California Veterinary Medical Board

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MEMORANDUM

DATE	April 3, 2026
TO	California Veterinary Medical Board (Board)
FROM	Cheryl Waterhouse, DVM, Chair Multidisciplinary Advisory Committee (MDC)
SUBJECT	**Agenda Item 6.B.1. HQHVSN Services and MASH Clinics**

Background

During the July 2025 Board meeting, Animal Balance and the San Francisco Society for the Prevention of Cruelty to Animals (SF SPCA) submitted this letter to the Board for "Public Comment on Items Not on the Agenda." The letter was regarding their desire to operate Mobile Animal Sterilization Hospital (MASH) clinics throughout California.

Animal Balance and SF SPCA work together to provide High-Quality, High Volume Spay and Neuter (HQHVSN) services within California registered veterinary premises. They would like to expand their necessary services through MASH style clinics. MASH style clinics enable Animal Balance and SF SPCA to "sterilize (and vaccinate) over 60 animals per day, and 200 animals over a three-day clinic."

As stated in the letter, "MASH clinics involve a single space that operates as a complete registration-through-discharge operation. The clinics are often set up inside a large room, such as a community center or gymnasium. They can be set up in any community, and are designed to be inclusive, accessible and affordable."

The main concern raised in the letter is the current regulatory requirements in California Code of Regulations (CCR), title 16, section 2030, subsections (g)(1) through (5), that require a surgery suite to have walls from the ceiling to the floor and a door. Animal Balance and SF SPCA state, "The undisputed crisis with respect to access to spay-neuter services, and the reality of disaster-response situations, presents the urgent need for a formal exemption for temporary HQHVSN and disaster response clinics that do not meet the current surgery suite requirements."

At the Board's July 16-27, 2025 meeting, Board members expressed strong interest in further research, through the MDC, of these issues. It was also anticipated these issues would be discussed more thoroughly after the public comment period for the recently approved alternate veterinary premises rulemaking (rulemaking). However, public

comment for the rulemaking ended on August 4, 2025, and the Board received no adverse comments.

On August 15, 2025, the Veterinary Practice Subcommittee met with representatives from Animal Balance, SF SPCA, and San Diego Humane Society to discuss the concerns raised in the July 7, 2025 letter. During the discussion, it was acknowledged MASH style clinics were not contemplated when the rulemaking was drafted, and the mobile veterinary premises were not intended to allow for aseptic surgeries to occur in large open settings like community centers or gymnasiums. As such, the Veterinary Practice Subcommittee invited the representatives to present to the MDC at its next meeting.

During the October 14, 2025 MDC meeting, representatives from San Diego Humane Society and Animal Balance provided a presentation to the MDC regarding how HQHVSN services are performed in a MASH style clinic. The presentation and subsequent MDC discussion can be seen here.

After hearing the MDC overview at the Board meeting the following day, the Board directed the MDC to continue researching HQHVSN services in MASH style clinics, focusing on concerns related to establishing the veterinarian-client-patient relationship (VCPR) and veterinary premises requirements. The Board encouraged the MDC to research any data specific to safety and infection rates and make recommendations to potentially amend regulations to allow MASH style clinics in California. The full Board discussion can be seen here.

Update and Recommendations

Since the MDC/Board meeting, MDC members Maria Solacito, DVM and Dr. Cheryl Waterhouse, DVM formed a Subcommittee to research this issue further. The Subcommittee independently researched HQHVSN services and MASH clinics and spoke with multiple veterinarians with significant HQHVSN experience. They also met with UC Davis representatives responsible for creating the HQHVSN education pursuant to Senate Bill (SB) 1233.

As discussed in more detail below, the Subcommittee provides the following recommendations:

- No amendments to VCPR requirement.
- Consider initiating a rulemaking to:
    - Define “high volume spay and neuter services”
    - Provide specified exemptions for mobile veterinary premises from which services are solely provided at temporary “pop up” locations created for the purposes of high volume spay and neuter events.
    - Add notification requirements so the Board can adequately enforce the minimum standards and so consumers know some surgeries may be performed as “clean” surgeries and not sterile surgeries.

Response to VCPR Concern

California Code of Regulations (CCR) section 2032.15 provides the following:

> (a) A veterinarian-client-patient relationship may continue to exist, in the absence of client communication, when:
>
> > (1) A veterinarian-client-patient relationship was established with an original veterinarian, and another designated veterinarian serves at the same location where the medical records are kept in the absence of the original veterinarian, and;
> >
> > (2) The designated veterinarian has assumed responsibility for making medical judgments regarding the health of the animal(s), and;
> >
> > (3) The designated veterinarian has sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means that the veterinarian is personally acquainted with the care of the animal(s) by virtue of an examination of the animal(s) or by medically appropriate and timely visits to the premises where the animal(s) is kept, or has consulted with the veterinarian who established the veterinarian-client-patient relationship, and;
> >
> > (4) The designated veterinarian has continued the medical, treatment, diagnostic and/or therapeutic plan that was set forth and documented in the medical record by the original veterinarian.
>
> (b) If the medical, treatment, diagnostic and/or therapeutic plan differs from that which was communicated to the client by the original veterinarian, then the designated veterinarian must attempt to communicate the necessary changes with the client in a timely manner.

Based on the Animal Balance presentation, it appears they are complying with CCR section 2032.15. And, while an Animal Balance presenter agreed establishing/maintaining the VCPR can get challenging in MASH style clinics, the Animal Balance founder later clarified to the Subcommittee that they do not have any concerns related to the VCPR. As such, the Subcommittee does not recommend any amendments at this time.

Defining “High Volume Spay and Neuter Services”

While “High Quality, High Volume, Spay and Neuter Services” is commonly used, it is not currently defined. Since “high quality” is subjective in nature and could imply standard spay and neuters are not of equal quality, the Subcommittee recommends not including the term “high quality” in any definition. Using the term “high quality” may also mislead consumers into thinking the Board has determined these services are higher quality based on set criteria (e.g., additional education, stricter requirements, etc.).

The Subcommittee would like the MDC to consider “high volume spay and neuter services” be defined as follows:

> A “high volume spay and neuter services” means the surgical sterilization by a veterinarian of 30 or more dogs, cats, or rabbits or any combination thereof, within 12 consecutive hours.

Specified Exemptions for Mobile Veterinary Premises

CCR section 2030.2 defines a “mobile veterinary premises” as “a mobile unit or vehicle within or from which veterinary services are being provided.”

During the alternate premises regulation discussions, large animal veterinarians and veterinarians performing “house calls” were considered mobile veterinary premises since the veterinarians provide the service *from* their vehicle. They drive their vehicles with any necessary portable equipment and medications to barns, stables, open fields, or client homes.

If the mobile veterinary premises is not tied to a fixed veterinary premises, veterinarians register their mobile veterinary premises (i.e., their vehicle) with the Board rather than registering each location the mobile veterinary premises visits.

Similarly, veterinarians drive their vehicles with their portable equipment and/or medications to large open spaces to provide their services. As such, they are providing services *from* their vehicle and are considered mobile veterinary premises.

Mobile veterinary premises are required to comply with all minimum standards in CCR section 2030 except for section 2030 (a)(5) related to signage posting and section 2030 (e) related to the building code standards. Notably, CCR section 2030.2 (a) provides the same consumer protection as 2030 (a)(5). In addition, the exemption to 2030 (e) was necessary to make it clear that, even if a mobile veterinary premises is providing services from a vehicle and going into a fixed building temporarily, such as a barn or client home, that building would not be considered a veterinary premises subject to building code standards.

Potential Exemption for Aseptic Surgical Room

The current request is that all HQHVSN services in MASH style clinics be exempt from the separate surgical room requirement and instead be performed in designated open areas. To determine whether a separate surgical room is currently required, the Subcommittee first examined whether all high volume spay and neuter surgeries are considered “aseptic” or whether they could be considered “clean” as defined in CCR § 2030 (d).

> “Aseptic Surgery”
> While not defined in the Veterinary Medicine Practice Act, “aseptic surgery” is generally understood as surgery requiring a set of specific, strict practices to create an environment *entirely* free of microorganisms, such as bacteria and

viruses. Its primary goal is to prevent the introduction of harmful pathogens into a patient's body, thereby reducing the risk of surgical site infections.

Mobile veterinary premises providing aseptic procedures are required to be performed in a separate surgical room (CCR § 2030.2 (c) and must comply with additional requirements specified in CCR section 2030 (b).

“Clean Surgery”
“Clean surgery” is defined as the performance of a surgical operation for the treatment of a condition and under circumstances which, consistent with the standards of good veterinary medicine, do not warrant the use of aseptic surgical procedures (CCR § 2030 (d)).

When performing clean surgery, the instruments used to perform such surgery shall have been sterilized, and the surgeon(s) and ancillary personnel shall wear clean clothing and footwear when appropriate (CCR § 2030 (c)).

In general, surgeries performed on equine and livestock in the field are considered “clean” surgeries and are not subject to the separate surgical room or other aseptic requirements. This is primarily due to practical limitations such as:

- Environmental Challenges: Large animal surgeries often occur in barns or fields, where it is impossible to eliminate all environmental bacteria.

- Contamination Rates: The skin of equine and livestock carries high bacterial loads, and it is often not possible to completely sterilize the operative site.

- Field Limitations: Field conditions lack the ability to fully sterilize tools or maintain a strict sterile field (e.g., using sterile gloves and gowns) in the same way an operating room does.

- Cost: Intensive, high-cost sterilization protocols are often not financially feasible or practical in food-animal production, where procedures like castration and dehorning are standard.

The goal of a clean surgery is not to eliminate all bacteria, but to reduce the number of germs to a level that the patient's immune system can handle.

Traditional vs. High Volume
Traditional small animal spay and neuter surgeries have historically been considered as aseptic procedures.

However, newer high-volume techniques generally utilize smaller, more precise incisions compared to traditional techniques and are significantly faster (e.g., less than fifteen minutes for high volume compared to 30-40 minutes for traditional).

While the available data is limited, entities known for performing high volume techniques report relatively low infection rates.

As such, there was discussion as to whether high volume spays and neuters could be considered “clean” surgeries.

High Volume Spays vs. High Volume Neuters

The Subcommittee and Board staff consulted with the UC Davis veterinarians who are creating the HQHVSN education programs pursuant to Senate Bill (SB) 1233. After multiple discussions regarding the difference between “clean” and “aseptic” surgery, a consensus was reached that a feline, canine, and rabbit spay is considered an aseptic surgery.

It was further agreed that feline neuters and scrotal canine neuters, on the other hand, could be considered “clean” surgeries, thereby not subjected to the aseptic requirements. This is because these are procedures performed on healthy tissues, and with minimal risk of contamination.

Separate Surgical Room

While a consensus was reached regarding “clean” and “aseptic” surgeries, there was not a consensus as to whether high volume spays in MASH style clinics should be required to be performed in separate surgical rooms.

Some believe that spays must be performed in a separate surgical room to maintain the aseptic aspect of the procedure. Arguably, the moment the surgery is performed in an open space outside of a dedicated surgical room, the surgery is no longer free of microorganisms and harmful air pathogens. There is concern about hair contamination from the surgical prep area where the hair is clipped from the surgical site.

Those with this view believe high volume spays performed in MASH style clinics can comply with the separate surgical room requirement by setting up a surgical tent reserved for animal spays.

Others believe high volume spays can be performed in a separate and distinct area, rather than a room, reserved for aseptic surgical sterilization. The area could be required to be a specified distance away (e.g., at least ten feet away) from foot traffic, sinks, storage or trash bins, outside doors, or equipment not normally related to aseptic surgical sterilization procedures.

Allowing spays to be performed in a designated area aligns with the Association of Shelter Veterinarians’ 2016 Veterinary Medical Care Guidelines for Spay-Neuter Programs (Attached). Those guidelines state, in pertinent part, the following:

Operating area environment
The operating area should be a room or space in which anesthesia, surgery, and immediate postoperative recovery can be safely performed. The necessary equipment for performing anesthesia and patient monitoring should be present and readily available. Traffic within the operating area should be limited to essential personnel. Sanitation procedures should be carried out on a regular schedule.

Since a consensus was not reached, the UC Davis representatives and other veterinary surgeons specializing in high volume spays and neuters were invited to present their perspectives during the April MDC meeting.

The Subcommittee requests the MDC and the Board discuss all perspectives and consider the consumer and patient impacts of the requirements. If entities such as Animal Balance claim they cannot comply with the separate surgical room requirement, the risks to animal patients if aseptic spays are performed in designated areas should be compared to the high animal euthanasia rates throughout California.

<u>Additional Potential Exemptions</u>
Similar to animal vaccination veterinary premises, high volume spay and neuter mobile veterinary premises are solely providing specific limited services at scheduled events. As such, the Subcommittee recommends considering exempting mobile veterinary premises performing services at high volume spay and neuter events from the following:

CCR section 2030:

(a) Unless otherwise specified in this article, all veterinary premises shall maintain the following minimum standards:

…

(7) The veterinary premises shall have the capacity to render diagnostic radiological services, either on the premises or through another veterinary premises or outside service. Radiological procedures shall be conducted in accordance with all applicable state, federal, and local laws and regulations.

(8) Clinical pathology and histopathology diagnostic laboratory services shall be available within the veterinary premises or through another veterinary premises or outside service.

…

(10) Sanitary methods for the disposal of deceased animals shall be provided and maintained.

In addition, the Subcommittee recommends considering exempting mobile veterinary premises who solely provide high volume spay and neuter services at low cost or no

cost to the public from veterinary premises application, registration and renewal fees. “Low cost” could mean a certain percentage (e.g., fifty percent) lower than the average price for the same services within a certain distance (e.g., 50-mile radius) from the event location. Since fees are set in statute, this exemption would likely require legislation.

Board Notification

To ensure these high volume spay and neuter events comply with required standards, the Board would need to be notified ahead of time when and where the events are occurring as well as what veterinarians are performing the veterinary services. If fee exemptions are requested, the Board would need to know the method for determining whether the services were low cost.

Consumer Notification

To ensure consumers are informed prior to having their animal spayed or neutered at the high volume spay and neuter events, the mobile veterinary premises should notify consumers that some surgeries may be performed as “clean” surgeries and not sterile surgeries.

Requested Action

After thoroughly considering all perspectives, please provide further guidance on the Subcommittees recommendations and what should be included in draft regulatory language.

Attachment:

1. The Association of Shelter Veterinarians’ 2016 Veterinary Medical Care Guidelines for Spay-Neuter Programs

Special Report

The Association of Shelter Veterinarians' 2016 Veterinary Medical Care Guidelines for Spay-Neuter Programs

Association of Shelter Veterinarians' Veterinary Task Force to Advance Spay-Neuter

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This article has not undergone peer review.

As community efforts to reduce the overpopulation and euthanasia of unwanted and unowned cats and dogs have increased, many veterinarians have increasingly focused their clinical efforts on the provision of spay-neuter services. Because of the wide range of geographic and demographic needs, a wide variety of spay-neuter programs have been developed to increase delivery of services to targeted populations of animals, including stationary and mobile clinics, MASH-style operations, shelter services, community cat programs, and services provided through private practitioners. In an effort to promote consistent, high-quality care across the broad range of these programs, the Association of Shelter Veterinarians convened a task force of veterinarians to develop veterinary medical care guidelines for spay-neuter programs. These guidelines consist of recommendations for general patient care and clinical procedures, preoperative care, anesthetic management, surgical procedures, postoperative care, and operations management. They were based on current principles of anesthesiology, critical care medicine, infection control, and surgical practice, as determined from published evidence and expert opinion. They represent acceptable practices that are attainable in spay-neuter programs regardless of location, facility, or type of program. The Association of Shelter Veterinarians envisions that these guidelines will be used by the profession to maintain consistent veterinary medical care in all settings where spay-neuter services are provided and to promote these services as a means of reducing sheltering and euthanasia of cats and dogs.

Spay-neuter programs represent a crucial component of community efforts to reduce the sheltering and euthanasia of unwanted and unowned cats and dogs. Designed to facilitate access to spay-neuter services among targeted populations of animals, spay-neuter programs prevent reproduction, reducing birth-rates and subsequent overpopulation. By targeting underserved populations for which spay-neuter services are unlikely to be available or accessible, these programs provide surgical sterilization to animals that are most at risk for contributing to shelter impoundment and euthanasia. In the United States, these typically

ABBREVIATIONS

ASV	Association of Shelter Veterinarians
HQHVSN	High-quality, high-volume spay-neuter

include pets from low-income households and community cats (ie, unowned free-roaming cats, including unsocialized feral cats and socialized stray cats).[1–4]

Over the past decade, spay-neuter practice has emerged as a rapidly growing area in clinical veterinary medicine. Currently available spay-neuter services include designated stand-alone spay-neuter practices in stationary and mobile clinics, MASH-style operations, shelter services, community cat programs, and voucher systems as well as other in-clinic programs provided through private practitioners. Many veterinarians provide spay-neuter services to large numbers of patients on a regular basis. Spay-neuter programs have also been incorporated into clinical training programs for students at most veterinary colleges in the United States.[5]

Recognizing that the proliferation and diversity of spay-neuter programs created a need for guidelines for appropriate veterinary medical care in these settings, the ASV convened a task force to develop veterinary medical care guidelines for spay-neuter programs in 2006. These guidelines, which were published in 2008,[6] consisted of recommendations for preoperative care, anesthetic management, surgical care, and postoperative care and were based on current principles of anesthesiology, critical care medicine, infection control, and surgical practice, as determined by reviews of the scientific literature and expert opinion. While focused on high-volume spay-neuter programs, the guidelines were intended to be applicable and achievable in any veterinary practice environment providing spay-neuter services. In 2014, the ASV reconvened its task force for the purpose of updating these guidelines by reviewing current scientific literature and integrating the latest information and evidence available into its recommendations for spay-neuter practice. In this second edition of its guidelines, the task force included general guidelines for patient care and clinical procedures and added recommendations for operations management of high-volume spay-neuter programs to address management, staff, and clinic issues.

The ASV defines HQHVSN services as efficient surgical initiatives that meet or exceed veterinary medical standards of care in providing accessible, targeted sterilization of large numbers of cats and dogs to reduce their overpopulation and subsequent euthanasia. The ASV supports continued development of HQHVSN services to provide the necessary capacity to serve existing cat and dog populations. While recognizing the importance of high-volume spay-neuter services, the ASV remains committed to the delivery of high-quality care to each individual animal. The ASV believes that the application of its veterinary medical guidelines for spay-neuter programs will enhance the quality of patient care, reduce risks, and improve patient outcomes in all settings where surgical sterilization is performed. While the ASV recognizes that nonsurgical sterilization is an emerging approach that may be of value for specific populations or patients, these guidelines do not include recommendations for nonsurgical methods of sterilization.

In developing these guidelines, the ASV seeks to support HQHVSN programs, encourage increased veterinary and public participation, facilitate patient referral, provide guidance for veterinarians in this practice area, encourage existing programs to recognize and adhere to these guidelines, and provide a reference for the veterinary profession, including state boards of veterinary medicine, other governing agencies, and veterinary professional associations as well as spay-neuter program donors and funding agencies. In keeping with its original intent, the ASV hopes that these guidelines will be used by the profession to maintain consistent veterinary medical care in all settings where spay-neuter services are provided and promote these services as a means to reduce sheltering and euthanasia of cats and dogs.

Guidelines for Patient Care and Clinical Procedures

As is the case for all clinical veterinary practice settings, attention to the details involved in providing patients with quality care during all aspects of their veterinary experience is integral to success. The provision of safe and humane patient housing and handling practices, infection control procedures, proper record keeping, emergency readiness protocols, and follow-up and emergency care plans are important considerations for spay-neuter programs.

Patient transportation services

Spay-neuter programs may include patient transport provided by program personnel to and from the clinic for surgery. Acknowledging the inherent risks associated with transport of live animals, provisions for safe transport are essential and should include the following considerations[7,8]:

- Proper confinement of animals and securing of enclosures.
- Means of verifying the identity of patients and matching them with corresponding medical records.
- Good air quality and comfortable temperatures with appropriate heating, air-conditioning, and ventilation.
- Periodic monitoring of animals within the transport vehicle.

Patients should be observed at appropriate intervals during transport as determined to be necessary on the basis of needs of the animals, duration of transport, and attendant environmental temperatures. Commercially available monitoring devices are especially helpful during extended transport. Patient monitoring may be facilitated by video surveillance without compromising efficiency or security. In addition, the use of portable, remote temperature and air-quality monitors may enhance monitoring during transport. The timing and methods of monitoring are chosen at the discretion of the program, taking into account the constraints associated with transport, resources,

and safety. To the extent possible, strategies to reduce animal stress during transport, including separation of species, should be employed.

Record keeping

Record-keeping procedures should comply with federal, state, and local laws and regulations. A medical record should be prepared for each animal and should include physical examination findings, body weight, information on all drugs prescribed and administered (including doses and routes of administration), the surgical procedure performed, any abnormalities identified, and any other pertinent information regarding the animal's condition. Standardized operative reports may be used but should allow for additions when necessary.

Vaccination

Vaccination is recommended prior to the day of surgery, but perioperative vaccination is safe and acceptable when necessary and can effectively confer immunity.[9–12] Vaccination against rabies should be strongly recommended, as it is mandated by state and local laws and regulations. Spay-neuter programs can facilitate owner compliance by offering rabies vaccination; however, pet owners are ultimately responsible for maintaining their pets' current vaccination status in accordance with existing laws and regulations. Vaccination procedures should follow current guidelines established by the American Association of Feline Practitioners and the American Animal Hospital Association.[13,14]

Patient handling and housing

Proactive strategies to decrease patient stress and fear while promoting patient comfort are essential components of patient care in all clinical settings. Among these strategies, safe, low-stress handling is a key requirement for animal health and well-being.[15,16] Dogs that do not walk willingly on a leash should be carried when possible. Cats exhibiting signs of fractious or feral behavior should be transported in covered traps or other transport carriers.

Procedures for temporary housing of patients before and after surgery must be designed to enhance safety and comfort. The following recommendations pertain to temporary housing.

- A system must be in place for identification of individual animals.
- Housing must allow for adequate temperature control and ventilation and stress reduction.
- Species should be separated to the extent possible.[17]
- Noise and other environmental stressors, such as barking, loud music, and unnecessary foot traffic, should be minimized.
- Housing must be properly cleaned and disinfected between patients.
- Tractable adult animals should be housed in individual cages or runs or in portable crates or pet carriers that allow for good visibility and adequate space to stand and turn around as well as for safety at various stages of sedation and anesthesia.
- At the discretion of the attending veterinarian, littermates or housemates may be housed together or with their mothers prior to administration of sedation or anesthesia.[18–21]
- Intractable or feral animals should be housed in traps or other enclosures that allow for administration of anesthetics without extensive handling to minimize animal stress and maximize handler safety.
- Intractable or feral animals should only be removed from their traps or enclosures after sedation.

Handling and movement of sedated and anesthetized patients warrant special considerations. The head and neck should be supported and maintained in straight alignment with the patient's body to promote optimal airway patency. The patient's torso should be continuously supported to avoid stressing joints. Patient comfort should be continuously addressed by ensuring proper thermoregulation and managing stress and pain.

Infectious disease control procedures

Reducing the potential risk of infectious disease exposure for patients undergoing spay-neuter surgery is a crucial priority. From the time of initial patient contact until discharge, patients should be carefully observed for signs of infectious disease. When such signs are identified, the patient should be segregated from other patients for the duration of its clinic stay. As is typical for any veterinary setting, standard procedures for cleaning, disinfection, and containment of potential infectious diseases should be established and regularly practiced.

In particular, spay-neuter programs should include the following biosecurity measures:

- Between each patient, all equipment with direct patient contact (eg, examination tables, endotracheal tubes, masks, laryngoscope blades, pulse oximeter clips, esophageal stethoscopes, and thermometers) should be thoroughly cleaned and disinfected with agents known to destroy common veterinary pathogens, including unenveloped viruses (eg, parvovirus and calicivirus), which are resistant to some disinfectants.[22,23]
- Anesthetic equipment should be inspected, cleaned, and maintained on a schedule commensurate with surgery volume.
- Staff should wash or sanitize their hands or change gloves between patients and litters.
- If determined to be appropriate surgical candidates, animals with clinical signs consistent with contagious infectious disease should be scheduled to undergo surgery following completion of procedures on all apparently healthy animals.

Spay-neuter programs may routinely admit patients from multiple sources on the same day, such as animals from shelters or rescue organizations. Strategies to limit cross-contamination among patients from multiple sources should be employed. For example, separate

sets of equipment could be designated for use with patients from a common source. In this situation, each set of equipment would be used on a rotating basis for patients from the designated source. When feasible, housing animals in cohorts by source or scheduling patients from different sources on different days may also facilitate infectious disease control.

Preparation for emergencies

Emergency readiness protocols are essential. A veterinarian should be present and available to triage and address complications that might occur during anesthesia, surgery, or the immediate postoperative period and should remain on the clinic premises until all patients are extubated, sternal, and responsive. Clinic staffing should be appropriate and commensurate with the volume of patients as necessary to provide high-quality veterinary medical care in accordance with these guidelines.

Clinic staff and volunteers should be trained to recognize emergencies. Designated clinic staff trained in cardiopulmonary resuscitation should be available to provide life support, if required. Staff training can include regular drills or rounds to review identification of respiratory or cardiovascular arrest versus depression and the fundamentals of cardiopulmonary resuscitation. Rounds may also include equipment inspections, record keeping for emergencies, reviews of difficult cases, and morbidity-mortality rounds.[24–26]

Standard emergency equipment, including a source of oxygen and means of ventilation (eg, an anesthesia machine or manual resuscitator[a]) and emergency drugs and reversal agents dated for current use, must be readily available in ample supply in all situations. In addition, emergency drug charts containing volumes of drugs to be administered by body weight (on the basis of the concentration of drug available) should be readily accessible to facilitate rapid preparation of doses. Emergency drug charts can be found in several references.[25–27]

Follow-up and emergency care

Spay-neuter programs must establish regular policies for managing complications and emergencies that occur after surgery. If possible, the program should perform its own reexaminations. For MASH-style and mobile unit programs, contingencies for emergency veterinary care must be arranged in advance. In the event of inpatient death, the owner, caregiver, or duly authorized agent should immediately be notified and permission to perform a necropsy should be requested. Patient discharge instructions should indicate that the clinic should be contacted regarding postoperative concerns or problems that may arise. In the case of patient death following discharge, a necropsy should be performed if possible to determine cause of death. The necropsy may be completed by a neutral source such as a diagnostic laboratory or by the clinic veterinarian with appropriate documentation.[28]

Guidelines for Preoperative Care

Careful attention to preoperative procedures and concerns is essential and fosters confidence in spay-neuter programs. Addressing client expectations and concerns, selecting patients appropriately, and ensuring patient safety collectively reduce client, patient, and staff stress. Each of these efforts increases the quality of patient care while reducing exposure to legal liability and positively supporting the program.

Patient selection

Patient selection will vary depending on clinic staffing, anesthetic capabilities, locale, technical training, and economics. A veterinarian should make the final decision regarding acceptance of any patient for surgery with acceptance based on historical and physical examination findings and the program's surgical schedule. The surgeon should use discretion regarding minimum and maximum patient age and body weight, taking into account the availability of staff expertise and necessary equipment to care for patients. Owned pets may best be served by scheduling surgery at 4 months of age or older to optimize development of immunity through timely vaccination. Neutering prior to sexual maturity is strongly recommended to prevent the birth of unintended litters, which commonly occurs when surgery is delayed.[8,16,29–37] In situations involving pediatric and adult animals that will be placed for adoption, neutering is best performed prior to adoption (as early as 6 weeks of age) to ensure compliance.[8,16,32–37] Neutering prior to adoption is likely to improve the odds that adopted animals will be retained in their new homes because being sexually intact has been identified as the leading risk factor for owner relinquishment of cats and dogs.[38–42]

Veterinarians must weigh the risks and benefits of neutering patients with mild infectious or noninfectious medical conditions, such as upper respiratory tract disease, parasite infestation, or subclinical heartworm infection.[43,44] Although some conditions may theoretically increase the risk of anesthetic complications or the risk of transmitting infectious diseases to other animals, the benefits of neutering likely outweigh these risks in the setting of a spay-neuter program.[45,46] Because the opportunity to neuter any individual animal may not present itself again in the future, the benefits of neutering such animals when the opportunity arises generally outweigh the risks posed by such medical conditions. For animals that are pregnant, lactating, or in estrus or that have pyometra, the task force's experience has been that neutering can be safely performed. Additional medical care should be provided if indicated by the patient's condition.

Client communication

A patient history must be obtained including current health status, current clinical signs of disease, current medications and supplements, previous vac-

cinations, pre-existing medical conditions, and previous adverse reactions. In addition, clients should be instructed to appropriately withhold food from their animals prior to surgery. Clients must be informed of surgical and anesthetic risks and must consent to the anticipated procedures.

Prior to initiation of anesthesia, consent forms should be signed by clients or their duly authorized agents (ie, individuals of legal age who are authorized to make decisions for the patient). Although the specific topics contained in the consent form may vary from one program to the next, topics to consider include the following items:

- Client confirmation of the patient's health, whenever possible.
- Acknowledgment of the risk of infectious disease exposure, including increased risk if the animal has not previously received vaccinations.
- Acknowledgment of the risks of anesthesia and surgery, including death.
- Acknowledgment of the risks of transport, if applicable.
- Notification of any permanent identification procedures, including tattooing, ear tipping, and microchipping.
- Authorization for surgery and other procedures.
- Recommendation that ongoing health care be provided by a full-service veterinary clinic.
- Client contact information, including emergency telephone numbers.
- A description of fees, if any.

Withholding food

Food should be withheld from all animals for an appropriate period prior to surgery[47]; however, withholding water is neither necessary nor recommended. For pediatric animals (ie, animals between 6 and 16 weeks old), a small meal should be fed 2 to 4 hours before surgery, and food should not be withheld for > 4 hours before surgery.[18–21] For juvenile and adult animals (ie, animals > 16 weeks old), food should be withheld for a minimum of 4 hours.[48–52] Although overnight fasting is acceptable, withholding food for > 6 hours is not necessary.[53] Exceptions to minimum fasting periods may be made for feral cats in traps because of the safety risks associated with removing uneaten bait.

Physical examination

For all patients, a physical examination should be performed by a veterinarian or a supervised veterinary student to qualify the animal as a surgical candidate. Ideally, the physical examination should be performed before the animal is anesthetized, but anxiety, aggression, or feral behavior may prevent a thorough examination prior to sedation or induction of anesthesia. Ultimately, whether the physical examination is performed before or after the animal is premedicated or anesthetized should be at the discretion of the attending veterinarian.

Physical examination should include verification of sex; reproductive status (sexually intact versus neutered) should be verified, if possible, by inspecting animals for the presence of ventral abdominal tattoos, surgically tipped ears, and other indicators of previous sterilization.[54] Microchip scanning can also be part of the physical examination.[55]

Body temperature may or may not be measured at the discretion of the attending veterinarian. In addition, preanesthetic diagnostic testing may or may not be performed at the attending veterinarian's discretion. Body weight should be determined as close to the time of surgery as possible. When weighing an individual animal is not feasible (eg, intractable or feral animals), body weight should be estimated as accurately as possible.

Guidelines for Anesthetic Procedures

Spay-neuter programs require safe and efficient protocols for anesthesia (ie, drug selection, perioperative care, monitoring, and overall technique) carefully designed to facilitate neutering of large numbers of animals in a short period. Balanced anesthesia is essential and involves the administration of a combination of drugs to safely produce effective analgesia, loss of consciousness, muscle relaxation, and immobility without patient compromise.[56]

Perioperative thermoregulation

Hypothermia can be an inadvertent perioperative problem in any surgical setting.[57–61] For most patients undergoing neutering through a spay-neuter program, there is a considerable potential for hypothermia. Therefore, efforts to maintain normal body temperature should be made from the time of patient admission until discharge.[62]

Prior to premedication and induction of anesthesia, ambient temperature and humidity should be controlled to keep animals comfortable. Drafts should be avoided, and animals should be kept dry. Body heat can be preserved through the use of various bedding materials, such as papers, towels, or blankets. The thermoneutral zone for cats and dogs will vary depending on the individual animal.[8,63–65] The recommended ambient temperature range for housing cats and dogs is between 18° and 28°C (64° and 84°F) with a temperature setting in the low to mid 70s being typical.[63] However, the temperature setting and amount of bedding material used for insulation should be tailored to the needs of individual animals. Animals recovering from anesthesia often require warmer environmental temperatures, and sick, frail, and pediatric patients may require warmer temperatures than healthy animals. The location of the animal should also be considered because there may be a temperature differential between the floor level and elevated enclosures.[63,64] If necessary, supplemental heat sources should be used, but care must be taken to prevent hyperthermia and

thermal burns. Studies[66-68] in human medicine demonstrate that patients remain warmer with warmer environmental temperatures in the preoperative, surgery, and recovery areas.

Prewarming patients prior to administration of premedications and anesthetic agents may reduce perioperative hypothermia.[69] Contact with cold surfaces, especially after premedications have been administered, will reduce patient body temperature, which subsequently is not easily increased during surgery. For this reason, contact with cold surfaces should be minimized to the extent possible, for example, by placing a small blanket, towel, fleece pad, or papers underneath each patient immediately following anesthetic induction and keeping these materials under patients as they are moved through various areas of the clinic (eg, preparation, surgery, and recovery areas). This technique may also serve to enhance biosecurity by providing a physical barrier to reduce the risk of cross-contamination among patients.

During patient preparation for surgery, excessive removal or moistening of the hair around the surgical site should be avoided, and warmed preparation solution should be used to minimize heat loss and aid in preserving the patient's body temperature.[70] The use of low oxygen flow rates with rebreathing anesthetic circuits can also help conserve body heat. However, low oxygen flow rates are inappropriate for use with nonrebreathing anesthetic circuits.[71] Surgery should begin as soon as possible after preparation is completed to minimize additional heat loss.

Intraoperative heat loss can be further minimized by limiting body cavity exposure, increasing environmental temperature, and providing additional insulation for patients (eg, by wrapping extremities in materials such as bubble wrap, newspaper, and polystyrene).[70] Active patient warming can be achieved through the use of heated surgical tables, semiconductive polymer fabric heating blankets, circulating warm water blankets, and warm air blankets.[72] Warmth in the patient's microenvironment can be provided by the use of carefully protected warmed containers. In contrast, unprotected contact with or careless use of blow dryers, heat lamps, drying cages, electric heating pads, and hot water or heated materials must be avoided to prevent thermal injury.[70]

Anesthesia equipment

The anesthesia equipment used in spay-neuter programs is generally the same as that used in any veterinary practice setting. However, when equipment is used in a high-volume setting, special consideration should be given to its use and maintenance to enhance patient safety. As in any surgical setting, all anesthesia equipment including endotracheal tubes, laryngoscopes, anesthesia machines, and monitors should be prepared and checked daily prior to use. Machine safety checklists are readily available.[73-76]

Anesthesia equipment in high-volume programs undergoes a high level of use, often by multiple personnel; therefore, all programs should develop and implement a regular maintenance schedule for equipment. The frequency of maintenance service should be commensurate with the level of use (ie, heavily used equipment in high-volume programs should be serviced more frequently). Anesthesia machines and monitors should be maintained in accordance with manufacturers' recommendations through regularly performed in-house procedures or regular outsourcing to equipment and vaporizer service companies.[74,77]

Carbon dioxide absorbents should be checked and changed regularly; higher volumes of patients dictate increased frequency of changing and cleaning of canisters. A waste gas scavenging system should be used; both active and passive systems are acceptable. For personnel safety, particularly in high-volume settings where surgery is performed for several hours a day on a regular basis, use of charcoal canisters for waste gas scavenging is discouraged. This is because charcoal canisters are effective for only short periods of time, typically < 6 to 8 hours or as determined by the weight gain of the canister, and may be variably effective.[78] When canisters are used, they must be carefully monitored, weighed regularly, and discarded at the conclusion of their effective service life.

Oxygen supplementation and ventilation strategies

While not required for all patients, oxygen supplementation, including before and after surgery, is recommended for high-risk patients, such as brachycephalic animals as well as those that are frail, ill, or in advanced stages of pregnancy. The ability to provide oxygen supplementation when medically indicated is a requirement for all spay-neuter programs. Appropriate flow rates for oxygenation by mask will vary depending on the patient's size, the breathing system used, and the degree of mask closure.[79] Oxygen flow rates for oxygen delivered through endotracheal tubes should be adequate and specific for the rebreathing or nonrebreathing circuits being used.

Ventilation can be accomplished in anesthetized patients by connecting the anesthesia machine to a rebreathing circuit with a functional carbon dioxide absorbent or to a nonrebreathing circuit with appropriate oxygen flow rates. Alternatively, a manual resuscitator[a] connected to an oxygen source with a regulator can be used as a means of oxygen supplementation and ventilation. Ventilation is compromised when carbon dioxide absorbents are depleted or exhausted; therefore, vigilance in monitoring carbon dioxide absorbent adequacy is necessary. Ventilation is also compromised when inappropriately low oxygen flow rates are used with nonrebreathing circuits. Capnography is a useful tool for judging adequacy of ventilation, carbon dioxide absorbent adequacy or other causes of rebreathing, and patient circulatory status.[80]

Airway management

For cats, dogs, and rabbits, options for airway management include the use of facemasks and en-

dotracheal tubes. An additional option is to use commercially available supraglottic airway devices.[81–87] When used, airway management devices should be properly fitted and carefully secured in place. Tape or ties made from plastic tubing, gauze, or other materials are acceptable for this purpose. When using a mask in patients with nasal congestion, care must be taken to ensure that the mouth remains open for breathing.

Intubation provides patients with a usable, patent, artificial airway but does not necessarily imply the use of oxygen or inhalant anesthetics. Historically, intubation with a cuffed endotracheal tube represented the gold standard for maintaining a protected airway in anesthetized patients.[88] However, intubation requires training, practice, time, patience, and the proper depth of anesthesia and may compromise patient care if it is not performed with skill, care, and efficiency.[89,90] Improper or traumatic placement of endotracheal tubes can increase patient risk, especially in cats.[91–93] A recent large-scale epidemiological investigation[94] of risk factors associated with anesthetic complications documented that intubation of cats is not a benign technique and may result in iatrogenic trauma. Furthermore, the study[94] documented a significant increase in the risk of adverse events related to intubation, including death, for cats undergoing a short duration of anesthesia (< 30 min). On the basis of these findings, it is acceptable not to intubate cats for procedures of short duration provided equipment for intubation is available in case of an anesthetic emergency.

The benefits of intubation must be weighed against the potential detriments for all patients undergoing spay-neuter surgery. When balanced anesthesia is achieved through the use of injectable drug protocols, routine intubation of all patients undergoing spay-neuter surgery is not required. However, the ability to perform intubation when medically indicated, including rapid intubation in emergency situations, is required for all spay-neuter programs.[25,27] If intubation is performed as a standard part of an anesthetic protocol, having an anesthesia team that possesses the required skills for this maneuver is critical to success.[24] The anesthetist must verify the placement of the endotracheal tube by direct visualization or by the use of a capnograph. In particular, patients that may benefit from intubation include all brachycephalic patients, overweight or obese patients, animals in advanced stages of gestation, patients with existing severe upper respiratory disease, and patients for which procedures are anticipated to require a longer duration of anesthesia (eg, > 30 minutes).

Fluid therapy

Fluid administration is not required for all elective surgical procedures, especially when surgical times are brief.[95,96] Fluid supplementation is recommended for high-risk patients, such as those that may be presented for ovariohysterectomy in advanced stages of pregnancy or with evidence of pyometra, and when substantial blood loss or prolonged surgery times are anticipated or encountered. The ability to provide IV fluid administration when medically indicated is required for all spay-neuter programs. For routine fluid support for many patients, SC administration is adequate. When SC fluids are used, administration during the immediate postoperative period is recommended because this avoids the stress and pain associated with SC administration in awake patients. For those patients at greatest risk of clinically important hypothermia (eg, pediatric, small, frail, and ill patients), consideration should be given to warming the fluids to body temperature prior to administration or the fluid line during administration.[67,97] Fluid administration may enhance recovery from anesthesia. When used, fluids should be administered in accordance with current veterinary medical guidelines for fluid therapy.[96]

Monitoring

Each individual patient should be carefully monitored beginning at the time of administration of premedications or anesthetic agents and continuing until the conclusion of the recovery period. Patient monitoring is essential for safety as well as ensuring maintenance of a safe and adequate plane of anesthesia.[98] Identification of changes in vital parameters is essential for accurate assessment.[80] The most reliable means to ensure ongoing patient assessment and safety during anesthesia is vigilant, hands-on observation by trained staff. In general, monitoring of several variables is required to accurately assess the plane of anesthesia. Reliance on any single variable can lead to an inadequate plane of anesthesia or, conversely, to an excessive depth of anesthesia, increasing the risk of complications, including death.[99]

Depending on individual circumstances, monitoring should involve assessment of various combinations of vital parameters. In accordance with current veterinary anesthesia monitoring guidelines, the use of an objective means of monitoring is also necessary.[76] Options include but are not limited to pulse detection via palpation or Doppler ultrasonography, auscultation of the heartbeat, pulse oximetry, capnography, and blood pressure monitoring. The use of pulse oximetry is highly encouraged because this modality provides an objective auditory and visual means of determining the presence of a pulse, pulse rate, and adequacy of oxygenation.[100] Use of pulse oximetry monitors has been shown to decrease the risk of anesthetic death in cats.[101] Pulse oximetry is preferred over electrocardiography, which may not accurately assess heart rate because it reflects electrical rather than mechanical activity and does not provide an indication of oxygenation.[102]

Although the use of various types of equipment can enhance patient monitoring, such equipment use should not serve as a substitute for continual monitoring by trained staff. The precise time frames for and means of monitoring and recording vital parameters are at the attending veterinarian's discretion and

should be appropriate for each program, patient, and procedure.

Pulse quality, rate, and rhythm—It is important to directly monitor patient pulse quality. The pulse can be assessed by manual palpation of the radial, dorsal metatarsal, femoral, lingual, facial, or carotid arteries.

Respiratory rate and pattern—Monitoring respiratory rate and pattern is particularly useful in the early identification of anesthetic problems. Respiratory rate should be assessed by observing chest excursions or by auscultating the lungs with a stethoscope. Direct monitoring is preferred over the use of respiratory or apnea monitors, which may sense false flow impedance changes that are more indicative of abdominal manipulation during surgery (false diaphragmatic motions) than effective respiration.[103] Similarly, monitoring of respiration solely on the basis of rebreathing bag movement may result in an inaccurate assessment.

Jaw tone—A moderately relaxed jaw tone is indicative of a surgical plane of anesthesia in most patients. Lax jaw tone may indicate excessive anesthetic depth, whereas tense jaw tone may be associated with an inadequate plane of anesthesia or be related to the use of dissociative anesthetic agents. An important caveat is that pediatric puppies normally lack mandibular tone; therefore, jaw tone should not be used to assess anesthetic depth in these patients.[80]

Eye position and pupil size—In general, a central eye position with dilatation of the pupils indicates a potentially life-threatening depth of anesthesia. However, a central eye position and pupillary dilatation can occur in cats and dogs anesthetized with high doses of dissociative anesthetic agents and may not be associated with complications.[104,105] Moderate ventral rotation of the eyes often indicates an adequate surgical plane of anesthesia in most species but is dependent on the drug combination used for anesthesia.[99,106]

Palpebral reflex—A diminished palpebral reflex is a sign of greater anesthetic depth. However, this reflex may be absent in animals when an injectable anesthetic protocol has been used, especially when dissociative agents are included.[105,106]

Mucous membrane color and capillary refill time—Mucus membrane color and capillary refill time are subjective assessments of perfusion but should not be used as sole indicators of adequacy of circulation. Many factors, including age, body temperature, and Hct, affect these parameters. The presence of pallor is a nonspecific clinical finding; pale mucous membranes can indicate peripheral vasoconstriction, which often accompanies the use of α_2-adrenoceptor agonists, hypothermia, anemia, or hypoxemia. Notably, a normal capillary refill time may be observed following cardiac arrest.[107–110]

Anesthetic protocol

Selecting anesthetic protocols for spay-neuter programs depends on many factors, including the number and type of patients, the skill and efficiency of available technical assistance, the timing of and competence in various surgical and anesthetic techniques, and drug availability. Four criteria remain crucial to identifying the safest, most humane, and most time- and cost-effective anesthetic protocols. These include the provision of analgesia, stress reduction or anxiolysis, immobility and muscle relaxation, and safe, controlled, reversible depression of the CNS resulting in unconsciousness. Numerous cost-effective protocols combining multiple anesthetic and analgesic drugs, including injectable and inhalant agents, exist for achieving balanced anesthesia in pediatric and adult patients.[20,21,111–122] A complete listing of all effective and appropriate anesthetic and analgesic drugs is beyond the scope of these guidelines and is not included here. Extralabel use of many of these agents is an appropriate and common practice in any veterinary medical setting.

Accurate dosing of anesthetic agents

Given the high-volume nature of many spay-neuter programs, veterinarians may be tempted to use predetermined or standardized drug doses (ie, a one-size-fits-all approach). These approaches do not take into account individual patient temperament, weight, or health status and consequently can result in inappropriate dosing, including overdosing of smaller patients and inadequate dosing of larger ones. For example, use of a standard dose of dexmedetomidine for all cats regardless of size is not recommended. Similarly, administration of drug volumes that only fill the needle hub should be avoided. On the other hand, use of drug doses for animals categorized on the basis of body weight (eg, X µg of drug for patients weighing 1 to 2 kg [2.2 to 4.4 lb] and Y µg for patients weighing 2 to 4 kg [4.4 to 8.8 lb]) may be an acceptable means to facilitate dose preparation. Furthermore, use of a chart that expresses drug doses as a function of body weight may help prevent calculation errors. However, when using a dose chart, caution should be used for patient weights at both extremes of the range provided (ie, very small and very large patients). In these cases, dosing based on body surface area or metabolic scaling is recommended to improve accuracy. For situations in which an accurate body weight cannot be obtained prior to drug administration, such as programs serving community cats, safety is increased by using reversible agents, avoiding drugs that result in marked cardiorespiratory depression, and estimating body weight as accurately as possible.

Careful attention to the labeled concentration of each drug is also essential for accurate dosing. Concentrations of drugs used should be selected to result in appropriate volumes for patients in the program. If commercially available drug concentrations do not accommodate accurate dosing, stock concentrations

should be diluted as appropriate for individual drugs. For example, an anesthetic drug that is commercially available as a 10 mg/mL solution could be diluted to a 1 mg/mL concentration to aid in preparation of small doses. Finally, the use of compounded drugs may facilitate accurate dosing of patients; however, clinics must be in compliance with all federal, state, and local laws and regulations related to compounding.[123]

Administration of analgesics and anxiolytics

Analgesic agents are required for all patients undergoing neutering and should be administered prior to the initial surgical incision.[124–126] Acceptable choices include opioids, α_2-adrenoreceptor agonists, NSAIDs, and local anesthetics.[127–150] Multimodal analgesia involves the use of multiple analgesic agents with different pharmacological mechanisms to control pain.[151] Its use is recommended whenever possible because agents work synergistically to control pain, usually with fewer adverse effects than when single agents are used and with improved analgesia.

Use and timing of NSAID administration should be based on the specific drug and individual patient. In particular, consideration should be given to patient hydration status and the presence of preexisting hepatic, renal, or gastrointestinal disease or clotting abnormalities.[125] Administration of NSAIDs to patients that are clinically or subclinically dehydrated should be avoided owing to the increased risk of adverse effects, including nephrotoxicosis.

Agents for stress reduction include minor and major tranquilizers (eg, acepromazine, midazolam, and diazepam) and α_2-adrenoreceptor agonists. These can be delivered in combination with analgesics.[111,129,152–155]

Total IM anesthesia

Administering a single injection that includes sedative, analgesic, and anesthetic induction agents may reduce patient pain and stress, compared with administering multiple injections. Combining premedications and anesthetic induction agents in a single injection is a useful technique for some spay-neuter programs. Recommended combinations for single injections include α_2-adrenoreceptor agonists, opioids, and dissociative drugs because such combinations provide patients with multimodal analgesia and balanced anesthesia when administered in appropriate doses.[45,119,156–163,b]

Anticholinergic agents

Anticholinergic agents may or may not be routinely administered as part of an anesthetic protocol.[76,164] However, they should be available in all spay-neuter clinics for individual patients and emergency use. Anticholinergic agents are not appropriate for the treatment of bradycardia induced by α_2-adrenoreceptor agonists[165,166] because of the increased cardiac workload that results. In rare cases when α_2-adrenoceptor agonist–associated bradycardia results in patient compromise, reversal or partial reversal of the α_2-adrenoceptor agonist should restore the heart rate.[167]

Induction and maintenance of anesthesia with inhalant anesthetics

Although there may be times when mask administration of inhalant anesthetics is required for patients in spay-neuter programs, use of mask administration should be minimized.[168] Furthermore, the use of a chamber for administration of inhalant anesthetics should be strictly avoided.

Mask induction—Mask induction refers to inducing general anesthesia through the delivery of inhalant anesthetics via a facemask. Mask induction should not be performed routinely and should be avoided[168] because loss of consciousness is poorly controlled and patients experience a relatively higher degree of stress during this method of induction, compared with stress associated with anesthetic induction using injectable agents. Furthermore, proper mask induction requires high oxygen flow rates, which produce substantial environmental contamination with waste anesthetic gases that can be particularly problematic in small spaces.[169,170,c] When inhalant anesthetics are used as sole agents, high concentrations are required for induction, which can potentially harm patients. In dogs, this method has been associated with a higher risk of anesthesia-related death.[171] Patients are more amenable to mask induction when adequately premedicated with injectable agents prior to administration of inhalant anesthesia.[47]

Chamber induction—Chamber induction refers to inducing general anesthesia through the delivery of inhalant anesthetics via a chamber (ie, an enclosure surrounding the animal or the animal's head and face). Given the availability of multiple safe alternative anesthetic protocols, the use of chamber induction in high-volume spay-neuter settings is rarely justified or necessary. However, in rare cases (eg, failure of an injectable protocol, lack of IV access, or extremely fractious animals that cannot be safely injected), chamber induction, particularly with rapid-acting induction inhalants such as sevoflurane, may be an appropriate choice for some animals. Clinicians should be aware that chamber induction produces the highest amounts of waste anesthetic gases.[47]

Mask maintenance—Mask maintenance or supplementation refers to continuation of general anesthesia for a period through the delivery of inhalant anesthetics via facemask. The use of mask maintenance on an as-needed basis for some patients is common in some spay-neuter programs. For cats, it may be safer than intubation for short procedures.[94] Potential risks associated with mask maintenance include bronchial irritation, aspiration of gastric contents, and environmental contamination with waste gases.[172–175] Fortunately, currently available, commonly used anesthetic gases (eg, isoflurane and sevo-

flurane) cause minor bronchial irritation, compared with the irritation caused by their precursors.[47] If mask supplementation becomes frequent or regular, altering the anesthetic protocol to reduce the need for it should be considered. For example, protocols could be altered to include employing more sedation and analgesia initially or administering additional analgesics, such as low doses of an opioid, ketamine, or an α_2-adrenoreceptor agonist, to maintain an adequate surgical plane of anesthesia.

Mitigating waste anesthetic gas exposure

Anesthetic machines may contribute to environmental pollution from waste anesthetic gases. In addition to performing daily leak tests and using properly functioning scavenging systems, several other measures should be routinely employed to limit waste gas release:

- Minimize airway leaks by using appropriately sized endotracheal tubes with proper cuff inflation.
- Eliminate as much residual gas as possible prior to disconnecting patients from the breathing system after surgery by turning off the vaporizer and allowing patients to breathe oxygen, ideally for 5 minutes, prior to disconnection.
- Prior to disconnecting patients, empty the rebreathing bag after the vaporizer is turned off and, if using a circle system, increase the oxygen flow rate to 2 to 3 times the maintenance rate to aid in flushing the system.
- Turn off vaporizers and flow meters when patients are disconnected from the anesthesia machine.
- Use caution when filling vaporizers to ensure that the room is well ventilated and as few staff members as possible are present.[168]

High-risk patients

Attending veterinarians may deem particular patients as being at a high risk for anesthetic or surgical complications on the basis of history and physical examination findings. Such patients may include brachycephalic and geriatric patients and patients with severe preexisting medical conditions. At the veterinarian's discretion, alternative anesthetic protocols may be indicated for high-risk patients. Anesthetic protocols for high-risk patients should rely less on agents that cause marked cardiorespiratory depression and might include the use of reversible agents, supplementation with oxygen and fluids, and intubation if airway patency is questionable. The veterinarian or a designated and supervised member of the care team should communicate with the owner, caregiver, or authorized agent of high-risk patients specifically about the patient's anesthetic risk.

Guidelines for Surgical Care

Use of spay-neuter surgical practices based on accepted principles of infection control, surgical asepsis, and surgical technique optimizes surgical success while decreasing the risk of complications. When surgical practices are efficient, surgery times are shorter, which in turn can be expected to improve patient recovery. Spay-neuter programs may establish and use standard operating procedures for surgical techniques, with these techniques tailored to the needs of individual patients at the surgeon's discretion. The practices described within these guidelines represent standards that are attainable in spay-neuter programs regardless of location, facility, or type of program.

Operating area environment

The operating area should be a room or space in which anesthesia, surgery, and immediate postoperative recovery can be safely performed. The necessary equipment for performing anesthesia and patient monitoring should be present and readily available. Traffic within the operating area should be limited to essential personnel.[176,177] Sanitation procedures should be carried out on a regular schedule.

Surgical pack preparation

Separate sterile instruments are required for each patient.[178–180] Instruments must be cleaned prior to sterilization. Sterilization of surgical packs may be accomplished with steam, gas, or plasma. The date of and person responsible for sterilization of packs should be identifiable. A sterility indicator should be located inside and outside the pack. Although sterility indicators do not ensure sterility of the pack, they help in the detection of procedural errors and equipment malfunctions and allow quick differentiation between processed and nonprocessed packs.[179] A number of materials, including reusable and disposable materials, are acceptable for the outer wrap of the surgical pack. The outer wrap material must provide a minimum microbial barrier equivalent to dry 270–thread count pima cotton.[179] Additionally, the wrap material and pack storage conditions must ensure sterility for the longest anticipated pack turnover interval.[179]

Patient preparation

The following issues should be considered during patient preparation.

Bladder—An empty urinary bladder simplifies abdominal surgical procedures and increases postoperative comfort for both male and female patients. If performed, caution should be exercised during bladder expression. If excessive pressure is necessary to express the bladder preoperatively and bladder expression is deemed necessary, urethral patency should be evaluated and expression should be delayed until deeper planes of anesthesia are attained or intraoperative examination and surgical expression are possible.

Skin—Preparation of the skin should be performed in a manner that preserves skin integrity. The prepared area should be large enough to prevent inadvertent contamination of the sterile surgi-

cal field and to accommodate extension of the incision if necessary. After hair removal, the entire skin area should be prepared with an appropriate surgical scrub agent used according to accepted patient preparation practices.[181,182]

Patient positioning—Ties, V-trays, adjustable tables, or other devices may be used to position patients for surgery. The patient's body may be maintained in a level or tilted position with the head and neck in straight alignment. Care should be taken to position the patient in a manner that avoids compression of the thorax or compromise of the diaphragm and that optimizes airway patency. The patient's limbs may be secured in place or left unconstrained at the discretion of the surgeon. Hyperextension of the limbs should be avoided, because it could limit excursion of the chest, compromising respiration, or result in increased tension on the suspensory ligaments, potentially complicating exposure of the ovaries and increasing postoperative discomfort. For abdominal procedures, the thoracic limbs may be positioned cranially such that they rest on either side of the head or neck or caudally such that they rest alongside the lateral aspects of the thorax. If ties are used to secure the limbs, care must be taken to avoid any constriction of the extremities.

Patient draping—Sterile patient draping is required for all abdominal procedures and for the castration of adult dogs. The surgical drape should be of adequate size to prevent contamination of the sterile field. Drape material must resist penetration by fluids and microorganisms under normal operating conditions.[181,183,184] The barrier function of reusable drapes is lost after repeated launderings; therefore, processing of packs should adhere to published guidelines for laundering, autoclaving, and useful service life.[185] For cats and puppies undergoing routine castration, use of a clean or sterile drape is left to the surgeon's discretion; however, if a drape is not used, extra care must be taken to prevent contamination during the procedure.

Surgeon preparation

The following issues should be considered with regard to surgeon preparation.

Surgical attire—The surgeon should wear appropriate surgical attire intended for use within the operating area.[186]

Surgical caps and masks—Surgical caps and masks[187] are required, except during routine castration of cats and puppies.

Surgical hand and arm scrub—Surgeons should perform appropriate hand and arm antisepsis prior to gloving for all abdominal surgeries and for castration of adult dogs.[183] This can be accomplished with a properly performed hand and arm scrub using an appropriate surgical scrub agent or by hand and arm washing followed by the application of a waterless surgical preparation agent in accordance with published guidelines.[188–196] For routine castration of cats and puppies, surgeons should wash their hands or perform hand antisepsis prior to gloving.

Surgical gowns—The use of sterile surgical gowns, either cloth or disposable, is left to the discretion of the surgeon provided that aseptic technique is maintained.

Surgical gloves—Single-use sterile surgical gloves are required for all abdominal surgeries and for castration of adult dogs.[187] For routine cat and puppy castration, either single-use sterile gloves or examination gloves are acceptable.

Surgical procedures

Veterinarians or veterinary students under the direct supervision of a veterinarian must perform all surgical procedures. For female cats and dogs, ventral midline, paramedian, flank, and laparoscopic approaches are acceptable and use of these approaches for ovariohysterectomy and ovariectomy in pediatric and adult patients has been described.[16,46,197–211] For male cats, scrotal approaches are acceptable, and for male dogs, prescrotal and scrotal approaches are acceptable. Use of these approaches for castration has been described for pediatric and adult patients.[16,46,200–202,211–218]

General principles of gentle tissue handling, meticulous hemostasis, and aseptic technique should be applied.[219,220] To reduce postoperative morbidity and improve overall outcomes, surgeons should strive to reduce surgical trauma in every way possible. Tissue handling, size and placement of sutures, and the length of the incision should all be considered. Small, properly located incisions can help to achieve the goal of minimizing surgical trauma while concurrently maintaining the goal of gentle tissue handling. Hemostasis must be ensured and verified prior to completion of procedures. Interrupted or continuous suture patterns are acceptable.[221]

Ovariohysterectomy and ovariectomy—There are many acceptable variations of the surgical procedures that can be used to sterilize female cats and dogs.[16,46,197–209,211,212,222–225] The particular surgical procedure and its details, including the length and location of the surgical incision and ligation techniques, will vary depending on the program, the veterinarian's preferences, and the individual patient's needs. In all cases, complete removal of both ovaries is required. For cats, ovarian pedicle ligation may be achieved by autoligation of the ovarian artery (ie, pedicle tie).[16,46,222,226,227] When ventral abdominal or paramedian incisions are used, closure must incorporate the external rectus fascia.[228,229] When flank incisions are used, closure must incorporate the transversus abdominus and internal and external abdominal oblique muscles.[212,228]

Spaying pregnant cats and dogs—When spaying pregnant cats and dogs, fetal euthanasia is not necessary to ensure humane death. Mammalian fetus-

es remain in a state of unconsciousness throughout gestation and, therefore, cannot consciously perceive pain. When a gravid uterus is removed en bloc, fetuses will not experience consciousness regardless of stage of gestation and death will occur without pain.[230,231] However, if the uterus and amniotic sac are opened, it may be possible for near-term fetuses to gain consciousness. In this case, humane euthanasia of each individual fetus is required unless resuscitation efforts are medically indicated and elected.

Orchidectomy—There are many acceptable variations of the surgical procedures to sterilize male cats and dogs.[16,21,46,200–202,207,211–216] The specific procedure performed will vary depending on the program, the veterinarian's preferences, and the individual patient's needs. In all cases, complete removal of both testes is required. When a prescrotal approach is used, closure of the subcutaneous tissue and skin are required. When a scrotal approach is used, incisions may be closed or left open to heal by second intention.

For cryptorchid cats and dogs, both testes must be removed. For animals with unilateral cryptorchidism, the undescended testis should be located and removed first. If the cryptorchid testis cannot be found, the descended testis should not be removed. An option is to refer the patient to another veterinarian for removal of both testes. The length and location of the surgical incision for cryptorchid animals should be chosen on the basis of the attending surgeon's preferences, taking into account the individual patient's needs. Closure of ventral abdominal incisions must incorporate the external rectus fascia.[46,228,229]

Procedures in pediatric (6- to 16-week-old) patients—Neutering of pediatric animals has been endorsed by the AVMA as well as numerous other national and international veterinary and humane organizations as a means of reducing the numbers of unwanted cats and dogs.[232–236] Various accepted techniques for neutering pediatric cats and dogs have been described.[36,198,200–202,211,214,217,237,238] The specific procedure performed will vary depending on the program, the veterinarian's preferences, and the individual patient's needs.

Suture materials

Sutures or surgical clips must be of biomedical grade, approved for medical use, sterile, and dated for current use. Materials must be absorbable or inert and nonabsorbable.[228,239] Suture materials supplied in individual packets or on a reel or cassette are acceptable and should be used according to manufactures' guidelines. Suture material must not be shared among patients owing to the risk of disease transmission.[240] Furthermore, with the exception of stainless steel, suture material cannot be effectively resterilized for future use.[241] If reusable needles are used, they must be cleaned and resterilized between patients.

Identification of neutered animals

Each spay-neuter program should choose a consistent, permanent means of visually identifying animals that have been neutered. Application of a visible, standard, distinct identifying mark is recommended. Specifically, the task force recommends the use of a simple green linear tattoo to identify all neutered pet animals and ear-tipping to identify all community cats.

For all male and female pet cats and dogs, a green linear tattoo should be applied to the ventral aspect of the abdomen at the time of surgical sterilization **(Figure 1)**. For female animals, the tattoo should be applied directly on or immediately lateral to the ventral midline incision. If a flank approach is used to spay a female patient, the tattoo should be placed in the area where a ventral midline spay incision would have been placed. For male dogs, the tattoo should be applied to the skin in the caudal aspect of the abdomen. If a prescrotal incision is used, the tattoo may be applied directly to the incision. Alternatively, the tattoo can be applied in the prescrotal area immediately lateral to the prepuce. For male cats, the tattoo should be applied in the area where a ventral midline spay incision would typically be placed. Sterile instrumentation should be used to apply tattoos regardless of the method of application. Acceptable methods for creating linear tattoos have been described and include the following methods[16,46]:

- Applying tattoo ink or paste directly to the surgical incision after intradermal closure.
- Applying tattoo ink or paste to a separate cutaneous incision other than the surgical incision.
- Intradermal injection of tattoo ink or paste.

Regardless of the method used to create them, green linear tattoos should be placed in the standard locations described and should be distinct and readily identifiable to effectively serve as an identifying mark for neutered pets.

For community cats, unilateral ear tipping (ie, surgical removal of the distal tip of 1 pinna) is the recommended method for identifying neutered cats **(Figure 2)**.[3,4,16,32] Humane surgical removal of an ear tip represents the universally accepted international standard for identifying a neutered community cat. To ensure a distinct and readily visible identifying mark, approximately a third of the distal earflap should be removed, taking care to transect perpendicular to the long axis of the pinna. In contrast, ear notching is not recommended because torn earflaps are a frequent occurrence in cats as a result of fighting and are easily mistaken for surgically notched ears.[4,16,46] Hemostasis of the pinna should be ensured prior to conclusion of recovery observation. Instruments should be thoroughly cleaned and disinfected or sterilized between patients to prevent the spread of pathogens.[16]

Spay-neuter programs may elect to use > 1 method of identifying individual neutered animals (eg, combining ear-tipping and tattooing, or implanting microchips, or using other forms of identification). In all cases, the task force recommends that neutered animals be marked by the recommended standard means described.

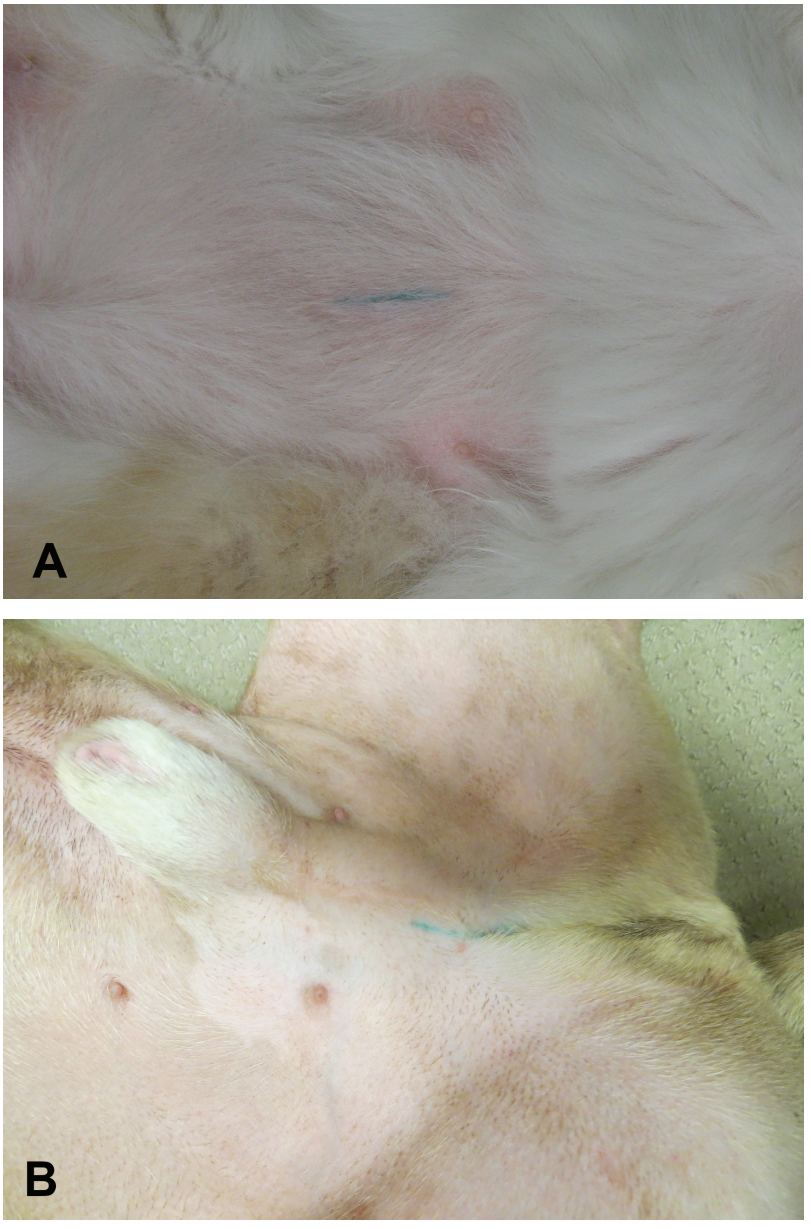

Figure 1—Photographs illustrating placement of a green linear tattoo to identify a cat (A) and a male dog (B) that have been neutered. For male and female cats and female dogs, the tattoo should be applied to the ventral aspect of the abdomen on or immediately lateral to the ventral midline incision or where a ventral midline spay incision would typically be placed. For male dogs, the tattoo should be applied on the prescrotal incision or immediately lateral to the prepuce.

Use of antimicrobials

Prophylactic antimicrobial administration may be considered, but is not necessary for every short, routine surgical procedure in healthy patients. If antimicrobials are used, they should be administered prior to surgery or as soon as a break in surgical asepsis or other indication is recognized.[242–245]

Use of biomedical skin glue

If biomedical skin glue is used to seal the skin incision, it should only be applied after satisfactory intradermal closure as described in the manufacturer's directions and should not be applied in the wound itself.[208]

Guidelines for Postoperative Care

Providing patients with a smooth transition from an anesthetized state to wakeful comfort for return to their home environments requires vigilance and diligent attention to detail. Successful recovery protocols are associated with a minimal number of adverse patient events and a rapid return to normal behaviors. Prompt attention to problems combined with open client communication serves to minimize negative consequences.

Recovery

Patients should be assessed at the completion of the surgical procedure to determine whether any conditions need to be immediately addressed or communicated to recovery personnel. The recovery environment should minimize the risk of complications and staff injury. Designated recovery areas should allow for continuous, direct observation of each patient. Patient recovery should occur on a secure, level surface, such as the floor or bottom of a cage. Animals on elevated surfaces must be protected from falls. All areas should be clean, dry, and warm. Loud noises should be minimized to reduce emergence delirium.

During recovery, animals should be positioned to prevent inadvertent airway restriction by ensuring that each patient's head and neck are carefully placed in slight extension and in straight alignment with the thorax. Pediatric patients or others at risk of hypoglycemia may benefit from transmucosal administration of sugar supplements (eg, corn syrup or dextrose solution) during recovery. For pediatric patients, recovery with littermates is recommended when possible to provide warmth and reduce anxiety associated with separation.[18–21] However, given that littermates normally pile one on top of another to sleep, inadvertent respiratory compromise may occur when littermates in various stages of recovery are housed together. When littermates are housed together during recovery, direct continuous observation is required until each animal is oriented and strongly ambulatory. To maximize personnel safety, community cats should

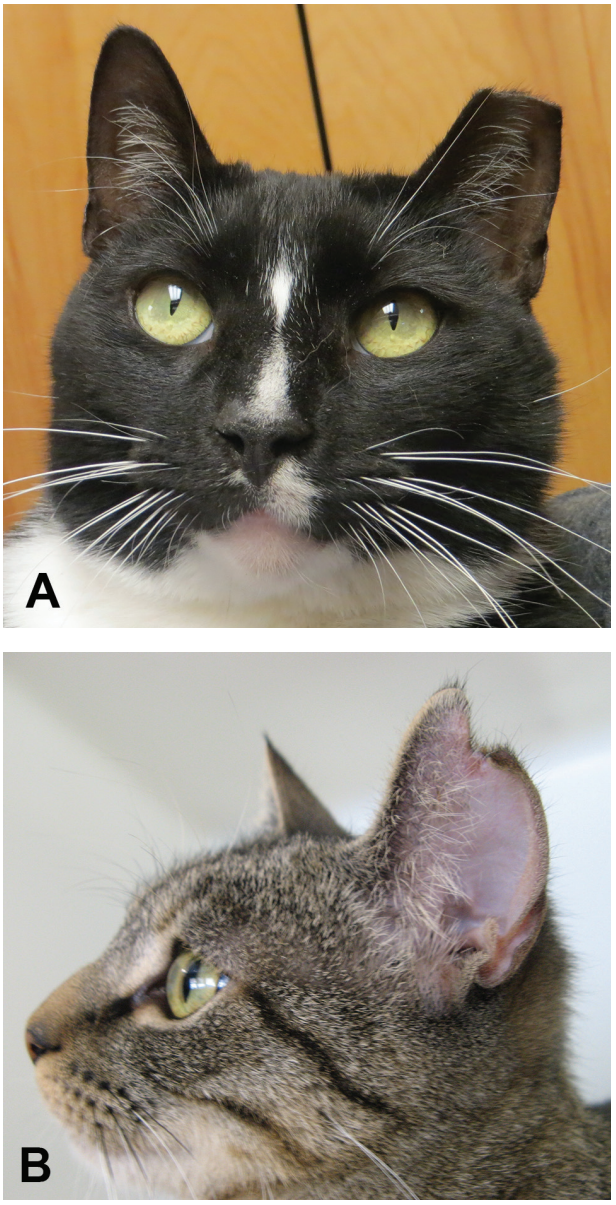

Figure 2—Photographs illustrating unilateral ear tipping to indicate that a community cat has been neutered (A) and showing a community cat with an injured ear flap (B). Ear tipping, rather than notching, is recommended to identify neutered community cats, because ear tipping results in a distinctive straight edge whereas ear flap injuries may easily be mistaken for surgical ear notching.

be returned to their traps or transport carriers while unconscious for recovery monitoring. In this case, cats should be carefully monitored to ensure that movement or turning in the confined space during recovery does not compromise airway patency; gentle rocking or tilting of the trap or carrier may be necessary to safely reposition the cat's head and neck.

Postoperative complications

Recovering patients should be continuously observed for complications related to anesthesia or surgery that may occur in the postoperative period, including hemorrhage, cardiorespiratory depression or compromise, pain, hypothermia, hyperthermia, distress, anxiety, vomiting, regurgitation, aspiration, or any other condition that could compromise recovery.[246] Postanesthetic hyperthermia has been reported in cats and most often occurs following the administration of opioids, although its occurrence has also been associated with the use of other drugs such as ketamine and may be multifactorial.[247–249] Treatment of affected patients may include selective drug reversal and supportive care (eg, removal of external heat sources, active cooling, or sedation), taking care to ensure proper analgesia.

Anesthesia-related death is most common during the postoperative recovery period, especially within the initial 3 hours after surgery.[94] The following parameters should be considered during recovery monitoring:

- Heart rate and pulse quality
- Respiratory rate and character
- Airway patency
- Mucous membrane color
- Signs of pain and anxiety
- Body temperature
- Degree of arousal or sedation
- Movement and ability to ambulate

Identified problems should be triaged and addressed accordingly.

Analgesia

Postoperative analgesia requirements will vary among individual patients owing to differences in surgical complexity, surgical technique, patient age, and individual responses to pain and analgesic agents.[250] If NSAIDs were not administered before or during surgery, they may be administered postoperatively, alone or in combination with additional opioids or other analgesic agents as needed to ensure appropriate analgesia.

Because a portion of patients will require analgesia beyond the 24-hour postoperative period, there should be a plan to address analgesia after patients are discharged. Options may include dispensing medication, providing a written prescription, or furnishing contact information for assistance in acquiring additional analgesic medication if needed. Clinicians must be prepared to adjust protocols to meet the needs of individual patients following surgery. Some analgesic agents, such as orally administered tramadol, are associated with greater variability in response than others.[251–254] Because multimodal treatment will improve analgesia for most patients, its use is recommended whenever possible.

Finally, postoperative pain medication is not a substitute for effective preoperative analgesia and minimally traumatic patient preparation and surgical techniques. If patients frequently exhibit ongoing signs of pain or discomfort postoperatively or induce self-trauma to surgical wounds, analgesic protocols and patient preparation and surgical techniques should be carefully reviewed to identify factors that may be contributing to these problems following surgery.

Anesthetic reversal

Reversal of sedative, anesthetic, or analgesic agents may be performed when patients experience prolonged recoveries or in emergency situations. Potential benefits of anesthetic reversal may include reducing or alleviating cardiorespiratory depression associated with anesthetic agents, hastening recovery, and promoting the return of thermoregulation. Potential detriments of rapid and complete reversal include increasing anxiety and reducing analgesia. In a recent study,[255] partial reversal of α_2-adrenoceptor agonists was associated with shorter recovery times without compromising patient analgesia when using a multimodal protocol. Rapid IV administration of reversal agents should be avoided except in emergency situations.[167]

Return to patient housing

When returning patients to assigned housing areas, verification of each individual animal's identification and specific cage assignment is imperative. Following initial recovery, patients should be periodically evaluated for changes in mental status and overall condition that could signal potential complications, stress, or pain. Cleanliness should also be carefully monitored. Pediatric, geriatric, frail, and at-risk patients should be protected from hypoglycemia and dehydration by offering small amounts of food and water as soon as appropriate, on the basis of adequate neurologic status, including mentation and swallowing reflexes.[202]

Prolonged confinement without opportunities for urination and defecation away from the enclosure can increase patient stress and discomfort. This problem may be exacerbated by perioperative administration of fluids and certain anesthetic agents such as α_2-adrenoceptor agonists,[256,257] which can increase urine output. In addition, confinement inhibits elimination behavior in some patients. For all of these reasons, expression of the patient's bladder, including both male and female patients, during anesthesia may improve comfort in the immediate postoperative period. For overnight stays, an absorbent substrate, such as paper, litter, or bedding, should be provided for cats. Dogs should be walked, provided that doing so does not pose a safety risk to staff; housed in an enclosure such as a run that allows for elimination away from the resting area; or provided with an absorbent substrate in their enclosures.Traps housing community cats should be covered to decrease patient stress and should be elevated to allow urine and feces to fall through the wire bottoms away from the patient or lined with absorbent material that can be safely changed if soiled.

Discharge of patients

Patients must be evaluated immediately prior to release. Postoperative evaluations should include assessments for normal mentation and respiration and adequate analgesia. Surgical incisions should be examined to ensure that the skin edges are clean, dry, and well apposed unless prohibited by fractious or feral behavior.[246] Prior to discharge, cats and dogs should be sternal, alert, and responsive. In addition, dogs should be able to ambulate.

Trapped cats should be returned to their familiar environment or site of capture when they are no longer under the influence of anesthesia (ie, mentally alert, oriented, and able to mobilize). Balancing the need to ensure safe recovery with the stress of confinement is required, but in most cases, release on the day following surgery is indicated.

Postoperative care instructions

Clients should be provided with clear instructions for postoperative care. Both written and verbal instructions should be provided when possible. Although instructions may vary from one program to the next, topics to consider include the following items:

- Summary of procedures performed
- Normal and abnormal recovery behavior
- Signs of discomfort or pain
- Care and monitoring of the surgical incision
- When to offer food and water
- Exercise restrictions, if any
- Medication instructions, if any
- Other special instructions as indicated based on the needs of the individual patient
- Instructions for notification of postoperative complications including contact information for questions or concerns
- Changes in status requiring urgent veterinary reevaluation
- Instructions for emergency care
- Recommendations for ongoing veterinary care

Guidelines for Operations Management

Operations management refers to a proactive approach in which continuous, strategic planning, control, and improvement are performed to effectively and efficiently produce and deliver the organization's services. This approach is recommended as a means of improving performance in HQHVSN programs. Operations management encompasses issues related to clinic direction and personnel such as standard work, training, cooperation, and planning, which are integral to the delivery of health-care services. The ultimate goal of operations management is strategic organization of logistics and procedures to improve the safe and efficient delivery of quality patient services.[258]

Process-oriented management of surgery

Process-oriented management involves defining the steps of the surgical process from intake to discharge. Patient care is delivered in a series of coordinated hand-offs, during which defined tasks are performed in accordance with accepted medical guidelines. This approach results in the delivery of consistent high-

quality care, which reduces the risk of errors and optimizes patient outcomes.[259] By defining and incorporating standard procedures in each step of the process, HQHVSN programs can improve the quality of care, reduce patient and staff risk, optimize patient outcomes, and improve time and cost efficiency.

Use of standard operating procedures and checklists

Standard operating procedures are recommended to ensure consistent care and to manage workflow as patients progress through the surgery process. Standard operating procedures should reflect current practice guidelines and be flexible enough to meet the unique needs of individual patients. Unnecessary deviations from standard operating procedures introduce greater opportunities for errors or omissions and should be avoided. Medical records can be designed to serve as checklists to prompt actions, confirm completion of tasks, and ensure accurate documentation.[260–262] Numerous studies[263–265] have demonstrated that regular use of customized checklists enhances compliance with standard operating procedures, avoids mistakes, and improves patient outcomes. The use of computerized records may further improve patient care and safety by facilitating analysis of trends in patient outcomes.

Data collection and analysis

Systematic collection and analysis of patient data in HQHVSN programs is recommended to identify, characterize, and track trends in patient outcomes, which serve as a basis for periodic refinement of existing protocols.[266] Research in human medicine regarding error and failure analysis illustrates the benefits of this approach and may provide an important model for HQHVSN programs.[267] Morbidity and mortality data, including both perianesthetic and postoperative complications and deaths, should be captured.[28] Such data may be characterized according to program type, veterinarian, animal species, surgery type, or other criteria to aid in identification of risk factors and inform subsequent refinement of protocols.[268,269]

As in any veterinary practice, recognizing patterns is crucial to reducing morbidity and mortality rates, because pattern detection alerts the healthcare team to areas where the likelihood of complications is greatest so that protocols can be improved and vigilance increased at critical points.[270–272] High-quality, high-volume spay-neuter programs can achieve morbidity and mortality rates similar to or lower than those encountered in small animal general practice.[28,156,222,268,273–278,d]

Staff training

Adequate training as well as ongoing skill and knowledge development is necessary for all program personnel to ensure proper animal care and safety as well as staff safety. A structured training plan based on the program's standard operating procedures allows for comprehensive and consistent instruction of new staff members and volunteers. Training may consist of written materials, videos, demonstrations, drills, shadowing current personnel, and supervised performance of job duties.[279] Prior to unsupervised performance of work duties, knowledge and proficiency in the required tasks, including technical skills, should be demonstrated. All staff members should participate in relevant continuing education and satisfy any state-mandated continuing education requirements.[280]

Leadership

Leadership that values and empowers followers has been shown to increase program performance and employee satisfaction and well-being and decrease employee turnover.[281–285] In addition, effective leadership is associated with improvements in staff and patient safety and can mitigate employee work stress and increase job satisfaction.[283,285–287] This has crucial implications in the context of HQHVSN programs because employee stress and work dissatisfaction are known risk factors for musculoskeletal pain[288–291] and decreased surgical performance[292,293] as well as for depression and suicidal ideation among veterinarians.[294] Leadership skills can be taught, and leadership training is an effective intervention that should be considered for anyone entering a leadership position.[285,295,296]

Personnel health and safety

High-quality, high-volume spay-neuter programs should foster a safe and healthy work environment for program personnel. Efforts to reduce environmental stress and unnecessary distractions are beneficial to the well-being of staff and patients alike and may increase safety. Common distractions to address include loud music, loud conversation, unnecessary foot traffic, barking dogs, slamming cage doors, and use of cell phones.

As with any type of veterinary practice, spay-neuter programs should take the necessary precautions to ensure chemical and biological safety, management of waste anesthetic gas exposure, and safe disposal of sharp instruments and to minimize the risk of occupational noise exposure, zoonotic disease transmission, physical injuries, compassion fatigue, and other work-related health problems. Badge monitoring for anesthetic waste gases is available as a means of assessing personnel exposure.

Patient handling presents one of the greatest physical health risks to HQHVSN program staff. Animal bites, musculoskeletal strains associated with lifting animals, and trauma from slips and falls that occur during animal handling represent the most frequent veterinary employee injuries.[297] Low-stress animal handling techniques using appropriate restraint methods and equipment decrease animal and staff stress, while enhancing safety.[15] Whenever possible, lift tables, stretchers, or blankets should be used to facilitate movement of conscious and anesthetized patients. When such equipment is unavailable, a 2-person lift, using bent knees and a straight back, will reduce risk of injury when lifting large dogs.[298]

Workplaces should also strive to create a safe, supportive environment in which mental health issues are not stigmatized. Shelter veterinarians are at high risk for developing depression,[299] and many spay-neuter veterinarians possess demographic risk factors that may place them at greater risk than other veterinarians for experiencing depression, burnout, compassion fatigue, or suicidal ideation.[299,300] Access to mental health care may be increased by posting information about mental health services, support groups, and suicide hotline numbers in staff areas and by providing flexibility in staff scheduling or duties to accommodate mental health treatment. Workers may be trained to recognize early signs of stress, compassion fatigue, and depression in themselves and others, and programs should provide a supportive atmosphere and referral to mental health services.[301]

Perioperative ergonomics

Optimizing perioperative ergonomics in HQHVSN programs is crucial for occupational health and safety and warrants special consideration because of the impact on surgeon health, productivity, and long-term sustainability. Some HQHVSN surgeons have worked in the field for decades without experiencing work-related pain, but most experience some musculoskeletal discomfort that they attribute, at least in part, to their work. Discomfort tends to be greater in those surgeons who spend more hours in surgery each week and in those who work in HQHVSN for more years.[290] Veterinarians who experience musculoskeletal discomfort should seek medical attention early in the course of the problem, rather than allowing pain to become chronic.

Surgeons in human practice who sit for surgery or who alternate between sitting and standing report less general fatigue and less fatigue specifically in the spine and lower limbs.[302] For surgeons who stand, the table should be adjusted to a comfortable height for each surgery. Standing surgeons may experience less discomfort and fatigue in the lower limbs with the use of a thick but firm elastic floor mat.[303] Cushioned shoes[304] and insoles[305] can also decrease fatigue during prolonged standing.

Being able to change position during an operation or between successive short operations is associated with decreased fatigue and decreased pain after surgery.[302] Micropauses of 15 to 30 seconds taken multiple times per hour reduce discomfort and fatigue and increase accuracy, especially if combined with active stretching or exercises that release the neck and shoulder tension inherent in surgical posture.[306,307]

Surgical tasks in HQHVSN programs require a combination of repetitive movements that can at times require force or may be performed with awkward positioning of the hands and wrists. Alone, each of these factors (repetition, force, and posture) is only moderately associated with musculoskeletal discomfort of the hand and wrist; however, when combined, their association with musculoskeletal discomfort is strong.[308] Use of efficient and gentle surgical technique and appropriately maintained instruments[309] can help minimize these risks.

Regulatory and legal considerations

These guidelines are meant to supplement, not replace, applicable laws and regulations, and where differences exist, veterinarians and administrators are encouraged to comply with the more stringent criteria. Local, state, and federal laws and regulations, including those promulgated by the Drug Enforcement Administration and Occupational Safety and Health Administration, all affect HQHVSN program operations. Veterinarians and administrators should consult local zoning and environmental regulations, state veterinary practice acts, and state boards of veterinary medicine, pharmacy, and public health for specific requirements in their respective jurisdictions. Consulting both an attorney and an accountant is recommended to help ensure compliance with all applicable laws and regulations.

Conclusions

Spay-neuter programs are an integral and imperative component of veterinary medicine and the community. They frequently provide initial veterinary care to at-risk and underserved animals, while exposing many clients to professional veterinary services for the first time. When spay-neuter services are accessible and attainable, pet owners can provide essential initial care for their pets, reducing the risk of relinquishment. For many pets, these programs may ultimately serve as gateways to a lifetime of care through referral to full-service veterinary practices for ongoing preventive care in the future.

By following these guidelines, spay-neuter programs provide quality veterinary care and succeed in their missions to provide humane methods for neutering large numbers of cats and dogs. At this time, HQHVSN programs offer the best approach to reducing shelter impoundment and euthanasia of cats and dogs. Furthermore, they represent the most financially responsible and humane way for communities to increase the numbers of cats and dogs that are neutered. By engaging in this rapidly developing practice area, veterinarians can play vital roles in alleviating overpopulation and decreasing untimely euthanasia of cats and dogs, while providing HQHVSN services to cats and dogs that would otherwise be unlikely to receive such care.

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Footnotes

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b. Robertson SA. Anesthesia protocols for early kitten steriliza-

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