improving canine welfare and enhancing cooperation during procedures.[12]

By implementing antecedent environmental management, positive human–dog interactions, and structured behavioral interventions, veterinary professionals can significantly reduce stress-related behaviors, improve clinical outcomes, and enhance pet and human experiences in the veterinary setting. TVN

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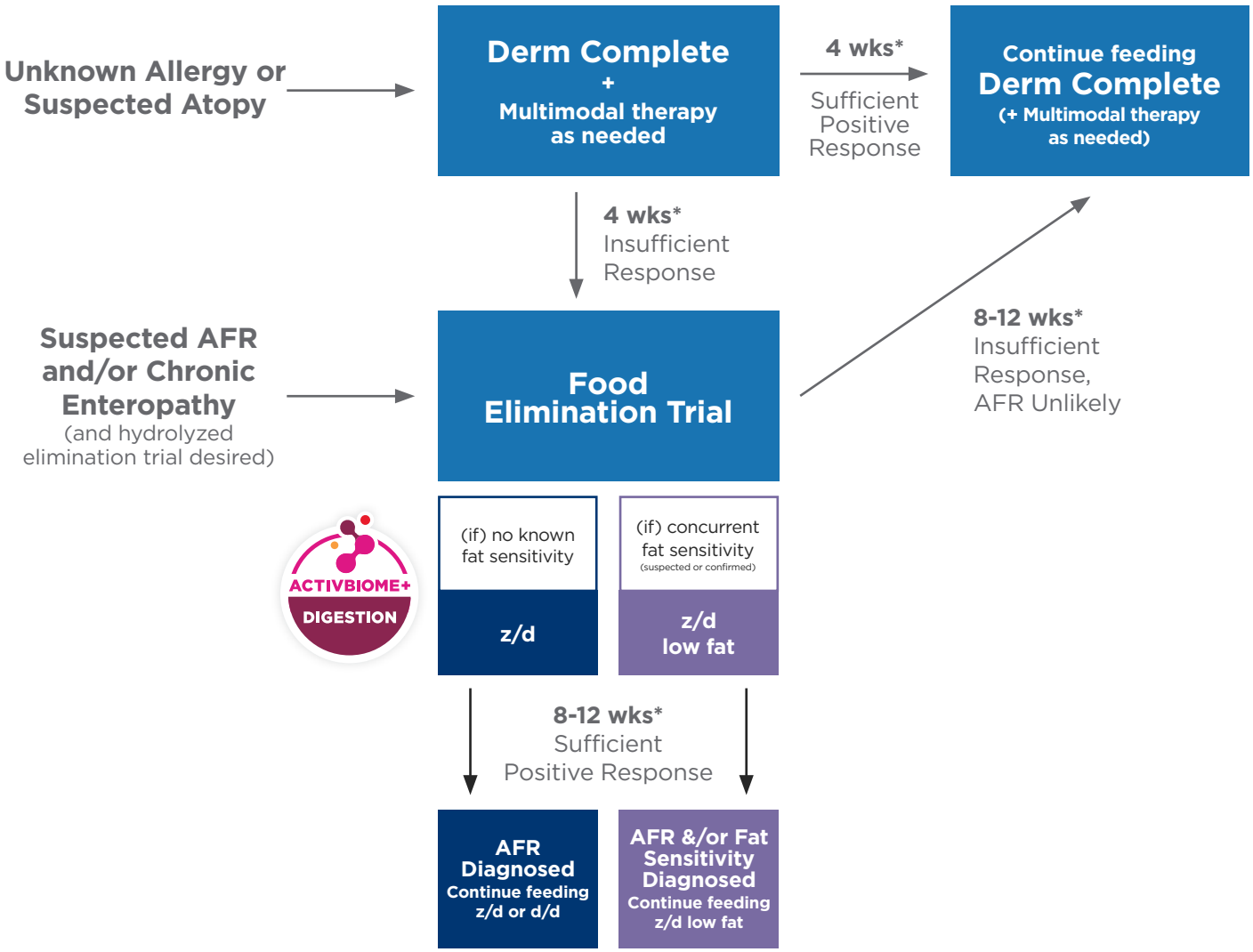
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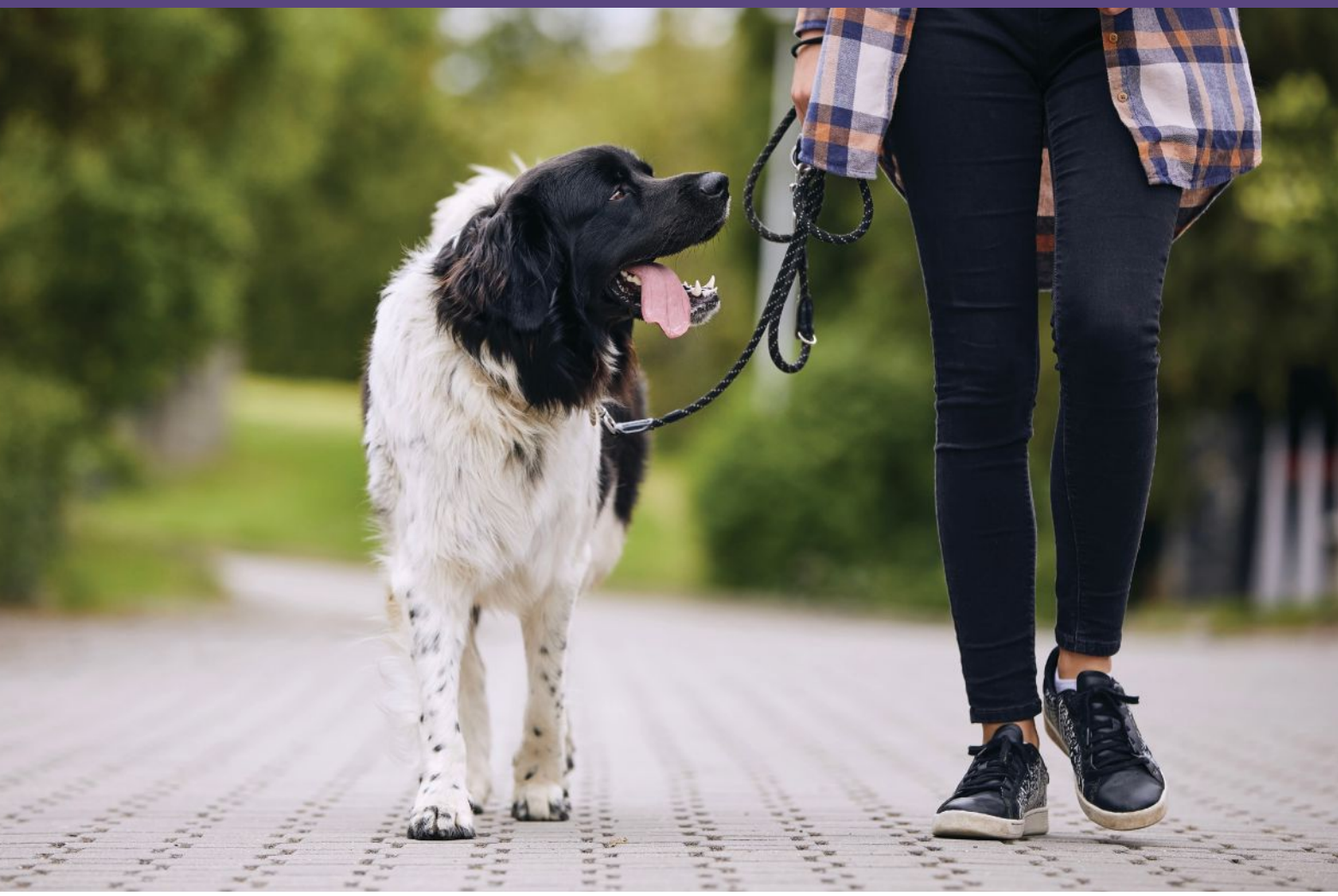
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NUTRITION CONVERSATIONS

How Exercise Fits With Nutrition in a Weight-Management Plan

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Abstract

Obesity is a complex chronic medical condition that needs to be managed throughout the life of the individual patient. All elements of a weight-management plan—nutrition, behavior, and exercise—should be discussed with the client. Exercise is a crucial part of this plan and should be tailored to meet the needs of the patient and the client.

Take-Home Points

- A weight-management plan should encompass nutrition, behavior, and exercise regimens.
- Exercise is a vital element for mental wellbeing in pets, and its role in weight loss helps with the balance of energy intake to energy expenditure.
- As with nutrition, exercise plans need to be individualized for each patient.

Exercise is an essential part of a weight-loss program for animals that are overweight or obese. When possible, as soon as a patient is identified as being over their ideal body condition score, veterinary practices should recommend that all overweight and obese patients are referred to the veterinary nurse for weight clinics. To achieve weight loss, an animal needs to be in a negative energy balance before it will use energy stored within the body, which can be achieved by reducing calorie intake and/or increasing energy expenditure.

Initial weight gain can begin with an imbalance between energy consumption (food intake) and expenditure (exercise), along with other factors that alter metabolism (e.g., breed, reproductive status, health status). Obesity usually results from either excessive food intake or inadequate energy expenditure, which causes a state of positive energy balance.[1] One study found clear evidence that obesity in dogs is affected by the interrelationships between food management, social factors, and exercise.[2] A similar study also found links between obesity and exercise, social factors, and owner education.[3] Weight-management discussions with clients should cover all of these factors to help the veterinary nurse make the most appropriate recommendations.

Exercise burns calories to maintain a higher level of metabolism, tone muscle, and preserve lean muscle mass and sometimes helps behavior responses (such as begging) that occur when a dog's food intake is restricted. However, exercise burns fewer calories than one might think; an average-size woman running at an average pace will burn 100 calories per mile. If she ran a 5K (3.1-mile) run, she would burn just over 300 calories, fewer than a bowl of most breakfast cereals with semi-skimmed milk.

It is also known that additional physical activity can lead to increased hunger and a subsequent increase in food intake. If increased exercise can cause increased energy intake but not burn as many calories as expected, what are the benefits of exercising? The benefits of exercising include:

- Preventing loss of lean body mass (sarcopenia) that can occur from dieting and/or aging
- Burning calories, especially via strength training and cardiovascular workouts
- Changing body composition, which helps shape (tone) the body and maintain health
- Strengthening bones, connective tissue, and muscles
- Improving coordination and balance and possibly helping prevent injuries by improving core strength, which is relevant for animals with limited mobility

In research on dogs, increased physical activity has been associated with higher energy intake if allowed, but maintaining weight-loss goals was possible if dietary intake was controlled.[4] Each 1000-step interval by a dog was associated with a 1-kcal/kg body weight$^{(0.75)}$ increase in energy intake.[4] Thus, the balance of energy intake and energy expenditure matters. Exercising animals being fed a restricted diet will help prevent loss of lean body mass and improve overall body condition and composition. Increased protein quality and intake combined with reduced calorie intake facilitates loss of body fat while minimizing loss of lean body mass. Limiting treats to 10% of calorie intake and increasing exercise aid in successful body weight management.[5]

This article discusses the roles of both nutrition and exercise in weight-management programs. In communicating with clients, drawing similarities between human and veterinary medicine can help them better understand their pet's situation. Some clients are more capable than others of limiting their pet's food intake successfully at home, but having an external source of motivation helps the weight-loss journey.

THE ROLE OF NUTRITION

Most clients do not weigh the amount of food they feed, and therefore it is difficult to know whether the pet is being overfed. Many commercial diets are available to aid in decreased calorie intake, usually through decreased energy density, and contain instructions on the proper amounts to feed. Nutrigenomics (the study of the relationship between the genome, nutrition, and health) has identified that specific nutrients can aid in weight loss.[6] Nutrition in the proper form can alter genetic expression, enabling overweight dogs to lose weight by changing their basic metabolism.[6] In addition, the correct specific nutrition can also be used to improve joint health and treat degenerative joint disease, such as arthritis, in dogs, which may enable the dog to be more active.

Among people, weight loss is most commonly attempted by dieting. As food intake is limited, the body adapts to using the calories consumed, which explains the plateau hit by people when they diet: the body has adapted to the lower calorie intake and reduced the metabolic rate. After each period of dieting, the body becomes better at working with reduced calories. Because of resultant metabolic changes, repetitive dieting becomes more and more difficult each time. Thus, the more often a person goes on a diet, the harder it becomes, which is a good point to convey to clients because the same metabolic changes have been documented for dogs.[7] If clients change their pet's food to a weight-loss diet, it is best to do it only a single time, achieve the pet's target weight, and then help the pet maintain the ideal weight. If not done well the first time, the second time will be harder, as will the third and the fourth and so on.

THE ROLE OF EXERCISE

Research has shown that energy expenditure in dogs and humans does not return to pre-exercise resting baseline levels immediately after exercise.[8,9] The amount of postexercise energy expenditure elevation depends primarily on exercise intensity and, to a lesser degree, exercise duration.

For humans, exercise at the intensity and duration commonly performed by recreational exercisers (e.g., walking for 30 to 60 minutes, running at a pace of 8 to 10 minutes per mile for 20 to 30 minutes) typically brings the energy expenditure to baseline within the first hour of recovery.[8,10] The postexercise calorie bonus for this type of exercise probably accounts for only about 10 to 30 additional calories burned. In human athletes performing high-intensity, long-duration exercise, the postexercise energy expenditure may remain elevated for a longer period and could contribute significantly to total calories burned daily. Whereas this is also true for dogs, the number of calories burned is negligible; exercise does, however, enable the metabolism to remain higher while a limited amount of food is being eaten. Thus, exercise is still an integral part of the weight-loss program.

Many clients have no idea how far they walk their dog each day. Not all tracks and trails have signs indicating their length. Recommending that clients use a pedometer or a phone app that can track their routes may help them measure the distances covered. To calculate by hand, the average walking pace for most adults is 3 miles per hour; a fit and healthy person walking fast will cover on average 4 miles per hour.

EVALUATING THE PATIENT'S ABILITY TO EXERCISE

Exercise can be difficult for both the dog and the owner. Reasons include inappropriate behavior when the dog is outside, health problems, and/or limited mobility.

Helping clients adhere to follow-up visits, deal with the dog pulling on the lead, and/or resolve socialization problems can in turn encourage them to exercise their dog more often and therefore help with weight loss. Referral to a dog trainer or behaviorist may be beneficial. It is also recommended that clients keep an exercise diary of the amount of daily exercise.

Health problems can lead to pain, meaning the dog is either unwilling to exercise or exercise is contraindicated altogether. For some clients, veterinary nurses might need to explain that the pet's limping, slowing down, and mobility issues are not necessarily just signs of "getting old" but may be signs of pain/discomfort and that different medications, multimodal approaches, and reassessment may be needed.

Before an overweight/obese patient begins an exercise regimen, evaluate their discomfort level. Monitoring and measurement resources such as mobility scoring, chronic pain scoring, and quality-of-life scoring can be used (**BOX 1**). If there is concern surrounding pain and quality of life, refer the patient back to the veterinarian responsible for the case. Use the appropriate pain scales

to differentiate between acute and chronic pain. Grimace scales for cats are useful for determining acute pain but potentially not suitable for chronic pain.

CLIENT CONVERSATIONS

Understanding the complex relationships between food intake, social behavior, and exercise is helpful when devising weight-management programs for dogs and cats and discussing them with clients. The following scenarios offer communication tips for some of the more common client concerns.

Client concern: Life is very busy and I don't have the time for increasing Bruno's exercise regimen.

- **Possible response:** Let's try reducing the length of time of each exercise session but increasing session frequency. So rather than a 1-hour walk, try two 30-minute walks. Bruno may burn more calories if the daily exercise is divided into 2 sessions instead of 1, even if the overall time spent walking is the same.
- **Rationale:** Consider first asking the client if they are open to changing their walking routine to improve their dog's metabolism and how they envision working exercise into their schedule. Most clients cannot argue against twice-daily 30-minute walks rather than a single 1-hour walk, and most may even be able to extend each of the shorter walks to 35 minutes.

Client concern: I have mobility issues and can't increase exercise levels or afford a dog walker for Cleo.

- **Possible response:** Are you open to different types of play for Cleo? Exercise doesn't have to be walking. We can try a form of scatter feeding, which uses kibble from her own daily ration to help get her moving. While sitting, you can throw a kibble to one side of the room and the next to the other side. Another option is providing puzzle feeders so Cleo can work at getting the food out herself without needing your active participation.
- **Rationale:** With scatter feeding, Cleo will still get food from the client without increasing her daily food intake but will be moving more. Give solutions and compromises, focusing on activities that are achievable by the client and taking into consideration their home lives, schedules, and limitations.

Client concern: Fluffy has mobility issues and can't exercise much.

- **Possible response:** Let's see what types of exercise would be appropriate for Fluffy to help her get moving around a bit more. Just getting a tiny bit of the weight off will really help Fluffy's quality of life and mobility. Are there any types of play she likes to do on her own? For example, with a puzzle feeder, she can move as little or as much and as fast or slow as she would like. Little and often are much better than nothing for Fluffy.
- **Rationale:** Before recommending an activity, take the patient's mobility limitations into consideration, not forcing the patient to do more than they should. For Fluffy, it was determined that exercise might be helpful and not harmful for her.

BOX 1

Pain and Quality-of-Life Scales for Dogs and Cats

Dogs

- **Mobility and Chronic Pain**
  - Liverpool Osteoarthritis in Dogs (LOAD) go.navc.com/42NtTu5
  - Helsinki Chronic Pain Index (HCPI) go.navc.com/42PiRoj
- **Quality of Life**
  - Hurt, Hunger, Hydration, Hygiene, Happiness, Mobility and More Good Days Than Bad (HHHHHMM) go.navc.com/3RQivYa

Cats

- **Mobility and Chronic Pain**
  - Feline Musculoskeletal Pain Index (FMPI) go.navc.com/44nWsQ2
  - Musculoskeletal Pain Screening Checklist (MiPSC) go.navc.com/3GJxmRU
- **Quality of Life**
  - Hurt, Hunger, Hydration, Hygiene, Happiness, Mobility and More Good Days Than Bad (HHHHHMM) go.navc.com/3RQivYa

SUMMARY

A complete weight-management plan typically consists of nutrition, behavior, and exercise. The nutrition component typically focuses on decreasing calorie intake, altering basic metabolism, and improving joint health. Exercise works with the reduced calorie intake by increasing energy expenditure to achieve a negative energy balance. However, before the patient begins an

exercise program, ensure that exercise is not contraindicated due to an acute health condition or pain. TVN

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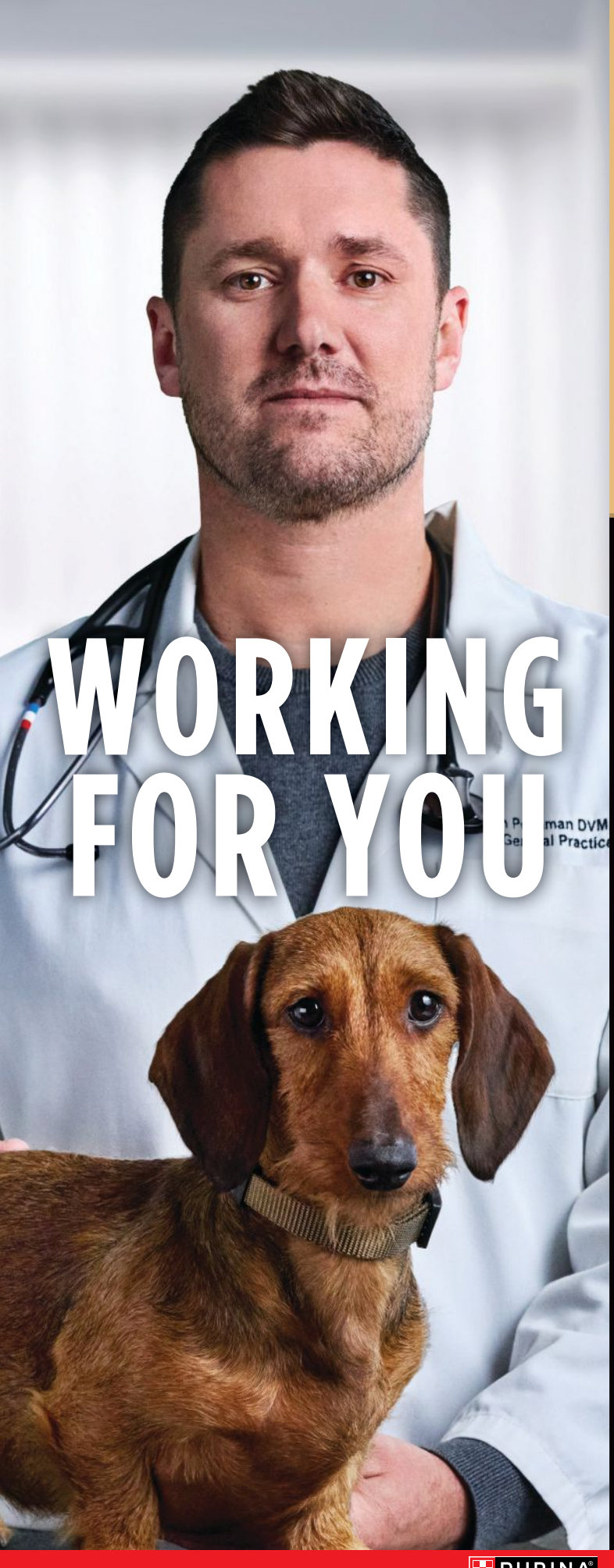
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IN YOUR REGION: PARASITOLOGY

The Western United States

***Elizabeth Kowalski**, CVT, FFCP*
Sycamore, Illinois

The western United States has various landscapes, including deserts, mountains, and coastlines, each boasting a different climate. Many of North America's most common pet parasites thrive in warm, moist conditions, but a few have adapted to specific ecosystems in the West. Veterinary nurses in the West should familiarize themselves with their area's unique local parasite risks and those that occur throughout the region. Here is an overview of common parasites and key prevention strategies for pet owners in the western United States.

1. *GIARDIA*

Giardia is an intestinal protozoan parasite of dogs, cats, and other mammals, including humans. It is highly prevalent in the western region of the United States and may spread through contaminated water sources and surfaces and from pet to pet. In a retrospective analysis of fecal flotation and antigen tests from across the United States, dogs in the West had more positive *Giardia* test results than in any other U.S. region, with 13.5% testing positive. Positive *Giardia* test results from cats were similar to those in other U.S. regions at 6.1%.[1,2]

Key prevention strategies include[3]:

- Maintaining proper hygiene and hand-washing
- Bathing infected pets after treatment with metronidazole, fenbendazole, or Drontal Plus (Elanco, elanco.com/us) to prevent reinfection
- Removing fecal waste
- Cleaning contaminated surfaces immediately

2. TICKS

The Western black-legged tick, *Ixodes pacificus*, is a primary vector for Lyme disease and anaplasmosis in the West. *Ixodes* species ticks are a threat to pet health year-round.[4] The Rocky Mountain wood tick, *Dermacentor andersoni*, thrives at high elevations and may lead to Rocky Mountain spotted fever in dogs or tularemia in dogs and cats, either directly or through contact with infected prey animals.[5,6]

Key prevention strategies include[5]:

- Administering species-appropriate tick preventives (e.g., fipronil, amitraz, isoxazolines, pyrethroids) year-round
- Avoiding grassy or wooded areas that harbor ticks and cleaning up leaf litter around the yard
- Checking pets after outdoor excursions and removing ticks immediately

3. FLEAS

The coastal West supports cat flea populations, but *Ctenocephalides felis* is uncommon in arid regions. In these areas, the rat flea, *Xenopsylla cheopis*, thrives. Rat fleas can transmit pathogens that lead to serious diseases in pets and people, including bubonic plague (*Yersinia pestis)*. Fleas are also well known for their ability to cause flea allergy dermatitis and transmit tapeworms.[7]

Key prevention strategies include[7]:

- Administering oral or topical flea preventives containing adulticides (e.g., imidacloprid, fipronil, spinosad, isoxazolines) or insect growth regulators (e.g., lufenuron) year-round

- Laundering bedding and vacuuming frequently if a pet has been exposed to fleas
- Controlling rodent populations near and around the home to reduce rat fleas

4. HEARTWORMS

Heartworm disease, caused by *Dirofilaria immitis*, is not as common in states that have a dry climate, as this type of climate does not support mosquitoes. However, pets in coastal states, such as California or Oregon, are at greater risk of contracting heartworms. Additionally, changing weather patterns and increased pet travel have made it challenging to predict heartworm trends. Regardless of historical patterns, heartworm disease has been reported in pets in all 50 states.[8]

Key prevention strategies include[8]:

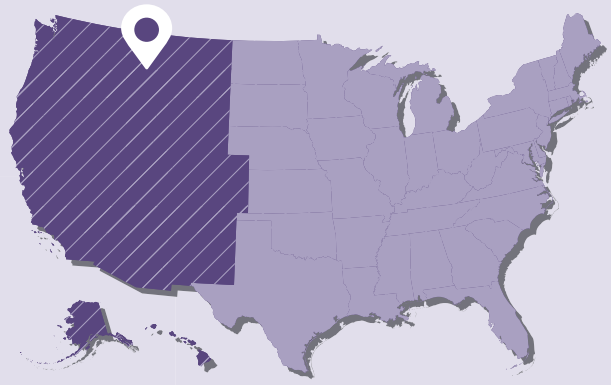
- Administering heartworm preventives (e.g., ivermectin, milbemycin oxime, selamectin, moxidectin) year-round
- Performing heartworm antigen testing at least once per year for all dogs

5. ROUNDWORMS

Although *Giardia* is by far the most prevalent intestinal parasite of pets in the West, retrospective analyses of fecal flotation and antigen tests show an ascarid (e.g., *Toxocara* species) positivity rate of 2.3% in dogs of this region.[1] According to the CAPC, transplacental transmission is a common route of infection in puppies, although dogs of all ages are at risk. Additionally, infective roundworm larvae can cause visceral larval migrans in children.[9]

Key prevention strategies include[9]:

- Deworming puppies beginning at 2 weeks of age
- Administering heartworm prevention containing ascaricides (e.g., pyrantel pamoate, milbemycin oxime, moxidectin)
- Checking fecal flotation tests at least 4 times during a puppy's first year, then twice yearly for adults. TVN



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SCAN THE QR CODE
Download a handout you can share with clients to educate them on the top parasites of concern in your region.

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Topic Overview

Cancer is a leading cause of morbidity and mortality in companion animals. This complex disease comprises a multitude of neoplasms, each of which behaves differently. For many patients, a successful outcome requires multiple modalities. Knowing how treatment modalities work and their associated adverse effects requires an understanding of how cancer develops and thrives, which empowers veterinary nurses with the information they need to further support cancer patients and clients.

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ONCOLOGY

Cancer: How It Happens and How It Is Treated

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The word "cancer" ignites fear in many, presumably because of how common it has become among all species as well as its overwhelming complexity that has challenged humans' ability to understand and cure it. Cancer is not a single disease, but many; the only commonality among cancers is how they originate.[1]

THE ORIGIN OF CANCER

Cancer is generally accepted as a genetic disease that is manifested after a series of events within the body that leads to uncontrolled cell growth. Cancer does not discriminate against any species, breed, age, or anatomic site. As written by Drs. Modiano and Hyuk Kim, "It can be said that simply being alive is the single largest risk factor for cancer."[2]

Genetic Mutation of Specific Genes

When a cell divides, the daughter cell is likely to contain a few hundred to a few thousand genetic mutations.[2] Most mutations, regardless of their cause, are unlikely to cause a problem for the host. However, ongoing research has shown that over 400 mutations are associated with an increased risk for cancer.[3] These mutations affect 2 classes of genes: proto-oncogenes and tumor-suppressor genes. Proto-oncogenes are responsible for normal cell growth and proliferation, and tumor-suppressor genes are responsible for controlling the rate of growth. When functioning normally, the 2 types of genes act as a checks-and-balances system: proto-oncogenes promoting growth and tumor-suppressor genes regulating the growth so it does not get out of control. A mutation in one of these classes of genes is not enough to set the stage for cancer; a mutation of both is needed. With mutations in both, proto-oncogenes can lead to

Learning Objectives

- All forms of cancer originate from uncontrolled cell growth, which is initiated by an accumulation of genetic mutations.
- Each type of cancer requires a different treatment approach based on the unique behavior of the specific neoplasm.
- Most cancer types will require a combination of treatment modalities, most commonly including surgery, chemotherapy, and radiation therapy.
- Understanding cancer treatment adverse effects will help veterinary nurses intervene early and provide optimal patient care.

out-of-control growth and tumor-suppressor genes can fail to limit cell growth.

A logical subsequent question is, what causes the mutations? They can be caused by intrinsic or extrinsic factors. Possible extrinsic causes include environmental exposures such as ultraviolet radiation from the sun, tobacco smoke, asbestos, pesticides/herbicides/insecticides, or infectious diseases. Other extrinsic causes have been reported, and others likely remain unknown. Possible intrinsic factors include inherited mutations, hormones that influence processes that can cause mutations, or random errors in DNA replication.[2] Inherited mutations are likely to play a part in cancer types that have a breed predilection. For example, the increased risk for mast cell tumors among boxers suggests that heritable factors could contribute to cancer development. Hormonal carcinogenesis is associated with mammary cancer in dogs, and risk for mammary cancer is greatly reduced in dogs spayed before first estrus; however, research has also shown that risk for several other cancer types may be reduced in reproductively intact animals.[2] Regardless of the origin of the mutations, they will accumulate with time, which explains why cancer risk increases with age. Mutations in proto-oncogenes give cells the capability to sustain proliferative signaling, and the mutations in tumor-suppressor genes deactivate antigrowth signals.[2] Together, these mutations make up the first 2 hallmarks of cancer.

Hallmarks of Cancer

A review of 40 years of research indicated that cancer has 10 essential characteristics, the hallmarks of cancer.[2]

- **Sustained proliferative signaling (proto-oncogene) and evasion of growth suppressors (tumor-suppressor gene mutations)**. These characteristics set the stage for cancer, but they do not act alone.
- **Apoptosis resistance.** The term "apoptosis" means programmed cell death, which is the imprinted outcome for every cell in the body. Apoptosis is a natural process as cells age or become damaged. For cancer to progress, the ability to resist apoptosis is necessary.
- **Replicative immortality.** Healthy cells are programmed with a set limit on how many times they can divide. Tumor cells, however, must have replicative immortality, which enables the cell to replicate without limit.
- **Angiogenesis.** Angiogenesis describes the formation of new blood vessels. To be provided with oxygen and nutrients, tumor cells must be able to induce angiogenesis and use existing vasculature to form new vessels and promote survival.
- **Invasion and metastasis.** Tumor cells must also be able to invade local tissue and spread to distant sites. Although not completely understood, the invasion–metastasis cascade results from dissemination of cancer cells traveling largely through the blood and lymphatics and seeding various organs.[4]
- **Genomic instability and mutation.** Cancer cells acquire and maintain genetic alterations that support uncontrolled growth. During the chaotic process of rapid division, DNA replication is subject to increased errors, which provides fertile ground for the continuous evolution of cancer cells.
- **Tumor-promoting inflammation.** Inflammation is a natural response to injury or infection, activating immune cells to assist in the repair or recovery at the site of injury. For cancer cells, this process leads to nutrient provision, angiogenesis, oxygen, and DNA damage, which further promote cancer development.
- **Deregulation of cellular energetics (properties of energy).** Because of the high amount of energy required for rapid cell division, cancer cells need to alter their metabolism in a way that promotes survival, which is accomplished by deregulating cellular energetics. Cancer cells need to be efficient glucose scavengers and adapt to situations in which glucose is limited (e.g., hypoxic tumors).
- **Avoidance of immune destruction.** The immune system identifies and eliminates abnormal cells, including cancer cells. Survival of cancer cells relies on the ability to hide from or suppress the immune system.

Cancer cells use many complex pathways to achieve each of the hallmarks. Understanding these hallmarks has led to the creation of new therapies, often referred to as targeted therapies, which differ from traditional chemotherapy and will be discussed later in this article.

CANCER TREATMENT

The goals of therapy for veterinary patients differ from that for human patients due to differences in longevity and perception. Companion animals do not live nearly as long as humans and they "live in the moment," not recognizing that today's discomfort during treatment may lead to a longer life. Thus, in weighing the pros and cons of treatment for veterinary patients, the goal should focus on maximizing their quality of life more than extending their lifespan.

TABLE 1 Degrees of Excision in Surgical Oncology[5]

DEGREE OF EXCISION	DESCRIPTION	PURPOSE
Debulking	Visible tumor left behind	Biopsies, palliative
Marginal (narrow)	Microscopic disease left behind	Conservative approach, area not amendable to wide excision
Wide	2–4 mm of clean margins	Removal of visible tumor and reactive zone
Radical	Extensive clean borders	Aggressive surgery (e.g., amputation)

Surgery

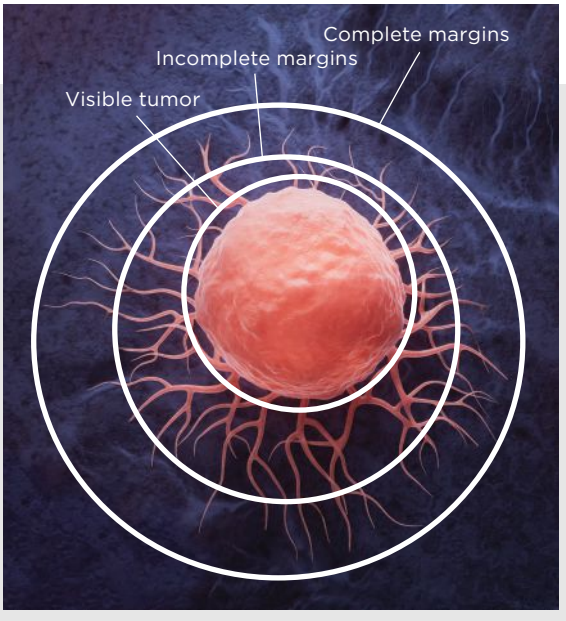
Surgery is a major part of cancer treatment. In dealing with nonhematopoietic (solid) tumors, the best chance of a cure is at the time of the first surgery. The degree of excision is considered debulking, marginal, wide, or radical (**TABLE 1**).[5] The goals of surgery are generally to remove the primary tumor with clean margins as well as any metastasis. Because biopsy samples do not necessarily represent the entire tumor, definitive diagnoses may also be obtained by surgery, in which case the primary goal of surgery should be obtaining an appropriate degree of excision.[6] However, using surgery to obtain a diagnosis may result in the surgeon being conservative and ultimately not obtaining clean margins, which can dramatically affect the patient's treatment response and outcome, especially with aggressive tumors.

Why is obtaining clean margins so important? The word "cancer" comes from the Latin word for "crab" because it resembles the shape of a crab with a body and finger-like projections, similar to legs. If the body of a tumor is removed while the legs are not, the tumor will usually recur (**FIGURE 1**).

Before and after surgery, veterinary nurses can assist surgeons by properly marking the tissue, preparing the samples for submission, and completing the report.

Tissue Demarcation

Tissue demarcation is the process of identifying the surgical margins by either applying surgical ink or placing sutures to help orient the sample in a manner that enables the pathologist to better assess the surgical margin.[7] Tissue should be marked before the sample is fixed as tissue can shrink after being put in formalin. Surgical inking is generally preferred by pathologists and surgeons because it is easy to apply and provides more detail for the pathologist. The process often requires only surgical ink and cotton-tipped applicators. The ink is easily identified both on gross examination of the sample as well as microscopically (**FIGURE 2**).



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FIGURE 1. Various surgical margins of a visible tumor.



FIGURE 2. Bladder mass with surgical ink applied to the margins.

Sample Preparation

Before neoplastic samples are submitted for histopathology, specimens should be placed in 10% neutral buffered formalin at a 1:10 ratio (tissue:formalin) no more than 30 minutes after excision.[7] Very small samples should be placed in a tissue cassette before being submersed in formalin (**FIGURE 3**). Oversized samples that cannot be easily shipped in formalin can be refrigerated and then shipped overnight with cooling materials. If additional guidance is needed, the receiving laboratory should be contacted.

Report Completion

The accuracy of the pathology report is critical for determining management and prognosis of the cancer patient. Providing adequate information will help the pathologist make an accurate diagnosis. A properly completed pathology request should provide patient signalment and a thorough history that includes lesion-specific information (e.g., anatomic information, growth rate), clinical and treatment history, and results of prior diagnostics performed on the mass.

Radiation Therapy

Radiation therapy is primarily administered by using a radiotherapy unit called a linear accelerator (**FIGURE 4**). These units are becoming increasingly common at specialty centers offering radiation therapy due to their greater flexibility for treating deep and superficial tumors. The intent of radiation therapy for cancer patients is often classified as either curative or palliative. Irradiation may also be used as adjuvant therapy (administered after the primary treatment) or neoadjuvant therapy (administered before the primary treatment) when combined with surgery[8] if the goal is to sterilize the margins to make complete excision more feasible (preoperative) or to address microscopic disease when the excision is incomplete (postoperative).

Radiation therapy is considered a cytotoxic (cell toxic) therapy for solid tumors and is rarely used as a sole modality, unless for palliative intent. In 90% of cases, radiation causes mitotic cell death by disrupting chromosome separation during cell division.[9] Disruption relies on oxygen free radicals; thus, the success of radiation therapy depends in part on the oxygen within the cells.[9] Normoxic cells are 3 times more sensitive to radiation than hypoxic cells.[10] Unfortunately, fast-growing tumors tend to be hypoxic due to their chaotic proliferation and inability to form adequate blood vessels; therefore, these tumors can be inherently radioresistant. However, for tumor types that are not overtly radioresistant, a higher mitotic rate tends to lead to a faster response to irradiation because the rate of tumor response is correlated with the rate of cell division (i.e., growth).

Radiation adverse effects are also correlated with the mitotic rate in the irradiated areas (**TABLE 2**). In tumor types and tissues with higher mitotic rates (e.g., oral mucosa, epithelial structures of the eye and skin), adverse effects are more acute, whereas in slower-proliferating tissues (e.g., bone, lung, nervous system),



FIGURE 3. Tissue cassette with small tissue sample.



FIGURE 4. A linear accelerator.

TABLE 2 Correlation of Radiation Response Rate and Adverse Effects According to Tumor Type

TUMOR TYPE	MITOTIC RATE	RESPONSE RATE	RADIATION ADVERSE EFFECTS
Epithelial	Generally high	Generally fast	Acute
Mesenchymal	Generally low	Generally slow	Late
Round cell	High	Rapid	Minimal/acute

adverse effects occur later.[8] Acute adverse effects after irradiation often include hair loss and moist desquamation (**FIGURE 5A**); other acute effects vary, depending on the site irradiated. Acute effects occur during and shortly after irradiation and do not tend to be life-limiting. Although they can be distressing to clients, acute effects can be adequately managed with multimodal analgesics (e.g., anti-inflammatories, gabapentinoids, *N*-methyl-D-aspartate antagonists), and most will resolve with time. Late adverse effects occur months to years after irradiation and can include bone/tissue necrosis and tissue fibrosis, which can be life-threatening (**FIGURE 5B**); however, appropriate irradiation planning and dosing can greatly reduce the risk.

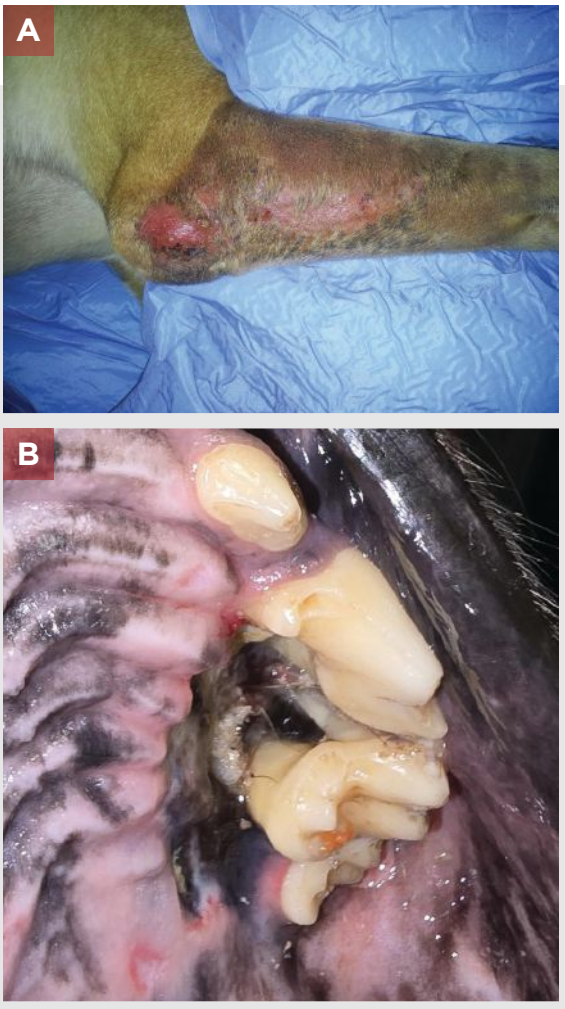


FIGURE 5. Radiation adverse effects. **(A)** Moist desquamation, an acute radiation adverse effect. **(B)** Oronasal fistula, a late radiation adverse effect.

Palliative irradiation protocols are used when the primary goal is to improve the quality of life of the patient rather than treat the cancer itself. Because the goal is to manage pain and improve patient comfort, the total radiation dose can be adjusted for most patients to minimize adverse effects.

To spare as much healthy tissue as possible from radiation, patients must be immobilized by general anesthesia during treatment. Patient positioning includes use of body molds and bite blocks to ensure that the patient's position is repeatable with each treatment (**FIGURE 6**), which also helps spare healthy tissue. Each radiation session is referred to as a fraction, with protocols ranging from 2 to 20 total fractions. Patient comorbidities should be considered when deciding whether repeated general anesthesia is clinically appropriate.



FIGURE 6. An anesthetized patient ready to undergo radiation therapy. The patient's positioning is repeatable with use of a bite block and body mold.

In the author's experience, GI adverse effects can cause major distress for the client, leading to discontinuation of therapy. A proactive approach to managing adverse effects along with client education on what to expect can be effective.

Chemotherapy

In the 1940s, cytotoxic drugs began being used for cancer treatment.[11] Drugs were very experimental at the time and often discovered accidentally. Although cancer treatment has advanced over the years, the chemotherapy drugs available are largely unchanged and focus on cytotoxicity to induce a response. Similar to radiation therapy, chemotherapy interferes with various parts of the cell cycle, depending on the drug. The interference leads to cell death, especially of rapidly dividing cells. Chemotherapy cannot distinguish between cancer cells and healthy cells; therefore, all rapidly dividing cells are affected, which is what leads to chemotherapy adverse effects. The most common adverse effects seen with chemotherapy include hair loss (resulting from the cell division rate associated with the cells of the skin, gastrointestinal [GI] tract, and bone marrow), GI upset, neutropenia, and thrombocytopenia.[11]

Hair loss (alopecia) is a cosmetic adverse effect of chemotherapy that may concern clients. It is more commonly noted in breeds with continuously growing coats but can be seen in any breed. Hair generally will grow back after treatment is discontinued, but the color or texture may change.

GI upset generally affects patients 2 to 5 days after chemotherapy administration and more commonly affects dogs than cats.[12] GI adverse effects are generally exhibited as decreased appetite, nausea, and/or diarrhea. A proactive approach to GI adverse effects, such as prophylactic administration of antiemetics (e.g., maropitant, ondansetron) and appetite stimulants (e.g., capromorelin, mirtazapine) and medical management of diarrhea the moment it occurs (e.g., probiotics, fiber supplementation, crofelemer), is highly recommended. In the author's experience, GI adverse effects can cause major distress for the client, leading to discontinuation of therapy. A proactive approach to managing adverse effects along with client education on what to expect can be effective.

Bone marrow suppression is primarily limited to neutrophils and platelets due to their shorter life cycle and rapid cell division. Thrombocytopenia is generally transient and not life-threatening; however, if thrombocytopenia is moderate to severe, chemotherapy delays may be needed. Neutropenia is the primary dose-limiting toxicity and (although rare) can be life-threatening due to the role that neutrophils play in fighting infection. Because bone marrow suppression itself, in the absence of a secondary infection, does not result in clinical signs, frequent laboratory work (e.g., CBC) is recommended during chemotherapy protocols, especially before administering chemotherapy, as well as the point at which the neutrophils reach their lowest (the nadir) after chemotherapy administration. Most commonly the neutrophil nadir is 7 days after treatment, although it can vary according to the drug used.[12] If the neutropenia is moderate to severe, antibiotics may be needed to protect the patient from a secondary infection. If a patient with neutropenia is febrile, hospitalization is recommended.[11]

The goals of chemotherapy vary and consist of adjuvant chemotherapy (given after surgery and/or radiation), neoadjuvant chemotherapy (given before surgery and/or radiation), induction chemotherapy (given to induce remission with chemotherapy alone), rescue chemotherapy (given after a relapse or lack of response), palliative chemotherapy (given to decrease clinical signs or slow progression), and radiosensitization chemotherapy (given to enhance the cytotoxicity of radiation therapy).

Veterinary nurses are often the team members administering chemotherapy to veterinary patients. Many chemotherapy drugs are either irritants or vesicants; therefore, the utmost caution and skill are required during intravenous catheter placement to avoid extravasation. Because administration considerations for each chemotherapy drug vary (**TABLE 3**), dedicated training associated with chemotherapy administration is necessary for the safety of the patient. Handling cytotoxic drugs also poses a risk for personnel. Research has shown that human

TABLE 3 Common Intravenous Chemotherapeutics and Considerations[11,13]

AGENT	ADMINISTRATION	TYPE OF AGENT	IF EXTRAVASATED
Vincristine	Bolus	Vesicant	Apply heat, dilute with hyaluronidase
Vinblastine	Bolus	Vesicant	Apply heat, dilute with hyaluronidase
Vinorelbine	5-minute infusion	Vesicant	Apply heat, dilute with hyaluronidase
Carboplatin	5- to 10-minute infusion		
Doxorubicin	15- to 30-minute infusion	Vesicant	Apply cold, neutralize with dexrazoxane administration

healthcare personnel working with hazardous drugs experience more reproductive difficulties, fetal loss, DNA changes, and cancer.[14-17] Before chemotherapy drugs are handled, safety mechanisms should be in place to minimize exposure (e.g., personal protective equipment, closed-system devices, needleless devices, a class II biological safety cabinet). For more information regarding chemotherapy safety for veterinary nurses, visit go.navc.com/48afSG6.

Targeted Therapies

Targeted therapies are drugs that focus on 1 or more of the hallmarks of cancer. In veterinary medicine, the only U.S. FDA-approved targeted therapy is toceranib phosphate (Palladia; Zoetis, zoetisus.com), which works by targeting the proliferative signaling found in dysregulated cancer cells. However, similar to the other therapies, the inability to distinguish between healthy cells and cancer cells can lead to adverse effects because rapidly dividing healthy cells also rely on the pathways that are being blocked.

Although not a true targeted therapy, NSAIDs are commonly used in oncologic treatment to target tumor-promoting inflammation as well as angiogenesis, both of which are hallmarks of cancer.

Immunotherapies

The ability to harness the immune system's ability to fight cancer is a newly advancing area of veterinary oncology that is often used in human oncology. Immunotherapies work through a variety of mechanisms and include cancer vaccines, checkpoint inhibitors, adoptive T-cell therapies, and others.[18] Currently, there are only 2 immunotherapeutic agents on the market for dogs:

- Oncept vaccine (Boehringer Ingelheim, bi-animalhealth.com), used for stage II or III canine oral melanomas
- Gilvetmab (Merck, merck-animal-health-usa.com), used for stage II or III canine melanomas and stage I to III canine mast cell tumors

Many clinical trials and research efforts are ongoing, which may lead to future treatment options.

SUMMARY

Although cancer has been around as long as humans have existed, minimal progress has been made in finding a cure. However, both human and veterinary oncologists continue to advance our understanding of the disease and surge forward in the efforts to find new treatments and better manage cancer patients. Ethically, managing veterinary cancer patients should prioritize quality over quantity of life, which can be challenging for clients. Veterinary nurses play a key role in not only the management of oncology patients but also the support of clients through education and quality-of-life discussions. Understanding the etiology of cancer and the various treatments available will support veterinary nurses in the oncology setting. TVN

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Jaclyn P. Christensen



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- Free registration is required.
- Questions and answers online may differ from those below.
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1. **What classification of genes, when mutated, can contribute to cancer development?**
   a. Duplicate genes
   b. Tumor-suppressor genes
   c. Proto-oncogenes
   d. B and C

2. **Which of the following is *not* a hallmark of cancer?**
   a. Resisting cell death
   b. Tumor-promoting inflammation
   c. Sustaining oxygen free radicals
   d. Avoiding immune destruction

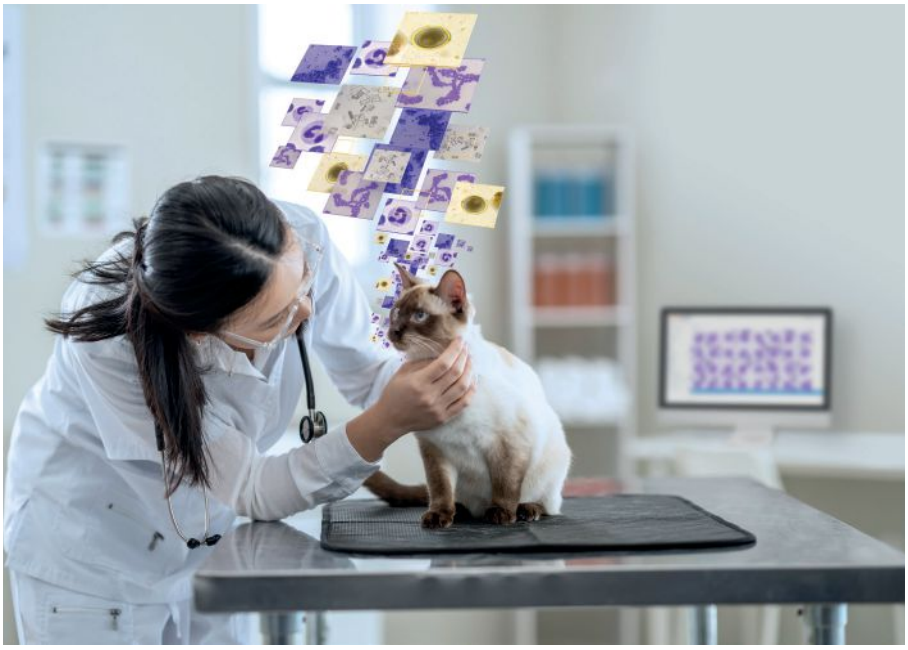
3. **Which of the following statements is false?**
   a. The body of the tumor is generally the most aggressive part of the tumor.
   b. Tumor demarcation can assist pathologists.
   c. Gastrointestinal adverse effects generally occur 2 to 5 days after chemotherapy administration.
   d. The primary goal of palliative radiation therapy is to improve the patient's quality of life.

4. **Targeted drugs are intended to treat:**
   a. Specific breeds or species
   b. Specific diseases or conditions
   c. One of the hallmarks or pathways of cancer
   d. Chromosomal aberrations

5. **Which of the following is true about the late adverse effects of radiation therapy?**
   a. They can occur months to years following radiation therapy.
   b. They could include tissue fibrosis or necrosis.
   c. They can be life-threatening.
   d. All of the above

Supporting Veterinary Nurses Who Perform Cytology with AI

BY **CORY PENN**, DVM, HEAD OF VETSCAN IMAGYST, IMMUNOASSAY, AND VIRTUAL LABORATORY–ZOETIS GLOBAL DIAGNOSTICS



Veterinary nurses play an essential and increasingly influential role in modern veterinary practice, particularly in diagnostics and patient care. As their responsibilities grow, so does the need for tools that support their expanding scope, especially in areas like cytology, where timely and accurate interpretation is critical.

Cytology, the microscopic examination of cells, is a powerful diagnostic tool used to evaluate masses, lymph nodes, and body fluids. While veterinary nurses are highly skilled in sample collection and preparation, cytological interpretation can be complex, especially in fast-paced clinical settings where immediate access to a pathologist may not always be available. In these situations, having timely, in-clinic support tools can enhance confidence and efficiency, helping nurses contribute even more effectively to diagnostic workflows[1].

This is where Zoetis' Vetscan Imagyst® can offer support. With artificial intelligence (AI) powered analysis backed by Add-On Expert Review*, this innovative platform combines advanced imaging with AI to deliver fast, accurate[2,3], in-clinic cytology analysis. Its latest capability, AI Masses, is designed to assist veterinary teams, including nurses, in screening lymph node and skin/subcutaneous lesions in minutes.

By integrating AI into the diagnostic workflow, Vetscan Imagyst® can empower nurses to support communication, client education, and the implementation of clinical decisions made by the veterinary team, enhancing both efficiency and patient care.



CASE STUDY: MEET SOPHIE**

Consider the case of Sophie, a 1.5-year-old Golden Retriever mix. While petting her, Sophie's owner noticed a small, hairless growth on her right elbow. Sophie was otherwise healthy, with no underlying conditions or medications.

During her clinical exam, Sophie presented as bright, alert, and responsive. Her vitals were normal, and the only notable finding was a 1 cm raised mass on her elbow. To investigate further, the veterinary team performed a fine-needle aspiration (FNA) of the mass.

Using the Vetscan Imagyst® platform, the sample was prepared and scanned in-clinic. The AI Masses application analyzed the slide and suggested the lesion was consistent with a histiocytoma, a benign tumor commonly seen in young dogs. This rapid, AI-assisted result allowed the team to reassure Sophie's owner immediately and avoid unnecessary stress, delays or referrals.

Why AI innovation matters to veterinary nurses

AI tools like Vetscan Imagyst are altering the way veterinary nurses interact with diagnostics. Here's how:

- Empowering Diagnostic Confidence: With AI support, nurses can take a more active role in cytology, from sample preparation to preliminary interpretation. This not only boosts confidence but also fosters a deeper understanding of pathology.
- Reducing Turnaround Time: Traditional cytology involves sending samples to external labs, which can lead to delays in diagnosis and treatment. AI Masses delivers results in minutes[2,3], enabling same-day clinical decisions and helping to improve patient outcomes.
- Enhancing Client Communication: Visual, AI-generated results help nurses explain findings to pet owners more clearly. This transparency builds trust and encourages compliance with treatment recommendations.
- Supporting Professional Growth: Access to cutting-edge diagnostic tools encourages continuous learning. Nurses can deepen their cytology skills and stay engaged in their professional development, especially when paired with continuing education opportunities.

Learn More

Veterinary nurses interested in exploring Vetscan Imagyst® can access a range of resources designed to help veterinary professionals confidently and effectively integrate AI into their workflow.

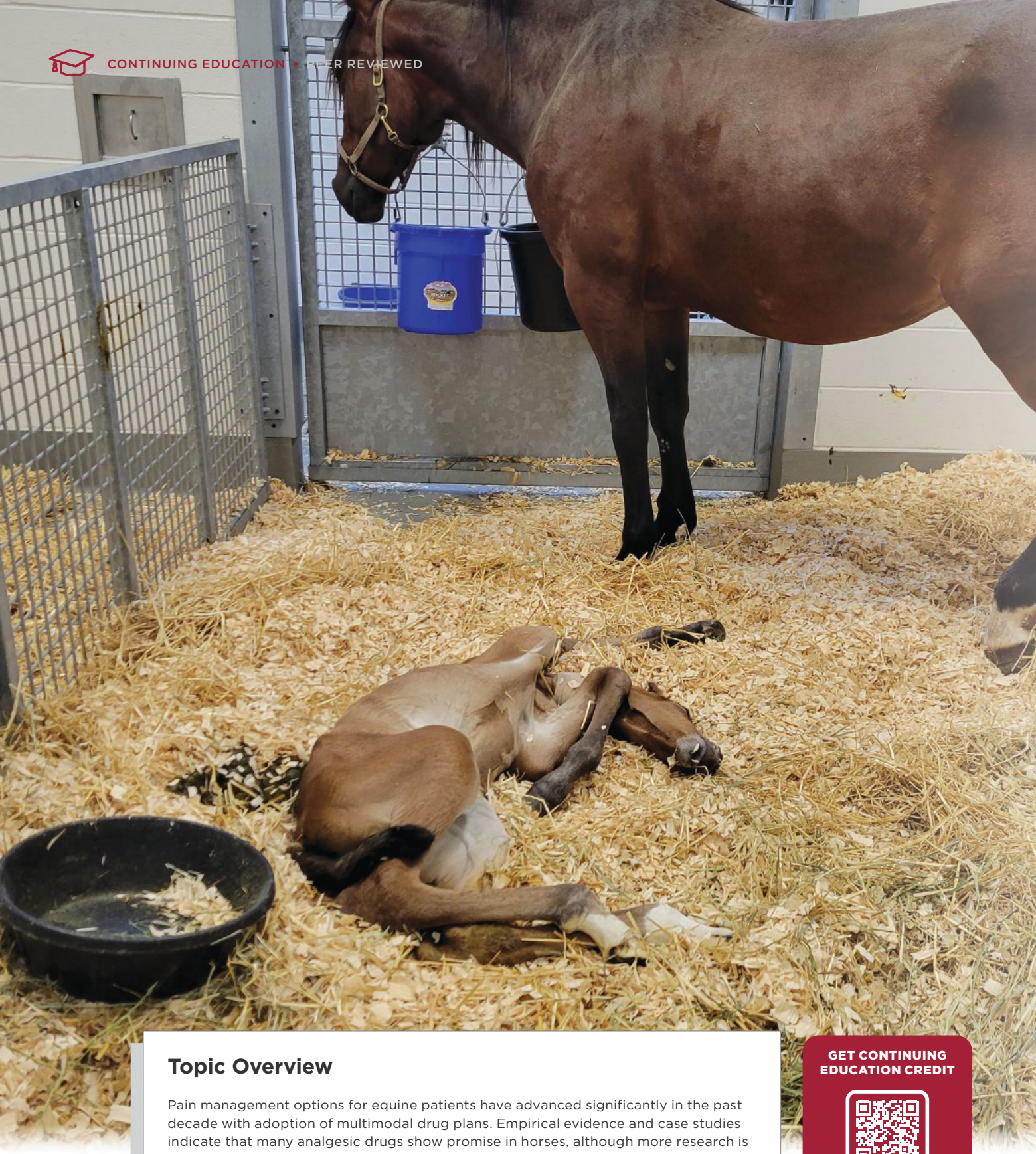
To request a demo or learn more about how Vetscan Imagyst® can support your practice, visit **https://www.zoetisdiagnostics.com/us/point-of-care/vetscan-imagyst/** or contact your Zoetis representative.

As veterinary medicine continues to evolve, so too must the tools that support those on the front lines of care. By integrating AI into cytology, Vetscan Imagyst® not only helps enhance diagnostic accuracy[2,3] but also uplifts the role of veterinary nurses, ensuring they remain empowered, informed, and indispensable members of the clinical team.

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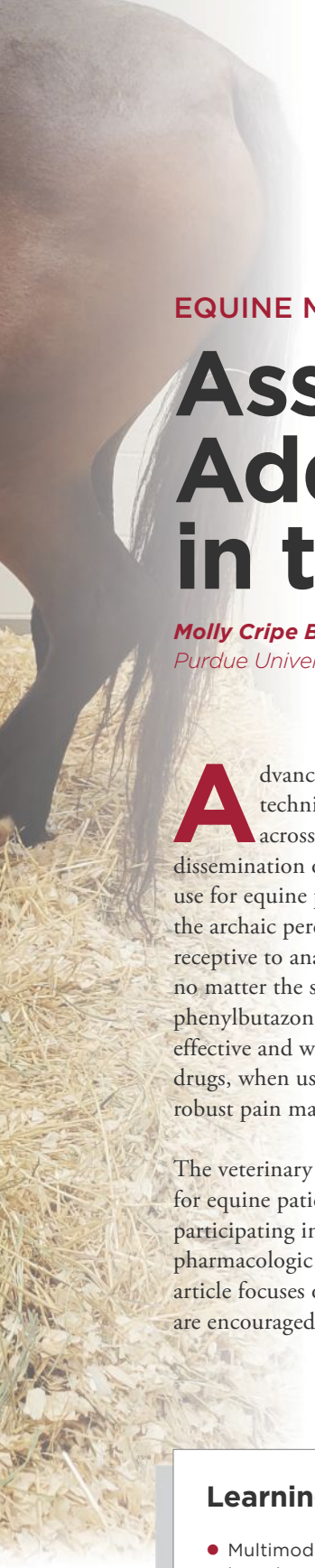


Topic Overview

Pain management options for equine patients have advanced significantly in the past decade with adoption of multimodal drug plans. Empirical evidence and case studies indicate that many analgesic drugs show promise in horses, although more research is needed to verify efficacy. The veterinary nurse plays a vital role in identifying equine pain behaviors through physical examination and rigorous monitoring, communicating with the attending veterinarian, advocating for additional analgesic medications, and implementing the pain management plan. This article details how to assess pain in the equine patient and gives an overview of several established analgesic options as well as nonpharmaceutical therapies.

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EQUINE MEDICINE

Assessing and Addressing Pain in the Equine Patient

Molly Cripe Birt, *BS, RVT, VTS-EVN*
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Advancements in pain management techniques have improved exponentially across all species; however, the dissemination of updates in multimodal analgesic use for equine patients is still incomplete. Despite the archaic perception that livestock are less receptive to analgesic medicine, analgesia is ethical no matter the species. While the NSAIDs phenylbutazone and flunixin meglumine are effective and widely used in equine patients, other drugs, when used adjunctly, can provide more robust pain management.

The veterinary nurse remains a frontline advocate for equine patients by assessing pain and participating in the implementation of pharmacologic and nursing management. This article focuses on the acutely painful horse; readers are encouraged to explore updates in anesthesia and analgesia specific to patients undergoing a surgical procedure.

IMPORTANCE OF PAIN MANAGEMENT IN HORSES

When a horse is injured, inflammatory mediators are released from the damaged cells and transmit signals from the site of injury to the brain. In response, the brain initiates a cascade of physiologic responses. The sympathetic response triggers vasoconstriction, an increase in myocardial work and oxygen consumption, and a catabolic state. Entering a catabolic state causes hypomotility of the gut, sodium and potassium imbalances, and muscle wasting.[1] Hyperglycemia and insulin resistance may also result. These responses increase the risk of infection, slow healing, and increase morbidity. Psychologically, the fight-or-flight response to injury can cause

Learning Objectives

- Multimodal analgesic options have become more accepted in treating pain in equine patients.
- More data have emerged to support the use of opioids, constant-rate infusions, gabapentin, local anesthetic blocks, and combination therapies in equine patients.
- While NSAIDs remain standard analgesics, and the use of multimodal analgesia is available, basic husbandry also provides pain and stress relief in horses.

hyperalgesia (increased perception of pain) and stress, which can cause delayed healing and negative behaviors. An effective analgesic plan can reduce the negative physiologic impact of pain and stress for patients, the length of time a patient is hospitalized, and client expenses and stress.

PAIN ASSESSMENT

Use of validated pain assessment scales, critical observation of patient behavior and attitude, and a thorough physical examination all provide essential information about patient comfort. Veterinary nurses should communicate their findings clearly and accurately to the attending veterinarian.

Equine Pain Assessment Tools

Use of emotional or casual language in describing signs of pain can be confusing. While multiple subjective and objective pain grading scales have been developed and validated to enable the veterinary team to consistently identify and describe subtle changes in equine facial expressions and body posture due to common causes of pain, there is no single comprehensive grading scale at this time.[2] Therefore, the veterinary team should choose a scale—such as the American Association of Equine Practitioners Lameness Scale (**TABLE 1**) or the Obel Laminitis Pain Scale (**TABLE 2**)—that meets their practice's needs or create a scale that incorporates aspects from other scales. Whichever scale is implemented, it must keep patient assessment unbiased and be used consistently, and staff must be trained on its use to reduce confusion.

The Horse Grimace Scale (HGS) is a powerful tool for the veterinary nurse when used alongside commonsense observations of equine behavior, physiologic changes, or other practical pain scales (**RESOURCE 1**). It is based on 6 facial expressions: ear position, orbital tightening, tension above the eyes, tension of the chewing muscles, strain on the mouth, and nostril flare (**FIGURE 1**).[4,5] These expressions are graded by their intensity (presence and prominence) on a scale of 0 to 2.[2] A score of 0 indicates that the qualifying feature is not present, a score of 1 that it is moderately present, and a score of 2 that the feature is obviously present. A proposal published in 2024 assigned more detailed anatomic structures to increase accuracy and decrease interpretation variability.[5] The HGS is validated for evaluation of pain across multiple origins, making it a versatile option for communicating both within the team and with clients.

Critical Observation

The instinct of the horse as a prey species is to hide pain, even as the survival pressures of the domesticated horse have lessened. This trait is particularly notable in draft breeds, older horses, donkeys, and mules

TABLE 1 American Association of Equine Practitioners Lameness Scale[3]

SCORE	DESCRIPTION
0	Lameness not perceptible under any circumstances
1	Lameness is difficult to observe and is not consistently apparent, regardless of circumstances
2	Lameness is difficult to observe at a walk or when trotting in a straight line, but is consistently apparent under certain circumstances
3	Lameness is consistently observable at a trot under all circumstances
4	Lameness is observable at a walk
5	Lameness produces minimal weightbearing in motion and/or at rest or a complete inability to move

TABLE 2 Obel Laminitis Pain Scale[3]

GRADE	DESCRIPTION
Normal	Horse appears sound
1	At rest, the horse shifts its weight between the forelimbs; sound at the walk, but gait is stilted at the trot, in a straight line, and when turning
2	The gait is stilted at the walk and the horse turns with great difficulty; 1 forelimb can be lifted
3	The horse is reluctant to walk and 1 forelimb can be lifted only with great difficulty
4	The horse will only move if forced

RESOURCE 1
Scan the QR code to access the Horse Grimace Scale.

(**FIGURE 2**). Young horses and "hot blood" breeds, such as thoroughbreds and Arabians, tend to be more sensitive to pain and more readily display signs of it (**FIGURE 3**).

Stress can induce either analgesia, as when a horse experiencing a fear response masks pain,[1] or hyperalgesia when the patient is anxious, overstimulated, or exposed to repetitive noxious stimuli (e.g., needle-shy horse).[1] Therefore, when critically observing an equine patient, the veterinary nurse should consider that a quieter patient is not necessarily comfortable. Conversely, pain management and careful handling should not be withheld from a reactive patient based on the perception that the patient is being unreasonable.

Physical Examination

In addition to use of a pain grading scale and critical observation, the veterinary nurse should assess pain with a thorough and systematic physical examination. A healthy horse is interested in its surroundings and has a good appetite to graze on small amounts of feed over a long period of time. In addition to normal vital signs (**TABLE 3**), it bears equal weight on all 4 limbs and is willing to walk and, if applicable, perform its discipline to the owner's standards. A healthy foal is very curious

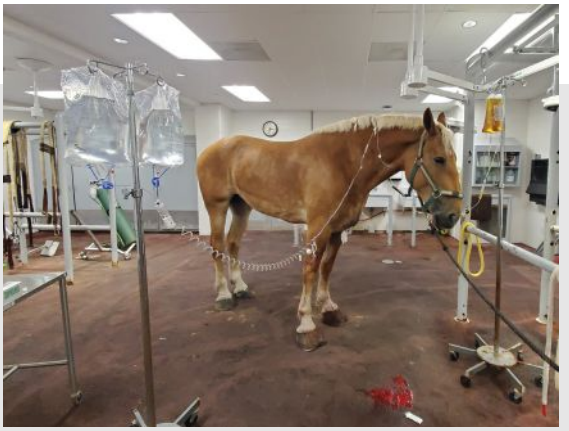


FIGURE 2. A Belgian mare displaying subtle behaviors from a painful abdomen caused by idiopathic peritonitis. These subtle behaviors include a dull demeanor, ears positioned at 3- and 9-o'clock, squinted eyes, and some grimacing noted around the nostrils and mouth.

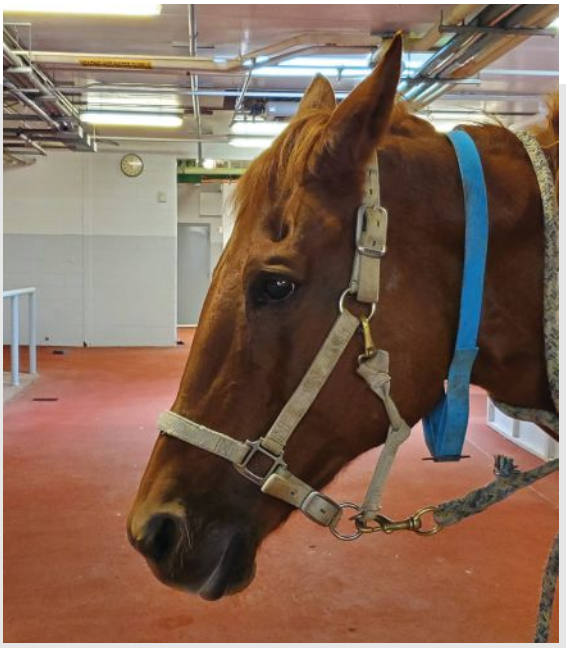


FIGURE 1. Patient grimace. Note the obvious stiffly backwards ears, orbital tightening, tension above the orbit, strained nostrils, and flattening of the profile.



FIGURE 3. Neonatal foal displays obvious colic signs from a meconium impaction, which was successfully treated with a soapy enema.

TABLE 3 Vital Signs in the Normal Horse and Foal[6,*]

VITAL PARAMETERS	ADULT	NEONATE
Temperature	37.2–38.6 °C (99–101.5 °F)	37.5–38.9 °C (99.5–102 °F)
Heart rate	24–44 bpm	80–120 bpm
Respiratory rate	8–24 breaths/min	24–40 breaths/min

**Donkey and mule parameters differ from those for horses.*

and reactive to its surroundings and nurses every 20 to 30 minutes from its dam. In a painful horse, vital signs are often abnormally elevated, with tachycardia and tachypnea present, similar to a patient with a disease process.

IDENTIFYING SOURCES OF PAIN

The most common pain syndromes equine patients experience include surgical pain; lameness resulting from chronic, degenerative, or acute injury; laminitis; gastrointestinal distress (e.g., colic, ulcers); and pleuropneumonia.[3] These syndromes fall into broad categories: somatic, visceral, and neuropathic pain. Somatic pain originates from skin, muscles, tendons, ligaments, joints, and bones, while visceral pain is caused by conditions associated with infection and inflammation of the major organs within the abdomen and thorax. Neuropathic pain originates within the peripheral or central nervous system.

Idiopathic pain is persistent pain without a specific source. It is often extreme and exacerbated by excitement, fear, and stress.



FIGURE 4. Gelding with osteomyelitis of the right hind third phalanx presented with 5/5 grade lameness, demonstrating guarding of the limb by refusing to bear weight while standing or walking.

Somatic Pain

Horses experiencing somatic pain exhibit abnormal weight distribution or shifting, posture in a "camped under" or "parked out" stance, and are reluctant to move. In some instances, they become recumbent and are reluctant or unwilling to stand. They guard the affected limb (e.g., pointing, rotating, hanging) and are sensitive to palpation, flexion, or extension of the painful area (**FIGURE 4**). They sweat and exhibit anxious expressions around their eyes, ears, and lips.

Visceral Pain

Visceral pain causes significant changes in physiologic findings. Affected horses sweat profusely, have muscle fasciculations or muscle tremors, and groan or grunt (**FIGURE 5**). Visceral pain from the abdomen causes



FIGURE 5. American Mammoth Jackstock donkey 12 hours after resection anastomosis for strangulated small bowel exhibiting signs of severe visceral pain and systemic inflammatory response syndrome with profuse sweating, muscle fasciculations, splinted abdomen, and anxious appearance around eyes.

TABLE 4 Common Equine NSAIDs and Dosages

NSAID	DOSAGE	COX SELECTIVE?
Flunixin meglumine	0.25–1.1 mg/kg IV or PO q6–12h	No
Phenylbutazone	2.2–4.4 mg/kg IV or PO q12–24h	No
Meloxicam	0.6 mg/kg IV or PO q12–24h	COX-2
Firocoxib	0.3 mg/kg PO loading dose, then 0.1 mg/kg PO q24h	COX-2

COX = cyclooxygenase

horses to look at their flank; kick at their abdomen; paw frequently; lie down and stand up repeatedly; and sometimes roll, thrash, or violently fall to the ground. Visceral pain originating in the thorax might cause the patient to take a rigid or sawhorse stance or be reluctant to move.

Neuropathic Pain

Neuropathic pain is difficult to address in equine patients, often due to their size. Damage or dysfunction of the nervous system can be caused by trauma, infection, ischemia, or cancer, but chronic laminitis is thought to be the most common cause of this pain.

ANALGESIC APPROACH

While the use of NSAIDs remains standard practice in pain management for equine patients, the use of adjunct analgesic drugs warrants exploration to provide thorough pain relief and decrease adverse effects of higher doses of NSAIDs. A multimodal analgesic plan targets different pain receptors to improve pain relief while minimizing adverse effects.

NSAIDs

NSAIDs (**TABLE 4**) work by inhibiting cyclooxygenase (COX) enzymes, thereby preventing the conversion of arachidonic acid into prostaglandins, which participate in the inflammatory cascade. There are 2 main types of COX enzymes: COX-1 and COX-2. COX-2 enzymes are specifically responsible for the prostaglandins associated with inflammation, pain, and fever. COX-1 enzymes primarily produce prostaglandins essential for maintaining healthy gastrointestinal mucosa. Maintaining the integrity of the gastrointestinal mucosa to prevent gastric ulcers is an important consideration in equine patients.

The most popular equine NSAIDs, phenylbutazone and flunixin meglumine, continue to be effective in addressing pain. They inhibit both COX-1 and COX-2 enzymes and are therefore referred to as nonselective COX inhibitors. Flunixin meglumine is best used for visceral pain and has antiendotoxic effects, while phenylbutazone remains the most reliable NSAID for orthopedic pain.[3]

Newer generations of NSAIDs target COX-2 specifically. Such COX-2–selective NSAIDs have the benefit of reducing the development of gastrointestinal ulcers. Meloxicam and firocoxib are more COX-2 selective, making them potentially safer for the gastrointestinal tract.[7] Studies indicate that their analgesic effects are at least equal to those of phenylbutazone or flunixin meglumine.[8,9] However, regular use, overdose, or "stacking" of NSAIDs can cause an array of negative adverse effects, such as gastric ulcers, right dorsal colitis, nephrotoxicity, and liver disease.

Constant-Rate Infusions

A constant-rate infusion (CRI) is intravenous administration of a drug at a specified rate over a certain amount of time. In a hospital setting, a fluid pump intended to infuse small amounts over a long period of time is often used; some patients may require multiple infusions at the same time (**FIGURE 6**). While ambulatory settings present logistical hurdles in administering a CRI, several sources recommend the use of a disposable flow meter that can be set to control the fluid administration rate (**FIGURE 7**).[10]

Opioids

Intramuscular injections of an opioid, such as butorphanol or morphine, are convenient but insufficient by themselves for relief of severe pain. Increasing the dose of morphine and butorphanol significantly affects the motility of the gastrointestinal tract.[3] A CRI of an opioid ensures stable plasma drug concentrations, thus preventing a "yo-yo" effect between comfort and pain.[11,12] The effects of hypomotility may also be decreased, but not

eliminated. For a butorphanol CRI, a loading dose of 18 µg/kg is delivered intravenously, followed by a CRI of 23 to 25 µg/kg/h.[13] Morphine given as a CRI is started with an intravenous loading dose of 0.16 mg/kg, following by 0.1 mg/kg/h intravenously.[10] If the patient becomes excitable, administration of a low-dose α_2 adrenergic agonist might be appropriate.

Lidocaine

Lidocaine is a sodium channel blocker that is used in CRIs in many practices to treat visceral and neuropathic pain. Because the pharmacokinetics are not completely understood, this use of lidocaine is controversial for some practitioners and warrants more research. Multiple studies have found it inhibits inflammatory mediators in the gastrointestinal tract as well as the GABA (γ-aminobutyric acid) uptake that is responsible for neuropathic pain.[10,14] This has made lidocaine a popular therapeutic drug for colic patients at risk for postoperative ileus. It also targets the pain pathway of acute and chronic laminitis.[15] Other studies report that patients have a desired decrease in heart rate and improvement of lameness within hours of administration.

An initial loading dose of 1.3 mg/kg 2% lidocaine is administered intravenously over 15 minutes, with a subsequent rate of 0.04 to 0.05 mg/kg/min.[13] It is important to note that lidocaine is protein bound in equine plasma, and patients with hypoproteinemia might reach a toxic threshold at a normal dose. Lidocaine toxicity appears with muscle fasciculations, agitation, ataxia, and collapse.

Ketamine

Ketamine is an NMDA (*N*-methyl-D-aspartate) receptor antagonist that targets receptors responsible for hyperalgesia, which can cause "wind-up" pain.[16] Its analgesic effects when given at a low dose as a CRI are notable, although some research indicates better analgesia when combined with another drug.[10,12] When administered alone, a ketamine CRI of 0.4 to 0.8 mg/kg/h improves appetite and comfort in patients with synovitis, osteomyelitis, burn wounds, and colic.[12,13,16] Some clinicians might order an increase up to 1.5 mg/kg/h, if needed. Gastrointestinal motility can be negatively impacted by ketamine administration, warranting the consideration of a combination of 2 or more analgesic drugs.



FIGURE 6. Multiple constant-rate infusions to provide hydration, nutrition, blood pressure support, pain relief, and plasma for immunoglobulin G therapy in a neonatal foal 3 hours after abdominal exploratory surgery.

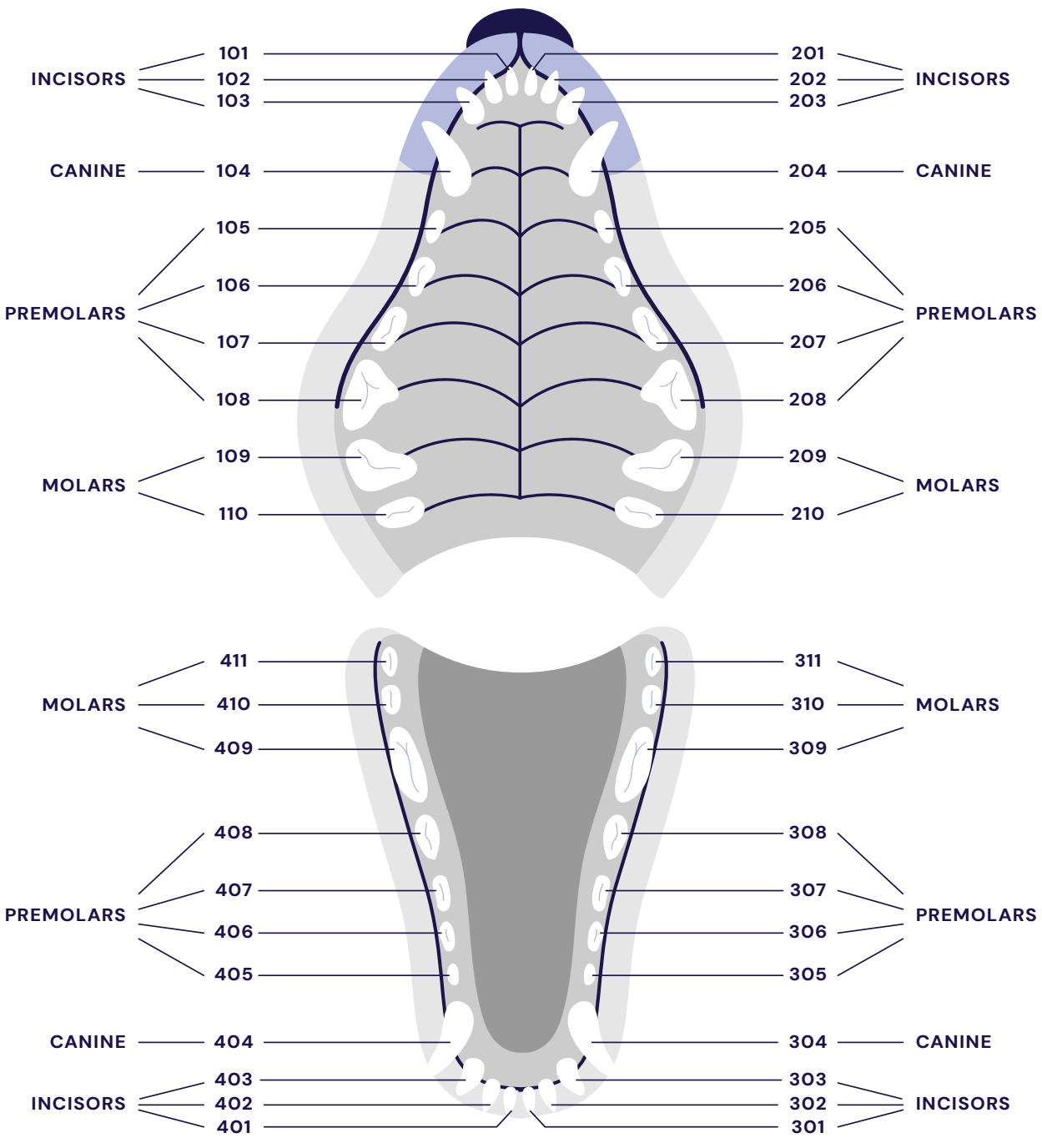


FIGURE 7. Example of a disposable flow meter (Dial-A-Flo; Hospira, **icumed.com**) setup to administer a ketamine constant-rate infusion during a general anesthesia case.

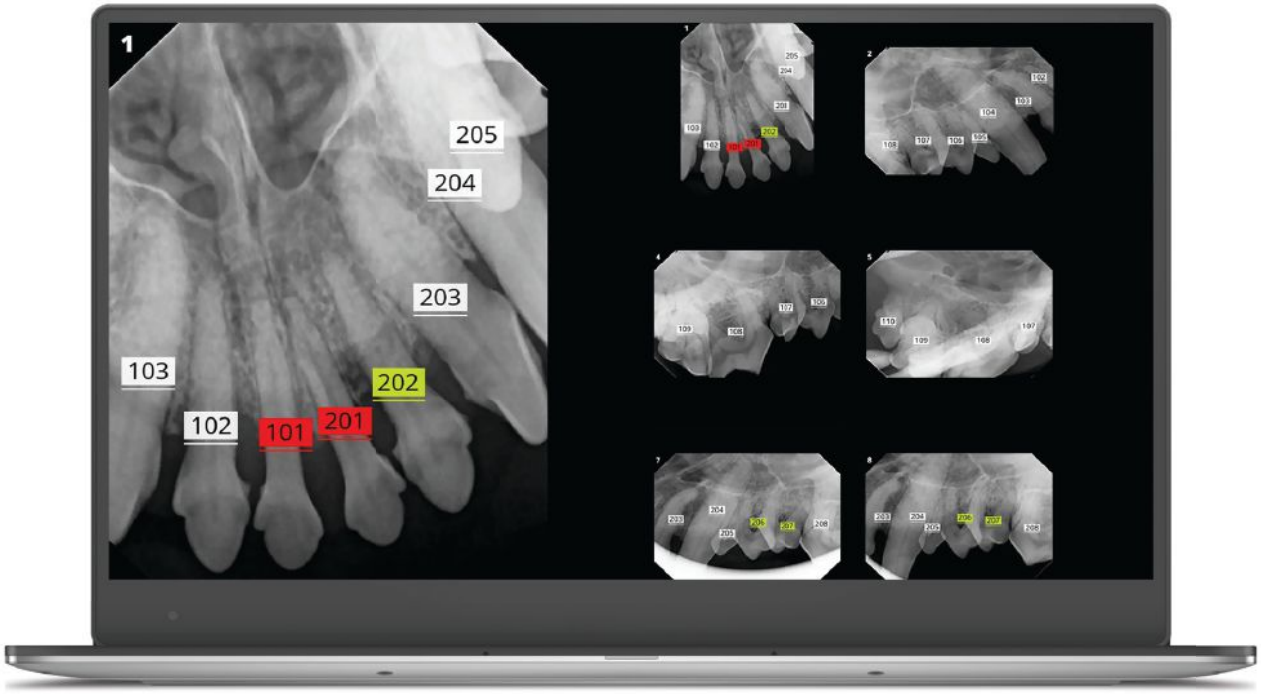
Figure 7: courtesy Lauren Kasnet, LVT, Rood & Riddle Equine Hospital

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Combination Therapy

A synergistic combination of drugs uses a lower dose of each, which reduces adverse effects while still offering the benefit of analgesia. Ketamine can be paired with an α_2 adrenergic agonist, lidocaine, or morphine to create a potent analgesic plan.[10]

Abrahamsen is credited with the development of pentafusion, an extremely potent combination of lidocaine, ketamine, morphine, detomidine, and acepromazine.[12,13] It is recommended to set up the CRI with two 1-L bags of normal saline and 2 delivery systems so the veterinary team can adjust the rate based on patient response (**TABLE 5**). The dosages are based on an average 450-kg (992-lb) adult horse, and it is recommended that the delivery rate be calculated to the patient's weight using a ratio. An intravenous loading dose of lidocaine (1.3 mg/kg) and morphine (0.1 mg/kg) is administered slowly before the pentafusion CRI is started.[12] When the patient is more comfortable, the fluid rate for the bag containing acepromazine, morphine, and detomidine can be slowed by half. Abrahamsen found that this method reduced the incidence of hypomotility of the gastrointestinal system. While pentafusion is supported by empirical evidence, it has not been validated through research at the time of publishing.

Local and Regional Anesthesia

The use of local and regional anesthesia aids in interrupting the pain impulses along peripheral nerves.

Perineural anesthesia targets specific nerves to block sensation to a particular area. These "blocks" include the palmar/plantar digital, abaxial sesamoid, low 4-point, and high 4-point nerve blocks. Abaxial sesamoid nerve blocks are effective against the pain of laminitis, subsolar abscesses, and other diseases within the distal structures.[10] Lidocaine, mepivacaine, and bupivacaine are all used for performing a local anesthetic block in the distal limb, although the duration of bupivacaine (up to 8 hours) makes it the ideal choice for long-term relief.[17]

Injection of local anesthetic into the caudal epidural space significantly reduces perception of pain in the hindlimbs and the perineum and is used to address the

TABLE 5 Pentafusion Protocol[13]

DRUG	DOSE	RATE
LOADING DOSE		
Lidocaine	1.3 mg/kg IV	Slow
Morphine	0.1 mg/kg IV	
CRI BAG #1		
Lidocaine	3 mg/kg/h	Start at 68 mL/450 kg/h
Ketamine	0.6 mg/kg/h	
CRI BAG #2		
Morphine	0.025 mg/kg/h	Start at 68 mL/450 kg/h; can slow rate when the patient first experiences pain relief
Detomidine	0.0044 mg/kg/h	
Acepromazine	0.0022 mg/kg/h	

TABLE 6 Recommended Doses for Epidural Anesthesia[18]

DRUG	DOSE	DURATION
Detomidine	30–60 µg/kg	2–3 h
Lidocaine	0.22–0.35 mg/kg	60–90 min
Mepivacaine	0.22–0.35 mg/kg	90–120 min
Xylazine	0.35 mg/kg	3–5 h
Butorphanol + lidocaine	0.04 mg/kg + 0.25 mg/kg	2.5 h
Lidocaine + xylazine	0.22 mg/kg + 0.17 mg/kg	5.5 h
Morphine + detomidine	0.1 mg/kg + 10 µg/kg	20–24 h

pain of osteoarthritis, laminitis, or traumatic injuries (e.g., fracture) (**TABLE 6**).[17] An 18- or 20-gauge, 1.5-in hypodermic needle or 18-gauge, 3-in spinal needle is used to inject the anesthetic within the first intercoccygeal space above the tailhead following aseptic preparation of the site.[18] An indwelling epidural catheter can be placed when the patient requires frequent dosing. Mepivacaine (0.22 to 0.31 mg/kg) lasts up to 120 minutes; however, combinations of a local anesthetic with an opioid, α_2 adrenergic antagonist, or ketamine allow for longer analgesia, less risk of ataxia, fewer cardiopulmonary effects, and mild sedation.[10,18]

Gabapentin

Gabapentin is an antiepileptic drug designed to inhibit the $\alpha_2\delta$ subunit of voltage-gated calcium channels, which disrupts the pain process most associated with chronic pain.[7] This mechanism of action has been widely used in human medicine to address chronic and neuropathic pain and has gained traction in veterinary medicine for the treatment of the same.

The implementation of gabapentin in horses is relatively new, with varied conclusions in studies regarding its efficacy against chronic osteoarthritis; laminitis; and headshaking from trigeminal neuropathy, temporohyoid osteoarthropathy, or an idiopathic cause. Gabapentin can be administered at 20 mg/kg PO q12h; however, because oral gabapentin has limited bioavailability in horses, higher doses and more frequent administration are often needed.[19] One study indicated that horses tolerate doses up to 120 mg/kg PO q12h without adverse effects.[20]

Oral gabapentin is ineffective when used as a monotherapy.[19] While more research is warranted to conclusively understand its pharmacokinetics and better implementation, its adjunctive role alongside other analgesic drugs is promising.

OTHER PAIN MANAGEMENT PRACTICES

The practice of compassionate care cannot be overstated in keeping painful horses comfortable. This includes basic care, corrective shoeing, and manual therapies. While it may seem obvious to the veterinary nurse, intentionally ensuring that patients are groomed at least daily decreases stress and alleviates discomfort by triggering the release of serotonin, dopamine, and oxytocin. Grooming also provides social interaction that hospitalization discourages. Deeply bedding stalls with shavings and straw encourages horses to lie down, rest, and take weight off overburdened contralateral limbs. If deep bedding obstructs ambulation, bedding can be banked to the back of the stall to allow a "sofa" for the horse to rest upon. Deep sand bedding can assist in the comfort of horses with acute laminitis.

Horses that are restrained, recumbent, or unwilling to stand regularly should have water and feed offered to them frequently and kept within reach (**FIGURE 8**). If the patient is reluctant to lower its head or is cross-tied to prevent further injury, feed and water should be elevated. If the patient is experiencing disease, healing from a surgery that causes dysphagia or quidding, or is inappetent, offering more digestible or palatable feed might prevent a negative energy balance.

Therapeutic farrier work includes corrective trimming, therapeutic horseshoes, and orthotics. A temporary sole-support orthotic that eases solar pain in laminitis cases can be applied using a dense foam pad. Commercial orthotic boots (e.g., Soft Ride Boots [**softrideboots.com**]) can be purchased by the client or stocked within the practice to rent for immediate use.

Cryotherapy is an age-old practice that reduces the inflammation and edema of injured tissues and is essential in the treatment of acute laminitis and flare-up pain in chronic laminitis patients.[21] Thermotherapy, especially when paired with manual therapies, supports the healing process. Manual



FIGURE 8. A mare with a fractured radius rests in an Anderson Sling (CDA Products, **andersonsling.com**). Note the elevated feed and water within reach.

therapies serve to strengthen soft tissue structures as much as relieve pain and include massage, passive range of motion stretching, and soft tissue and joint mobilization.[22] There are many indications to implement these therapies in patient recovery plans. They should be performed by an educated and experienced member of the veterinary team, and a veterinary nurse could receive an added credential as a Certified Equine Rehabilitation Practitioner from a reputable program.

SUMMARY

Pharmaceutical pain management has developed significantly in the past decade as more studies have validated novel analgesic drugs, doses, and adjunct therapies. Multimodal pain management should be considered in every equine practice, with competent veterinary nurses making recommendations within the team based on observation and assessment of their patients. TVN

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- Free registration is required.
- Questions and answers online may differ from those below.
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1. **What behavior(s) is/are observed in a horse with visceral pain?**
   a. Shifting weight, pointing toe
   b. Weaving, cribbing, or stall walking
   c. Pawing, looking at flank, rolling
   d. Refusal to walk

2. **Which sign(s) best describe(s) unmanaged pain in a patient diagnosed with laminitis?**
   a. Wringing tail and pinning ears
   b. Stilted walk, reluctance to lift limb
   c. Parked-out stance
   d. Frequently lying down and standing up

3. **What is the benefit of using a multimodal analgesic approach in a severely painful horse?**
   a. The analgesic drugs selected will address multiple pain pathways.
   b. The patient might experience fewer adverse effects from administered analgesic drugs.
   c. There will be fewer swings between pain and comfort for the patient.
   d. All of the above

4. **Why does gabapentin require higher doses and more frequent administration in equine patients?**
   a. The patient is significantly larger.
   b. The pharmacokinetic pathway has not been identified.
   c. The bioavailability is low when given orally.
   d. None of the above

5. **What adverse effect is associated with frequent use of NSAIDs?**
   a. Ulceration of the stomach and colon
   b. Muscle fasciculation and sweating
   c. Excitement and aggression
   d. Vasodilation and low cardiac output

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Sibling Survivors. Cheeto and Frito, both with *MDR1* mutant/mutant genotypes, survived adverse reactions to an eprinomectin-containing product.

Topic Overview

This article describes how the multidrug-resistance 1 (*MDR1*) gene mutation in cats affects P-glycoprotein, the effects of P-glycoprotein substrate drugs on cats with the mutation, and the value of testing cats for the *MDR1* mutation.

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INTERNAL MEDICINE

Multidrug-Resistance 1 (*MDR1*) Mutation in Cats

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A multidrug-resistance 1 (*MDR1*) gene, also known as adenosine triphosphate–binding cassette transporter subfamily B member 1 (*ABCB1*), was discovered in dogs in 2001[1] and in cats in 2015.[2] Although the *MDR1* mutation itself differs between dogs and cats, the clinical implications are the same. Less information, however, is available regarding the mutation in cats.

Originally called ivermectin sensitivity in collies, the predisposition of collies to experience adverse reactions to ivermectin led to the discovery of the gene mutation.[1] In dogs, the *MDR1* mutation can be traced back to herding breed ancestry.[3] Today, the mutation is still most prevalent in herding breeds, such as collies and Australian shepherds. Other breeds affected include German shepherds, Shetland sheepdogs, and border collies.[4]

After neurologic toxicity in cats that had received ivermectin was reported, researchers examined the *MDR1* gene and identified a mutation that differed in genetic makeup from that in dogs. For cats, however, the history of the mutation is unknown.

In 2022, according to the AVMA, approximately 7% of cat owners purchased their cat from a breeder,[5] which means that 93% of owners adopted their cats from shelters or friends or found them as strays. Thus, because most pet cats in the United States are adopted, it is not possible to trace their genetics. Additionally, millions of cats without owners live and breed on their own, making it impossible to control which cats reproduce and which genes they pass on. Despite this uncertainty, it is known that incidence of the *MDR1* mutation is higher among Maine Coon cats than among

Learning Objectives

- There are no physical indicators of which cats could have the multidrug-resistance 1 (*MDR1*) genetic mutation.
- The *MDR1* mutation is associated with P-glycoprotein dysfunction, which can lead to toxic accumulation of certain drugs and neurologic signs in cats.
- Animals with the *MDR1* mutation are generally healthy unless or until they receive a P-glycoprotein substrate drug.
- P-glycoprotein substrate drugs known at this time include, but are not limited to, macrocyclic lactones, some chemotherapy drugs, and some sedatives.
- Testing cats for the *MDR1* mutation should become a routine part of new-patient screening and should be performed before P-glycoprotein substrate drugs are administered.
- Cats that experience an adverse reaction need correct treatment that avoids making symptoms worse.

other purebred cats and that mixed-breed cats (i.e., domestic short-, medium-, and long-haired cats) are affected.[6] Among domestic cats overall, the *MDR1* mutation is found in 1% to 4%,[2] which means that 738 000 of the 73.8 million cats in the United States could have the *MDR1* mutation.[7] On a smaller scale, this prevalence rate means that if a veterinary clinic sees 100 cats per week, 1 or more of those cats is likely to have the *MDR1* mutation (**FIGURE 1**).

THE *MDR1* GENE MUTATION AND DRUG SAFETY

The *MDR1* genetic mutation disrupts the function of P-glycoprotein, a protein that acts as an efflux pump to remove foreign substances (e.g., drugs) from cells, particularly endothelial cells of blood vessels and cells of the brain and liver.[8] The absence of P-glycoproteins makes animals susceptible to adverse reactions from drugs that are not transported out of essential organs.

Drugs that are removed by P-glycoprotein are called P-glycoprotein substrates. P-glycoprotein substrate drugs used in cats include macrocyclic lactones, chemotherapeutic agents, and sedatives. Because the *MDR1* mutation severely blunts P-glycoprotein's ability to transport drugs from essential organs, P-glycoprotein substrates can accumulate with dangerous and possibly deadly consequences. If P-glycoprotein cannot remove the substrates from the brain (through the blood–brain barrier and into the bloodstream), their accumulation in the brain can lead to neurologic signs. For patients with the *MDR1* mutation, P-glycoprotein substrate medications should be avoided or dosages should be modified.[9] Dosing modifications depend on multiple factors, including the patient's health status, concurrent medications, and the specific *MDR1* genotype (*MDR1* mutant/mutant, mutant/normal, normal/normal; see ***MDR1* TERMINOLOGY**).

For patients with the *MDR1* mutation, P-glycoprotein substrate medications should be avoided or dosages should be modified.[9]

CONSEQUENCES OF ADMINISTERING A P-GLYCOPROTEIN SUBSTRATE TO CATS WITH THE *MDR1* MUTATION

Some of the most common P-glycoprotein substrates used in veterinary medicine are macrocyclic lactones.[10] Examples of those used as parasiticides for cats are ivermectin, eprinomectin, selamectin, milbemycin oxime, and moxidectin. Reports of eprinomectin toxicosis in *MDR1* mutant/mutant cats describe ataxia, tremors, lateral recumbency, mydriasis, and tongue protrusion.[11] Affected cats cannot eat or drink normally. If these signs are noted after macrocytic lactone administration, care should be taken to not make the situation worse. Additional P-glycoprotein substrates can have a cumulative effect on the central nervous system and lead to a worsening of clinical signs, coma, and possibly death. Supportive therapy is essential, and the recovery period can be lengthy and expensive, making treatment cost prohibitive.[10] Testing for the *MDR1* gene mutation before administering macrocyclic lactone products circumvents the risk for adverse effects and saves money in the long run.

Other P-glycoprotein substrates include some chemotherapeutic agents,[12] which can lead to neutropenia, thrombocytopenia, vomiting, and diarrhea in animals with the *MDR1* gene mutation, delaying much-needed therapy when time is crucial. It is better to test a cat before treatment and modify the dosages than to risk potentially life-threatening adverse effects in an already compromised patient.

Much of what is currently recommended for drug safety with respect to P-glycoprotein comes from research in dogs with the *MDR1* mutation, but it is reasonable to apply this knowledge to cats. For example, some commonly used sedatives in dogs are P-glycoprotein substrates, such as butorphanol and acepromazine.[9] Another P-glycoprotein substrate used in dogs is maropitant, which is widely used for prophylactic treatment of nausea and vomiting.[13] Although these medications have not been tested in cats with the *MDR1* gene mutation, it is reasonable to use caution when administering them to cats, especially if the drugs are used in conjunction with other P-glycoprotein substrates. Some P-glycoprotein substrates are not as strong as others, so the effects might not be as obvious, but when a P-glycoprotein substrate is combined with another, the results can be more profound. Anecdotally, some owners have reported that their pet was lethargic or seemed "off" or

"not themselves" while receiving maropitant (a weaker P-glycoprotein substrate) but returned to normal as soon as maropitant was discontinued.

DETECTING PATIENTS WITH THE *MDR1* MUTATION

Unlike dogs, for which more than 50% of some breeds are affected,[4] there are no strong breed predilections for cats or ways to predict which cats might have the *MDR1* mutation. The only way to know if a cat has the *MDR1* mutation is testing (genotyping), which should be offered as part of every cat's health screening, especially those that will receive parasiticides. An easy, widely available, and affordable ($70) test is available through the Washington State University College of Vetrinary Medicine Program in Individualized Medicine (PrIMe; go.navc.com/4INbYdF) and can be performed by clients at home (cheek swab sample) or in the clinic (blood or DNA collection brush sample) before any potentially toxic medication is given to a healthy cat.

The lack of physical characteristics associated with the *MDR1* mutation in cats and the lack of information on drug labels regarding their P-glycoprotein substrate status increases the risk for serious adverse drug reactions. Some P-glycoprotein substrate drugs in one species might be applicable to another species but also may differ among species. It is conceivable that P-glycoprotein substrates for dogs or humans could be P-glycoprotein substrates for cats.[9]

Among new drugs continually being developed and marketed for dogs and cats, most are not assessed for P-glycoprotein substrate status. Thus, prescribing medication for cats with an unknown *MDR1* genotype can be risky. In 2023, a new parasiticide containing eprinomectin was introduced to the market, after which increased adverse reactions were noticed in



FIGURE 1. Locations of cats tested at the Washington State University Veterinary Clinical Pharmacology Laboratory and determined to have the multidrug-resistance 1 mutation, showing widespread distribution.

An animal with only 1 copy of the genetic mutation will not be affected as severely as an animal with 2 copies but still can experience adverse effects if drug doses are not reduced.

MDR1 mutant/mutant cats. Many young, healthy cats experienced neurologic effects for weeks and subsequently died. Thus, the key to preventing P-glycoprotein–mediated adverse drug reactions is determining the genotype of feline patients before administering potentially harmful medications.

One source for problem medications for cats with the *MDR1* mutation can be found at **go.navc.com/4IRHpDD**. This list is not exhaustive as new drugs are being tested on an ongoing basis. A few examples of drugs currently being tested are cisapride, cyclosporine A, and methylprednisolone. The FDA recommends determining the P-glycoprotein substrate status of drugs before the drug is marketed for use in humans, but the same requirement does not exist for drugs for animals.[14] Veterinary pharmaceutical companies do not perform this testing; however, testing is being performed at the Washington State University Veterinary Clinical Pharmacology Laboratory and is funded by the EveryCat Health Foundation (**everycat.org**). Organizations must rely on private donors or grants to support the testing of possible P-glycoprotein substrates for cats. After results from testing are peer-reviewed and published, P-glycoprotein substrates are added to the problem medications list on the Washington State University website listed previously. It is hoped that in the future drug companies will begin to test medications for P-glycoprotein status before they are released for use in veterinary medicine. Such a preventive measure could supply veterinary professionals with valuable information and avoid many adverse reactions in patients with the *MDR1* mutation.

MDR1 TERMINOLOGY

An animal inherits 2 copies of the *MDR1* gene, 1 from each parent, which is relevant as many clients report that their dog or cat is "positive for *MDR1*," which is incorrect because the *MDR1* gene exists in every cat and dog (**FIGURE 2**). It is the *MDR1* gene mutation that causes problems.

- For animals with 2 copies of the *MDR1* gene mutation, the preferred terminology is "*MDR1* mutant/mutant."
- For animals with only 1 copy of the *MDR1* gene mutation, the preferred terminology is "*MDR1* mutant/normal."
- For animals with no *MDR1* gene mutation, the preferred terminology is "*MDR1* normal/normal."

The *MDR1* gene mutation is considered a dominant mutation, meaning that an animal with only 1 copy of the genetic mutation experiences susceptibility to adverse effects from P-glycoprotein substrates. The

***MDR1* Genotype Combinations**	**Mutant/Mutant**	**Mutant/Normal**	**Normal/Normal**
Mutant/Mutant	Mutant/Mutant	Mutant/Mutant	Mutant/Normal
		Mutant/Normal	
Mutant/Normal	Mutant/Normal	Normal/Normal	Normal/Normal
	Mutant/Mutant	Mutant/Normal	Mutant/Normal
		Mutant/Mutant	
Normal/Normal	Mutant/Normal	Normal/Normal	Normal/Normal
		Mutant/Normal	

FIGURE 2. Punnett square showing genotype combinations of the multidrug-resistance 1 (*MDR1*) gentoypes.



FIGURE 3. Cat with the multidrug-resistance 1 mutation as identified at Washington State University's Veterinary Clinical Pharmacology Laboratory.

term "carrier" is also incorrect in that it implies that the animal is not affected and is only able to pass the gene to offspring. An animal with only 1 copy of the genetic mutation will not be affected as severely as an animal with 2 copies but can still experience adverse effects if drug doses are not reduced.

HYPOTHETICAL CASE SCENARIO

One morning, a 9-month-old intact male domestic shorthair kitten is taken to an emergency veterinary hospital due to neck ventroflexion and lateral recumbency. Examination further determines that he also has mydriasis with no palpebral reflex and tongue protrusion. The client states that the kitten started to "walk funny" last night and that they found him in this condition in the morning. Coincidentally, he had been seen at his local veterinary clinic the day before for a kitten wellness examination. He was a perfectly healthy, playful kitten. He received his last set of vaccinations and an application of parasiticide at the office visit. The kitten was fine when he left the hospital the day before. His full sibling in the same household received the same treatments. The cats were kept separate after the application of the parasiticide to prevent unintentional oral ingestion of the topical parasiticide by grooming. The sibling did not exhibit any clinical signs.

This scenario is a classic presentation of a cat that is homozygous for the *MDR1* genetic mutation and is experiencing an adverse reaction to an eprinomectin-containing parasiticide. Time and supportive therapy, specifically hydration and nutritional support, are needed to help cats clear the eprinomectin from the brain, but equally valuable is avoiding drug treatments that exacerbate the neurologic toxicosis.

COMMUNICATING WITH CLIENTS

Explaining the *MDR1* genetic mutation and its consequences to clients during their cat's yearly examination might encourage them to test their cats for the *MDR1* genetic mutation. Owners should be informed that the genetic mutation makes cats more susceptible to adverse reactions to certain medications, including some parasiticides, anesthetics, antinausea drugs, and chemotherapeutic agents. Clients should also be informed that there are no physical predictors, such as breed or coat color, for the mutation (**FIGURE 3**) and that testing is the only way to determine a cat's *MDR1* genotype.

SUMMARY

Knowing a patient's *MDR1* genotype could be lifesaving for both preventing and treating adverse reactions to P-glycoprotein substrates. Unfortunately, the *MDR1* mutation is often diagnosed after a cat experiences an adverse drug reaction rather than during genotyping performed before drug administration. The author is aware of many situations in which the mutation was discovered too late and the cat died or was euthanized due to the severity of the adverse drug reaction. Cats can, and have, fully recovered from the insult if given time and appropriate supportive medical management. Testing for the *MDR1* gene mutation should be added to the tests offered to clients to ensure that patients are not inadvertently harmed by measures designed to protect them. **TVN**

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Jennifer Heusser



Jennifer graduated from Bel-Rea Institute of Animal Technology in 1994 and began working at Washington State University in 1995. While taking time off to raise children, she finished a bachelor's degree in social science from Washington State University. Jennifer resumed her career as a veterinary technician at Washington State University in 2013 and worked in various departments in the Veterinary Teaching Hospital. Jennifer recently moved to the veterinary clinical sciences department and works in the Veterinary Clinical Pharmacology Laboratory as a clinical studies coordinator. Jennifer's recent work with cats with the multidrug-resistance 1 (MDR1) gene mutation experiencing adverse reactions, along with her communication with their veterinarians and clients, has made her dedicated to increasing awareness about cats with the *MDR1* genetic mutation.

EARN CE CREDIT

Multidrug-Resistance 1 (*MDR1*) Mutation in Cats

SCAN THE QR CODE to take the quiz for free on VetFolio

This article has been submitted for **RACE approval for 0.5 hour of continuing education credit** and will be opened for enrollment upon approval. To receive credit, take the test at **vetfolio.com** by searching the name of the article or scanning the QR code.

- Free registration is required.
- Questions and answers online may differ from those below.
- Tests are valid for 2 years from the date of approval.

1. **P-glycoprotein transports drugs into the brain through the blood–brain barrier.**
   a. True
   b. False

2. **Why is it important to recognize the clinical signs of a cat with the *MDR1* gene mutation that could be experiencing an adverse reaction?**
   a. The *MDR1* gene mutation makes the cat resistant to certain treatments.
   b. You could make the cat worse by giving drugs that could cause a cumulative effect.
   c. You need to know which diagnostic tests to perform.
   d. The cat is highly contagious.

3. **Testing for the *MDR1* gene mutation in cats is not often done because:**
   a. It is expensive.
   b. It is hard to acquire.
   c. There is a lack of awareness.
   d. There is no reason to test cats.

4. **P-glycoprotein substrates include:**
   a. Macrocyclic lactones
   b. Some sedatives
   c. Some chemotherapeutic drugs
   d. Some antinausea medications
   e. All the above

5. **The most common clinical signs exhibited by a cat homozygous for the *MDR1* gene mutation (mutant/mutant) that is experiencing an adverse reaction to eprinomectin include:**
   a. Vomiting/diarrhea
   b. Incontinence
   c. Seizures
   d. Ataxia, mydriasis, tremors, and tongue protrusion

EXTRA MILE



Melinda Nagy/shutterstock

WHAT'S INSIDE

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WORKPLACE TABOOS

Romantic Relationships

Theresa Cosper-Roberts, *RVT, CVPM, ACVE (DE)*
Purdue University College of Veterinary Medicine, West Lafayette, Indiana

Veterinary hospitals offer unique conditions that foster close personal relationships. Small practice dynamics create intimate working environments where staff members can spend more time together than with their own families. The shared emotional experiences of saving lives, comforting grieving pet owners, and working through critical cases forge bonds that can easily evolve into romantic attraction.

Milijan Zivkovic/shutterstock

According to the Society for Human Resource Management's (SHRM) 2024 workplace relationship research, 49% of workers admitted to having a crush on a coworker in the past year, with 21% going on dates with coworkers.[1] The veterinary field, with its intense emotional situations and bonds over patient care coupled with extended work hours, creates fertile ground for romantic connections.

"It's hard to find someone outside of the field when you commit so much of your life to it," stated a veterinarian when asked about workplace relationships. "I think there is a lot of gray area and there is no set right/wrong but some boundaries that could and should be established that would be agreeable to the majority."

UNDERSTANDING POWER DYNAMICS IN VETERINARY SETTINGS

The power dynamics inherent in veterinary medicine add another layer of complexity to workplace relationships. Teams operate within established hierarchies that influence communication patterns, decision-making, and professional relationships. When romantic relationships develop across these hierarchical lines—such as between veterinarians and veterinary nurses/technicians or managers and support staff—the existing power dynamics become even more complex.

These dynamics often manifest in concerning ways. One veterinary nurse/technician reported witnessing a coworker announce to the hospital, "I can do whatever I want!" because they had a physical romantic relationship with the clinic veterinarian. Conversely, a veterinarian who eventually married a veterinary nurse/technician reflected more thoughtfully: "I suppose there was a power dynamic in the sense that if things didn't go well, he would leave and I would stay at our job."

ASSESSING PROFESSIONAL ACCEPTANCE STANDARDS

Not all workplace relationships carry equal weight in terms of professional impact and team acceptance. SHRM data reveals a clear hierarchy of acceptability: 58% of workers say workplace romances are acceptable between workers of the same level who rarely work together, but only 27% approve of relationships between different hierarchical levels who work closely together.[1]

When romantic relationships create tension or perceived inequity, they can undermine positive outcomes.

In situations where most roles require close collaboration regardless of hierarchy, this presents a significant challenge. The reality is that veterinarians work directly with veterinary nurses/technicians, veterinary nurses/technicians coordinate closely with assistants, and reception staff interacts with everyone throughout the day.

According to a practice manager, "When 2 people are dating, especially if 1 supervises the other, it can create perceptions of favoritism that damage team morale. Other staff members start questioning whether schedules, assignments, or performance evaluations are fair."

MANAGING THE RIPPLE EFFECT ON TEAM DYNAMICS

These perceptions of unfairness extend beyond the couple to affect broader team dynamics and workplace satisfaction. When romantic relationships create tension or perceived inequity, they can undermine positive outcomes. This inequity or favoritism signals that performance is less important than personal relationships, causing employees to question the fairness of leadership decisions. Research shows that when romantic relationships create tension or perceived inequity, they can undermine positive workplace outcomes by contributing to these destructive dynamics that negatively impact patient care quality and team effectiveness.[2]

As a veterinary nurse/technician explained, "My biggest issue wasn't their relationship. It was the way that it affected us when they were fighting. When they were getting along, it was great. But when they weren't, we were walking on eggshells the whole time. You just never knew what would set them off and they would start arguing in the middle of surgery or while we were trying to recover a noise-sensitive patient and they were just screaming at each other."

Perspectives on Veterinary Nurses Entering Workplace Relationships

> *It's easy to meet someone at work; you share an interest, can commiserate and celebrate together, and already spend a lot of time together. But, it's important to have a plan for what happens if things don't work. Otherwise, all those shared positives suddenly turn into negatives that eventually impact patient care.*

Anonymous, CVT, Utah

> *My husband and I met while working at a small animal hospital, married during his time in vet school, and weathered the challenges of academia and residency. I love that we share an understanding of the demands, culture, and emotional weight of veterinary medicine. The hardest part is when lines become blurred. We spend an extended amount of time with our coworkers, often giving the illusion that there is an entitlement to know things beyond the boundaries of professional work. Keeping work life and home life separate is important for the betterment of your patients and your own sanity.*

Anonymous, CVT, Florida

> *The real question to answer before delving into a romantic relationship in a professional setting is not necessarily that they should not happen. Ensuring that healthy boundaries are in place before stepping into a relationship at work can support all involved. In a practice I once worked at, a technician and veterinarian/practice owner were very passionate in their relationship—without boundaries in the work setting. When things went awry, the ripple effects included loss of other employees and an unhealthy environment.*

Anonymous, RVT, North Carolina

IMPLEMENTING STRATEGIES FOR PROFESSIONAL BOUNDARY MANAGEMENT

Successful workplace relationships require intentional effort to maintain professional boundaries and team trust. This means avoiding public displays of affection, maintaining professional communication in front of colleagues and clients, and ensuring personal disagreements don't spill into the workplace. The challenge intensifies in smaller clinics where privacy is limited and staff members work in close proximity throughout their shifts.

Communication with the broader team requires strategic finesse. While complete secrecy often backfires in small clinic environments, oversharing personal details can make colleagues uncomfortable. The goal is transparency without inappropriate disclosure, acknowledging the relationship while maintaining professional focus.

To address any appearance of unfairness within the practice hierarchy, equal treatment becomes non-negotiable. This means fair task assignment, consistent performance standards, and avoiding any perception that a romantic partner receives benefits unavailable to other team members.

ADDRESSING POSTRELATIONSHIP WORKPLACE CHALLENGES

The statistics on workplace relationship endings reveal significant operational challenges for veterinary practice managers dealing with romantic entanglements in their facilities: 62% of former workplace couples continued working together after breakups, while 1 in 10 left jobs they otherwise liked due to relationship endings.[1] In an industry where quality job opportunities may be limited and professional relationships span entire careers, reality means that there may be limited options for avoiding ex-partners from relationships that end poorly.

Unlike large corporations where former couples might transfer to different departments or buildings, veterinary staff often continue working in the same treatment rooms, sharing the same equipment, and collaborating on the same cases every day.

Postbreakup dynamics require the same professional standards expected during the relationship, but with added emotional complexity. Veterinary teams require

reliable teamwork and collaboration for safe patient care, making personal conflicts a patient safety issue as well as a workplace concern. When professional conduct breaks down following a relationship's end, practice managers may need to make difficult staffing decisions if the situation remains unresolved.

PROFESSIONAL RECOMMENDATIONS AND POLICY CONSIDERATIONS

For those contemplating workplace romance, self-reflection is necessary. Consider the following questions:

- How will this relationship affect my professional reputation?
- Will there be a power dynamic at play?
- Can I maintain objectivity in situations involving my partner?
- How will I handle disagreements or conflicts that arise?
- Am I prepared for the possibility that one of us might need to leave if the relationship ends badly?
- Is there a policy regarding relationships? What does it say?

Risk assessment should extend beyond personal consideration to potential legal implications. Workplace relationships can create scenarios that may result in harassment claims, conflicts of interest, or allegations of favoritism. Understanding and preparing for these risks may help with making informed decisions about pursuing romantic relationships with colleagues.

THE MANAGEMENT REALITY

Despite the challenges and complexities, 74% of those who had workplace romances said the experience was worthwhile,[1] suggesting that many people successfully manage these relationships without significant professional damage. A successful workplace relationship requires commitment from both partners to prioritize patient care and team dynamics over personal convenience or preference. It demands honest communication, consistent professional behavior, and the maturity to separate personal emotions from clinical decision-making. TVN

Note: *Individuals quoted in this article spoke with the author under the condition of anonymity given the sensitive nature of this topic.*

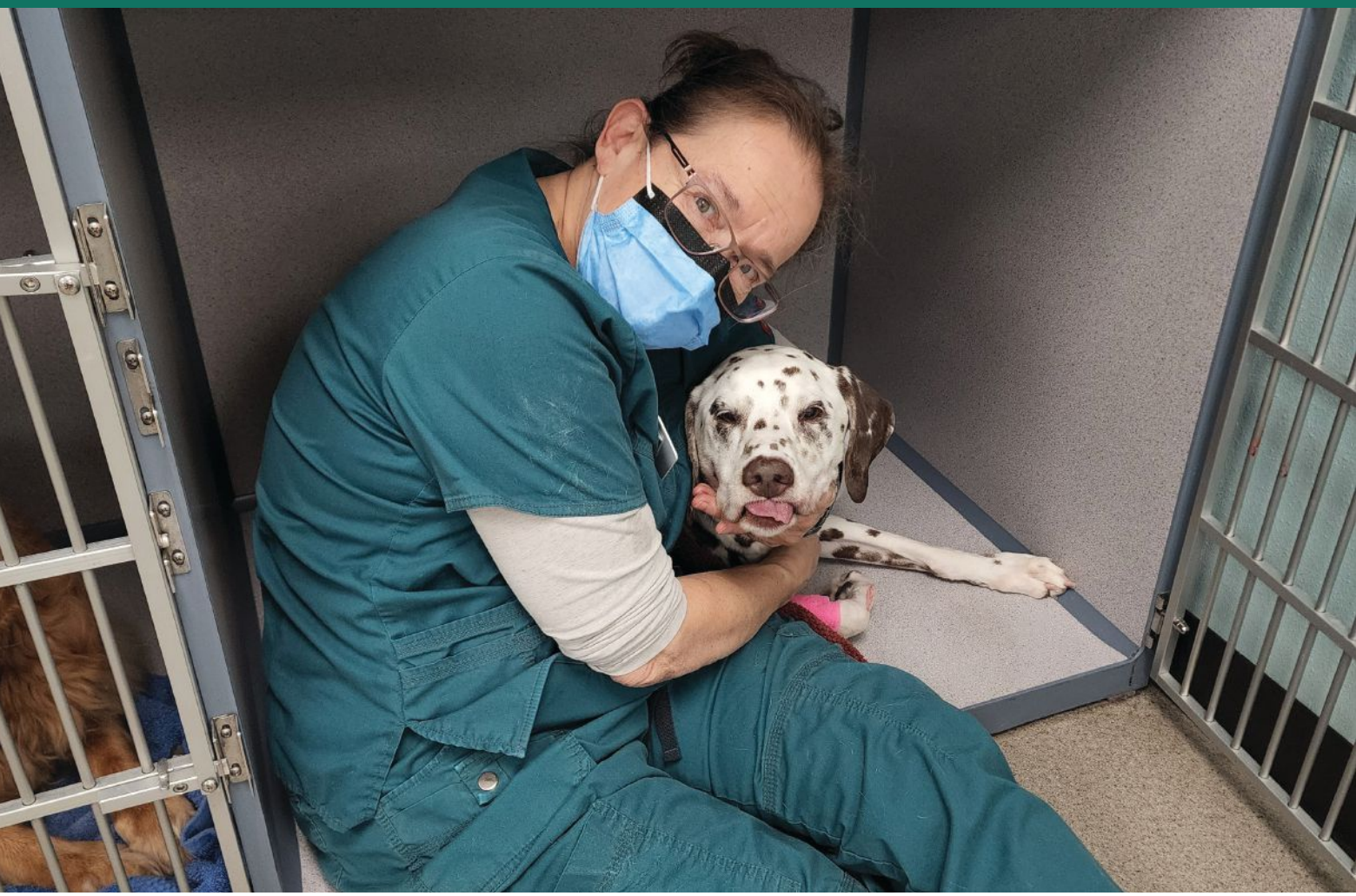


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CLINIC CHAMPIONS

A Beautiful Ride



Dolores Stantorf, LVT, reflects on the rapid pace of progress, steadfast relationships, and memorable moments through her 50 years in veterinary medicine.

VCA Eagle River Animal Hospital, Eagle River, Alaska

When Dolores Stantorf, LVT, heard about the veterinary technology program at Cosumnes River College in Sacramento, California, she thought: *I can do 2 years. That's easy*.

Little did she know, she would be charting a path for the next 50 years of her life.

Stantorf, a licensed veterinary technician supervisor at VCA Eagle River Animal Hospital located outside of Anchorage, Alaska, celebrated her golden work anniversary in June.

"I've had so many friends that have patted me on the back and have been there for me when I needed them, because there are long, hard days," said Stantorf. "You have to give a lot of empathy to the clients and the animals, but you don't always take care of yourself. I've always had somebody there to say, 'You're going to make it.'"

From the days of manual blood pressure readings and lengthy anesthesia prep, Stantorf has seen a lot of progress over 5 decades, but the core of what keeps her passionate about the profession remains. She loves helping animals and making connections with clients. A self-proclaimed "big talker," Stantorf uses her communication skills to develop a deeper relationship with pet owners and offer personalized guidance.

"I try to take that extra step to get to know our clients a little bit more," she said. "So, No. 1 they enjoy talking to you and know that you're there to help them. No. 2, they're going to come back to the clinic because they were treated with kindness, even in a difficult situation."



MAKING THE NEWS
A 1986 edition of the *Anchorage Daily News* features Dolores Stantorf volunteering at the Iditarod Trail Sled Dog Race.

After starting in California, Stantorf has spent the bulk of her professional life in Alaska, where she has seen everything from basic wellness visits to animals being flown in from the bush and special care appointments for mushing dogs. One of her career highlights includes 3 years volunteering at the Iditarod Trail Sled Dog Race in the mid-1980s. During this iconic race, sled dogs cover nearly 1000 miles of rough terrain and harsh winter conditions in Alaska. Veterinary medical professionals volunteer to test and provide medical care for the racing dogs at various checkpoints.

We spoke with Stantorf about the lessons learned from her career and her experience working at the Iditarod.

TODAY'S VETERINARY NURSE: What do you think has been the biggest change you've seen over the past 5 decades?

DOLORES STANTORF: Well, I think the biggest change is technology, because it's made our job less

2025
TODAY'S VETERINARY NURSE

CLINIC CHAMPIONS

Today's Veterinary Nurse aims to shine a light on inspiring stories with its Clinic Champions series. Each issue, *TVN* will honor a veterinary nurse for their contributions in community service, scholarship, advocacy, or innovation. This series will highlight unsung heroes who make a lasting impact on their patients and community.

At the end of the year, 1 of the 4 honorees will be recognized as the Clinic Champion of the Year.

→ SCAN THE QR CODE to nominate a veterinary nurse/ technician.

complicated. We've got more ways to diagnose in a shorter period of time, so we can take care of these patients faster. But you also have the change in mindset for the clients. When I started out, they were just a pet and clients weren't going to spend a lot of money on them. But now they're not just a pet, they're a family member. People will do more for their pet than they used to; they'll spend a little bit more money or they'll try a new drug or they'll do physical therapy. Before, the mindset was: If they don't get better on their own, then that's it. Technology plays a huge role in it, because clients want answers, and they don't want to have to wait 3 or 4 weeks to get the blood work back (or even a couple of days). Seeing what technology has done, it's fantastic. Holy cow. We used to hand dip x-rays, and now we've got them up in seconds with digital radiography. What used to take half an hour is now 5 to 10 minutes.

TVN: What is your advice on how to adapt to change?

STANTORF: Be flexible. Just because you learn something in school does not mean that's the way it's done at another hospital. And just because they do it one way and you were taught another way does not mean it's wrong. Keep an open mind about it. People come in and expect it to be the same way that they were taught. In veterinary medicine, we're learning new things all the time. There are always new drugs. I was taught you don't put anything opaque into a vessel. And yet, all of a sudden, we're using propofol. That was so hard for me to do the first couple of times. You have to learn to be flexible. Take that and put it in your toolbox.



GOLDEN ANNIVERSARY
Stantorf celebrated 50 years of working as a veterinary technician in June; she started in California but has been at a clinic outside of Anchorage, Alaska, for more than 2 decades.

TVN: What is your advice for standing out in the clinic and making a positive impression on your team and clients?

STANTORF: Be assertive. Put yourself out there when you see somebody needing help, don't just stand back and watch. Prove that you can be there to help them. Whether it's cleaning the kennel because everybody else is too busy, or assisting a technician for IV catheter placement or with x-rays. If a doctor needs somebody, you're right there, take that animal from them, find out what they need to do. Be proactive in what you want to do so that they can see that you do have the capabilities, that you have the desire, and that you want to be there for them. Because if you stand back, pretty soon they're not going to ask and you're not going to learn anything. You're going to get upset because they're not utilizing you, and that's because you're not jumping in.

TVN: That can be hard for some people if it does not align with their personality.

STANTORF: Well, especially if you're a new person coming into a hospital, you don't want to overstep your bounds or step on anyone's toes. But you still have to find out how to step up in some way, just so that people know that you are interested and that you do want to do this. Because if you're just going to stand there and hold up the wall, nobody's going to ask you to do anything. It's important that you show that you care about what you want to do and that you want to learn. Make sure you've got some magazines that are interesting to you to pick up new skills or new information. Make sure that you're going through your emails so that you can see anything new. Find places where you can go to get more education for it. If you've got something on the wall that says there's a CE opportunity coming up, ask "Can I go to this?" The more that you do that, the more you've got other people asking you for their help, and that makes you feel good.

TVN: What were some of the injuries you all had to treat during the Iditarod?

STANTORF: The first year that I was out there, Susan Butcher's dog team ran into a moose. The moose killed a couple of her dogs and injured a lot of them. When she made it to Skwentna, we were able to get her dogs on a plane and get them out of there. She ended up dropping out of the race that year. That was the worst injury that I had ever seen. We've had a couple through the years, like a snow machine came through and didn't realize that there was a team and caused several injuries. But most of the problems are usually because the dogs are having some bloody diarrhea or other issues due to the stress of running. Or they sustain injuries going over the burn area (a large stretch of the race that had been ravaged by a forest fire)—it's a very rough area to go through, and so you end up with a lot of leg injuries or foot injuries.

TVN: What was the most memorable moment from that experience?

STANTORF: When I was out at White Mountain, a snowstorm came in—and I mean it *really* came in. All the power was out. When we fly in, we fly on little Super Cubs. It's not a big plane. The next day, I flew out with 2 doctors, and we ended up landing on the ice because we couldn't see to reach Nome. And the pilot says, "Well, we need to turn this plane around so that we're facing the wind." The 2 doctors and I got out of the plane, and he gave me the engine cover, and he says, "Let me see if I can't turn it around with the wind and a little bit in the engine." So we all backed up, and he gives the engine some power, and all of a sudden it's total silence. When he went to give it power, that flipped the plane up on its wing, tipped the plane, broke the wing tip off, and bent the prop. He comes over and goes, "Well, I'm not flying you out of here." We got the plane back on all of its wheels, and he called in for another plane to come in and get us. When the weather cleared up, we ended up with a little plane that the media had been using out of Safety. Well, Safety is the last checkpoint before they get to Nome, and so they flew us all into Safety, and then the guy says, "OK, I've only got room for 1 person in the plane to head back to Nome." And he said, "I need 2 people to go back on a snow machine." Well, I had never been on a snow machine before, so I said "OK, I'll go!" They took us to Nome on the snow machine, and it was the most beautiful ride. We were out on the ice along the Bering Sea in the winter time. We could see huge chunks of ice, and traveling around there was so gorgeous.

— By Andy Zunz TVN



Test Your Knowledge

Up for a challenge? Once you finish reading this issue, put your learnings to the test with quiz questions covering several clinical articles. Find the answers at the bottom of this page.

1 **SKILLS CHECK**
Placing Central and Peripherally Inserted Central Catheter (PICC) Lines (p. 18)

Which of the following is not necessarily an indication for placing a central or PICC line in a veterinary patient?

a. Need for frequent blood sampling
b. Administration of vasopressors
c. Parenteral nutrition
d. Administration of 5% dextrose solution

2 **NUTRITION CONVERSATIONS**
How Exercise Fits With Nutrition in a Weight-Management Plan (p. 38)

Limiting treats to ___% of daily calorie intake of a complete and balanced diet and increasing exercise aid in successful body weight management.

a. More than 30%
b. No more than 5% to 10%
c. No more than 10% to 20%
d. None of the above

3 **CONTINUING EDUCATION: ONCOLOGY**
Cancer: How It Happens and How It Is Treated (p. 48)

Which of the following statements is false?

a. Mutated tumor suppressor genes will not cause cancer; however, mutations of a proto-oncogene will.
b. Proto-oncogenes are responsible for normal cell growth and proliferation.
c. Most genetic mutations are unlikely to cause an issue for the host.
d. Certain environmental exposures can cause genetic mutations.

4 **CONTINUING EDUCATION: EQUINE MEDICINE**
Assessing and Addressing Pain in the Equine Patient (p. 58)

Rate how pronounced this patient's chin is (FIGURE A), based on the Horse Grimace Scale.



FIGURE A.

a. 0 – Not present
b. 1 – Moderately present
c. 2 – Obviously present
d. None of the above

5 **CONTINUING EDUCATION: INTERNAL MEDICINE**
*Multidrug-Resistance 1 (*MDR1*) Mutation in Cats (p. 70)*

A possible outcome for a litter of kittens for which both parents are mutant/normal for the *MDR1* genetic mutation is:

a. All kittens will be carriers.
b. Half the kittens will be mutant/mutant and half will be normal/normal.
c. It is possible for all the genotypes to be represented in this litter of kittens.
d. All the kittens will have mutant/mutant status because *MDR1* is a dominant gene.

Answers: d, b, a, c, c



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Hacks for Discounted or Complimentary Travel

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If you want to go on a vacation, you may feel like your travel opportunities are limited, especially if your budget as a veterinary nurse doesn't have much wiggle room. Thankfully, there are ways you can afford to travel without breaking the bank or making a career change. Getting away to relax and recharge doesn't have to cost a fortune.

1 CE and PTO Benefits

At least 60% of veterinary employers provide a continuing education (CE) stipend, paid vacation time, and paid holidays.[1] CE stipends vary in amounts and details, but if you have one, you should fully utilize it. Try to choose a veterinary conference for which your stipend covers most, if not all, costs and is in a location to which you want to travel. Veterinary conference options can be found all over the world. Your paid vacation time may help extend your time away on either end of the conference to further maximize your CE stipend.

SCAN THE QR CODE
Looking for more financial tips for veterinary nurses? Scan the QR code to see Adrienne's entire Dollars & Sense series.

2 Credit Card and Loyalty Rewards

If your finances are in order and you can trust yourself to pay off your balance in full each month, consider using a credit card that earns travel miles or points with every purchase. Use this card to make all your purchases, pay it off in full each month to avoid interest charges, and watch your points or miles accumulate. When it comes time to use your paid vacation time, redeem your points or miles to pay for travel-related costs like flights and hotels. Points and miles can also be earned without a credit card by joining free airline, hotel, and other travel loyalty programs. This way you can still earn points and miles when you are traveling using your CE stipend, even if you don't want to get a credit card.

3 Conference Lecturing

If you like public speaking, presenting at veterinary conferences can get you an all-expenses-paid trip. Veterinary conferences often pay for your travel, hotel, and meals, plus they provide a speaking stipend. Submit your lecture proposals to a conference in a location that appeals to you.

4 Travel Pet Sitting

If your travel plans are flexible and you can cover the cost of your flight or gasoline, consider joining a site like TrustedHousesitters (**trustedhousesitters.com**). These memberships allow you to apply to pet sitting opportunities all over the world where, in return for caring for the resident pet(s), you can stay for free. It's like a free Vrbo or Airbnb but with pets! With TrustedHousesitters there is an annual membership fee, but for less than $200 a year (or about the cost of a night in a hotel), you get unlimited pet/house sitting opportunities, which can make trips much more affordable. TVN

Reference

1. NAVTA demographic survey results 2024. National Association of Veterinary Technicians in America. Accessed July 31, 2025. https://drive.google.com/file/d/1zNiH8h2ZqSMYbs_NAglOyfiXxmBYIlv_/view



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Adrienne has been a credentialed veterinary technician for 16 years, is passionate about helping the next generation of vet techs, and is semi-obsessed with personal finance.

Jarom Vogel

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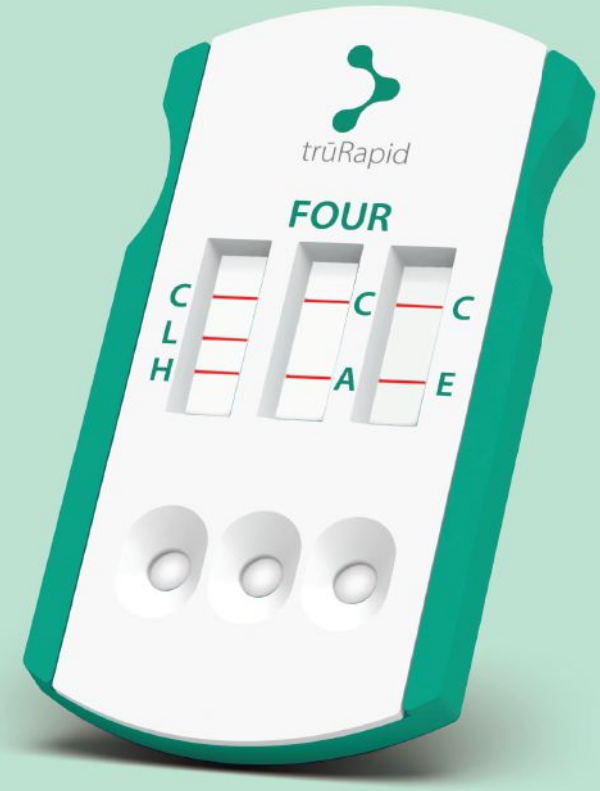
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