

# Wound Drain Placement

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Drains are sometimes necessary for managing fluid accumulations or prophylactically when postoperative fluid accumulation is likely due to dead space or wounds in high-motion areas. Although drain placement can be beneficial, drains increase the risk for infection in clean wounds, as they are foreign bodies and interfere with normal host defense mechanisms.<sup>1,2</sup> Drains are categorized as passive or active.

Passive (ie, open) drains draw fluid from the wound via a combination of a typically higher pressure in the wound in combination with gravity and capillary action along the drain surface.<sup>1,3</sup> Dependent drainage must be established for these drains to work effectively. The most common

passive drain used in veterinary medicine is the Penrose drain, which is composed of soft latex or silicone tubing and available in widths from ¼ in to 1 in. Because fluid flows along the outside of the drain rather than through it, fenestrating Penrose drains decrease their effectiveness. Tubing with stiffer walls can be used but offers no real advantage because the fluid still flows along the drain surface. Passive drain materials are readily available and typically cost less than active drainage systems but are less efficient in evacuating fluid and may cause skin irritation at the exit site due to moisture accumulation. In addition, sterile dressings used to cover the drains may need to be changed multiple times daily,

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depending on the amount of drainage, and can quickly offset the initial lower cost.

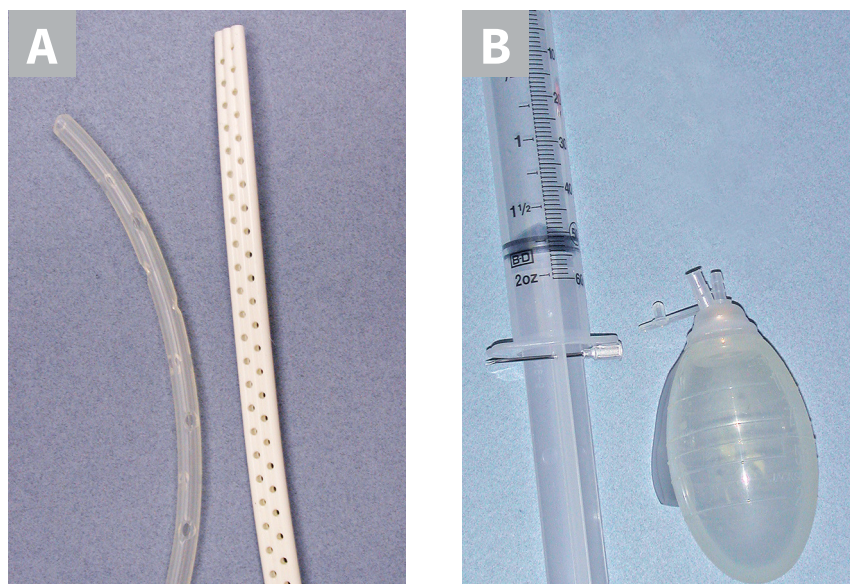
Active drains (ie, closed suction drains) are preferred by many veterinary surgeons because they are more efficient in removing wound fluid, can be exited wherever it is convenient to secure the drainage reservoir, and have a significantly low risk for skin irritation at the tube exit site.<sup>1,3</sup> Disadvantages include increased cost and complications that can affect drain performance and require interventions to maintain optimal function. Active drainage systems can be homemade or commercial.

The Jackson-Pratt drainage system is commonly used in veterinary medicine. An alternative is to buy bulk rolls of silicone rubber tubing that can be cut to any length and sterilized. Fenestrations are cut into the distal end of the drain with scissors (**Figure 1A**); the drain is then attached to a Jackson-Pratt (grenade) reservoir that can be purchased separately. Large syringes can also be used as drainage reservoirs (**Figure 1B**). An 18-g or larger needle can be used to create a hole(s) along the plunger. The syringe can be attached to the drain. Negative pressure can be established by pulling back on the plunger, and the blunted needle can be placed through the hole(s) in the plunger to maintain the suction. Active drains for small wounds can be made using butterfly catheters and blood collection tubes (**Figure 2**, next page). The reservoir can be emptied or the blood collection

tubes can be replaced when more than half-full to maintain adequate suction. If the reservoir does not have a one-way valve, the tubing can be crimped when emptying it to prevent fluid in the drain tube from flowing retrograde back into the wound. Placement of an active drain after excision of a large intermuscular lipoma in the thigh of a dog is shown in **Figure 3**, page 99.

### Management & Complications

Gently massaging the wound area may facilitate removal of fluid from wounds with passive drains. The skin around the exit site and the exposed end of passive drains should be kept clean by using an antiseptic solution. Obstruction should be suspected if drainage from active drains slows dramatically or stops completely. “Stripping” the drain may re-establish flow. Stripping is performed by first



▲ **FIGURE 1** (A) Silicone tubing with multiple fenestrations on the left and a Jackson-Pratt catheter on the right. (B) Reservoir made from 60-cc syringe on the left and a Jackson-Pratt reservoir on the right.

grasping the drain close to its exit site from the skin with one hand to stabilize it and minimize the risk for dislodgement. Next, the drain should be compressed with the thumb and index finger (or fingers) of the other hand close to the exit site; the thumb and forefinger should then be slid along the drain while maintaining compression to force any material in the drain toward the reservoir to empty the drain. This may have to be repeated multiple times if the drain is obstructed. Moistening the outside of the drain may facilitate the ability to slide along the drain while keeping it compressed. Bandaging wounds with drains helps protect the drain and provides a means of estimating the amount of fluid being removed by passive drains.

Potential complications include premature removal of the drain, obstruction, drain breakage, and infection.<sup>1,3</sup> If the drain breaks, any portion remaining in the wound should be removed or it could serve as a nidus for infection. A retro-

spective study reported a 15.6% infection rate with active drains used in clean canine surgeries.<sup>4</sup> The majority of infections occurred in patients that had axial pattern flap reconstructions. As indicated by the authors, it is difficult to determine whether the relatively high infection rate was associated with the surgical procedure, complications of the procedure (high rate of partial flap dehiscence), or other factors (eg, length of procedure) caused by the drain itself. Aseptic placement and meticulous post-operative management minimize the risk for drain-associated surgical site infection. Little information is available on the infection rate associated with use of passive drains, particularly in veterinary patients.

### General Principles of Drain Placement

These principles apply regardless of whether a passive or active drain is placed.

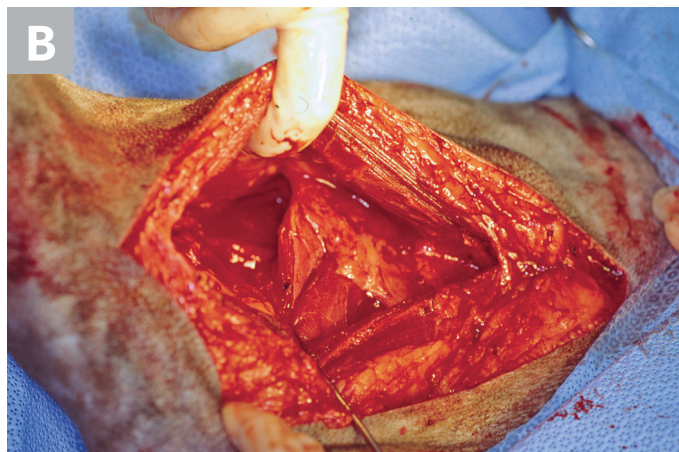
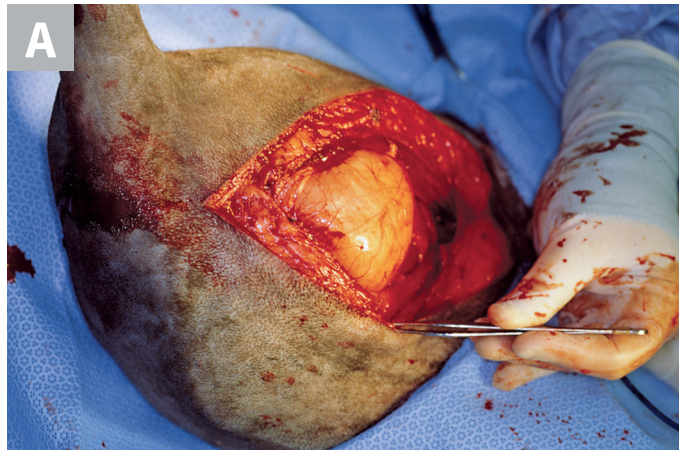
- ▶ The proximal end of drains placed in very superficial wound cavities (eg, subcutaneous pockets) can be secured with a suture placed through the skin, engaging the drain and then exiting back through the skin to minimize movement/migration of the drain within the wound. Although double exit sites are used with passive drains by some practitioners, there is no evidence that the second opening increases the efficiency of the drain, unless both openings create ventral drainage. For example, a passive drain placed in a wound on the dorsum



▲ **FIGURE 2** Active drains for small wounds can be constructed from butterfly catheters and blood collection tubes. Remove the Luer lock attachment from the catheter and cut holes with small scissors.

of the back and exited laterally on both sides of the patient would establish ventral drainage from both openings.<sup>1</sup> A second opening in high-motion areas (eg, axilla) may help reduce the risk for subcutaneous emphysema.

- ▶ Exit the drain through a separate incision at least 1 cm from the primary suture line. Exiting drains through the primary incision line increases the risk for wound dehiscence.<sup>1</sup>
- ▶ Secure the drain at the exit site. Sutures can be placed through passive drains, but a Chinese finger trap suture (or similar) should be used to secure active drains.
- ▶ Avoid placing drains directly under the primary suture line.
- ▶ Cover the surgical site and drain with a sterile bandage postoperatively.
- ▶ Remove the drain when the wound exudate is serous or slightly serosanguinous and the volume is what might be expected for the type of wound being drained. Premature removal increases the risk for seroma formation; therefore, removal should be based on the condition of the wound being drained rather than the length of time the drain has been in place. The maximum amount of time a drain can be maintained has not been established. Maintaining active drains until fluid production is  $<0.2$  mL/kg/hr has been suggested to reduce the risk for seroma formation.<sup>4</sup> Quantifying the amount of drainage when passive drains are used would be difficult due to evaporative losses through the bandage.



▲ **FIGURE 3** (A) Large intermuscular lipoma being excised from the thigh. (B) Resulting wound cavity with high potential for seroma formation. (C) Postoperative appearance after placement of a Jackson-Pratt drain, which has been exited through a separate stab incision.

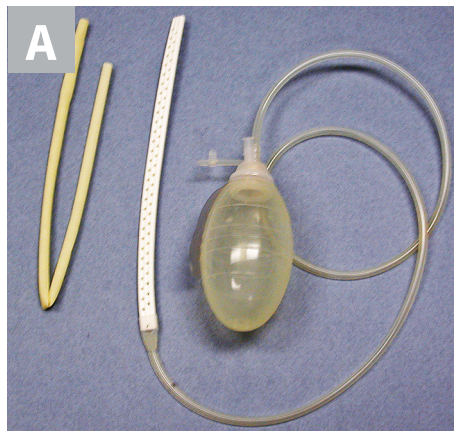
## WHAT YOU WILL NEED

- ▶ Sterile drapes and gloves
- ▶ Surgery pack with needle drivers, Metzenbaum scissors, thumb forceps, hemostats, towel clamps, and scalpel handle with a #10 or #15 blade
- ▶ 3-0 or 4-0 monofilament absorbable suture for wound closure
- ▶ 3-0 or 4-0 monofilament nonabsorbable suture for skin closure and to secure drain
- ▶ Passive or active drain system
- ▶ Bandage materials—sterile primary dressing, cast padding, or other absorbent secondary dressing, elastic gauze, cohesive bandage material, and/or porous tape

## STEP-BY-STEP WOUND DRAIN PLACEMENT

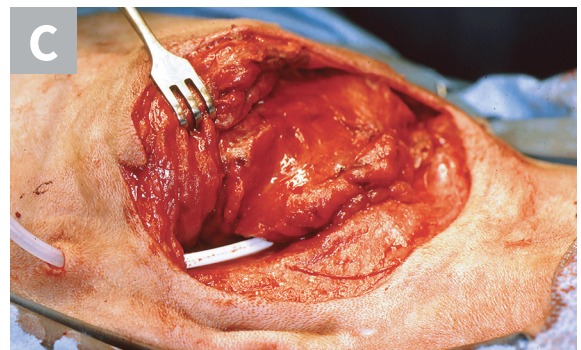
### STEP 1

Select the most appropriate drainage system. (A) The Penrose drain (left) and the Jackson-Pratt drain system (right) are the most commonly used passive and active drains, respectively. (B) Placing an active drain in the pictured wound would be preferable, as it would likely be more effective in a wound of this size, depth, and location (ie, area of high mobility). Placement of a passive drain in a superficial wound is demonstrated, but the same steps apply to the placement of active drains.



### STEP 2

The proximal end of drains placed in subcutaneous wounds can be secured with a suture to facilitate maintaining optimal placement of the drain within the wound. The suture can be placed (A) blindly or, more accurately, by (B) first passing the needle under the skin and out through the incision. Next, pass the suture through the drain and then pass the needle back under the skin to exit close to the initial entry site. The drain will be pulled to the desired location when the suture is tightened. (C) Drains placed in deeper wounds do not need to be secured. Apposition of tissue layers during closure will maintain the drain's position.

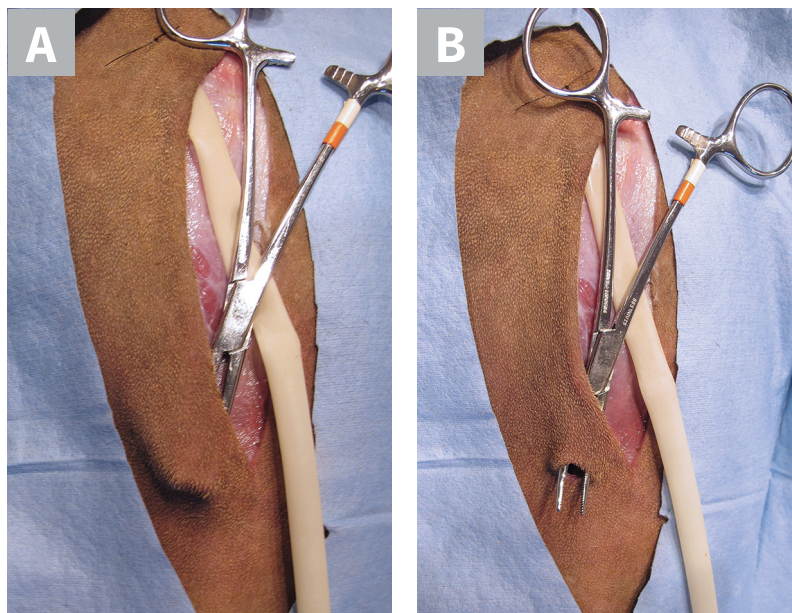


### STEP 3

Select the exit site. Exit passive drains from the most dependent area of the wound. Active drains can be exited wherever it is most convenient to secure the drainage reservoir. (A) Tent the skin with hemostats, then make a stab incision. (B) Spreading the tips and using them to tent the skin facilitates the incision process while protecting deeper tissues. Some active drainage systems come armed with a trocar that is used to exteriorize the drain through the skin.

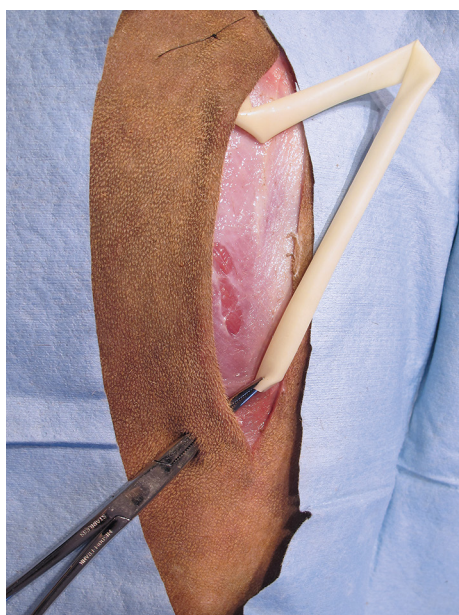
#### Author Insight

Keep the incision as small as possible with active drains to minimize air leakage and loss of suction.



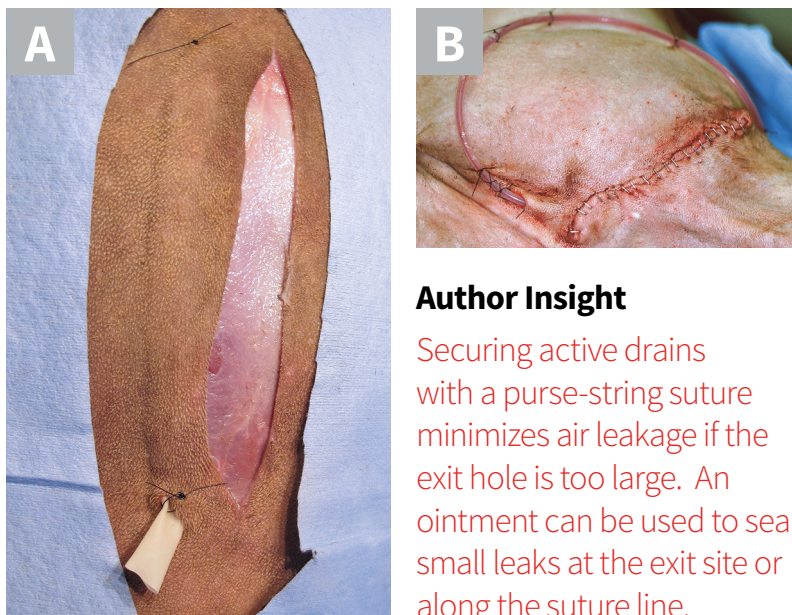
### STEP 4

Insert the hemostats through the incision to facilitate exteriorization of the drain.



### STEP 5

Secure the drain to the skin. (A) An interrupted suture through one side of the skin incision and the drain works well for passive drains. (B) Secure active drains with a Chinese finger trap suture or similar friction suture.



#### Author Insight

Securing active drains with a purse-string suture minimizes air leakage if the exit hole is too large. An ointment can be used to seal small leaks at the exit site or along the suture line.

## STEP 6

Change the bandage and/or empty the drainage reservoir as needed. Empty reservoirs when half-full or more to maintain adequate suction. Bandages covering passive drains should be changed if the wound fluid soaks through to the surface of the bandage.



### Author Insight

Do not retrograde flush through the drain. If wound lavage is desired, place a separate ingress catheter, which should extend to the deepest part of the wound cavity. Ingress catheters are not often used with wound drains and should only be used for flushing into the wound. ■

### References

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- Durai R, Ng PC. Surgical vacuum drains: types, uses, and complications. *AORN J*. 2010;91(2):266-271.
- Bristow PC, Halfacree ZJ, Baines SJ. A retrospective study of the use of active suction wound drains in dogs and cats. *J Small Anim Pract*. 2015;56(5):325-330.

## NexGard® (afoxolaner) Chewables

**CAUTION:** Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

### Description:

NexGard® (afoxolaner) is available in four sizes of beef-flavored, soft chewables for oral administration to dogs and puppies according to their weight. Each chewable is formulated to provide a minimum afoxolaner dosage of 1.14 mg/lb (2.5 mg/kg). Afoxolaner has the chemical composition 1-Naphthalenecarboxamide, 4-[5-[3-chloro-5-(trifluoromethyl)-phenyl]-4,5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-N-[2-oxo-2-[(2,2,2-trifluoroethyl)amino]ethyl].

### Indications:

NexGard kills adult fleas and is indicated for the treatment and prevention of flea infestations (*Ctenocephalides felis*), and the treatment and control of Black-legged tick (*Ixodes scapularis*), American Dog tick (*Dermacentor variabilis*), Lone Star tick (*Amblyomma americanum*), and Brown dog tick (*Rhipicephalus sanguineus*) infestations in dogs and puppies 8 weeks of age and older, weighing 4 pounds of body weight or greater, for one month.

### Dosage and Administration:

NexGard is given orally once a month, at the minimum dosage of 1.14 mg/lb (2.5 mg/kg).

### Dosing Schedule:

| Body Weight        | Afoxolaner Per Chewable (mg)                        | Chewables Administered |
|--------------------|---|------------------------|
| 4.0 to 10.0 lbs.   | 11.3  | One                    |
| 10.1 to 24.0 lbs.  | 28.3  | One                    |
| 24.1 to 60.0 lbs.  | 68  | One                    |
| 60.1 to 121.0 lbs. | 136   | One                    |
| Over 121.0 lbs.    | Administer the appropriate combination of chewables |                        |

NexGard can be administered with or without food. Care should be taken that the dog consumes the complete dose, and treated animals should be observed for a few minutes to ensure that part of the dose is not lost or refused. If it is suspected that any of the dose has been lost or if vomiting occurs within two hours of administration, redose with another full dose. If a dose is missed, administer NexGard and resume a monthly dosing schedule.

### Flea Treatment and Prevention:

Treatment with NexGard may begin at any time of the year. In areas where fleas are common year-round, monthly treatment with NexGard should continue the entire year without interruption.

To minimize the likelihood of flea reinfestation, it is important to treat all animals within a household with an approved flea control product.

### Tick Treatment and Control:

Treatment with NexGard may begin at any time of the year (see **Effectiveness**).

### Contraindications:

There are no known contraindications for the use of NexGard.

### Warnings:

Not for use in humans. Keep this and all drugs out of the reach of children. In case of accidental ingestion, contact a physician immediately.

### Precautions:

The safe use of NexGard in breeding, pregnant or lactating dogs has not been evaluated. Use with caution in dogs with a history of seizures (see **Adverse Reactions**).

### Adverse Reactions:

In a well-controlled US field study, which included a total of 333 households and 615 treated dogs (415 administered afoxolaner, 200 administered active control), no serious adverse reactions were observed with NexGard.

Over the 90-day study period, all observations of potential adverse reactions were recorded. The most frequent reactions reported at an incidence of > 1% within any of the three months of observations are presented in the following table. The most frequently reported adverse reaction was vomiting. The occurrence of vomiting was generally self-limiting and of short duration and tended to decrease with subsequent doses in both groups. Five treated dogs experienced anorexia during the study, and two of those dogs experienced anorexia with the first dose but not subsequent doses.

**Table 1: Dogs With Adverse Reactions.**

|                                   | Treatment Group |           |                     |           |
|-----------------------------------|-----------------|-----------|---------------------|-----------|
|                                   | Afoxolaner      |           | Oral active control |           |
|                                   | N <sup>1</sup>  | % (n=415) | N <sup>2</sup>      | % (n=200) |
| Vomiting (with and without blood) | 17              | 4.1       | 25                  | 12.5      |
| Dry/Flaky Skin                    | 13              | 3.1       | 2                   | 1.0       |
| Diarrhea (with and without blood) | 13              | 3.1       | 7                   | 3.5       |
| Lethargy                          | 7               | 1.7       | 4                   | 2.0       |
| Anorexia                          | 5               | 1.2       | 9                   | 4.5       |

<sup>1</sup>Number of dogs in the afoxolaner treatment group with the identified abnormality.

<sup>2</sup>Number of dogs in the control group with the identified abnormality.

In the US field study, one dog with a history of seizures experienced a seizure on the same day after receiving the first dose and on the same day after receiving the second dose of NexGard. This dog experienced a third seizure one week after receiving the third dose. The dog remained enrolled and completed the study. Another dog with a history of seizures had a seizure 19 days after the third dose of NexGard. The dog remained enrolled and completed the study. A third dog with a history of seizures received NexGard and experienced no seizures throughout the study.

To report suspected adverse events, for technical assistance or to obtain a copy of the MSDS, contact Merial at 1-888-637-4251 or [www.merial.com/NexGard](http://www.merial.com/NexGard). For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at <http://www.fda.gov/AnimalVeterinary/SafetyHealth>.

### Mode of Action:

Afoxolaner is a member of the isoxazoline family, shown to bind at a binding site to inhibit insect and acarine ligand-gated chloride channels, in particular those gated by the neurotransmitter gamma-aminobutyric acid (GABA), thereby blocking pre- and post-synaptic transfer of chloride ions across cell membranes. Prolonged afoxolaner-induced hyperexcitation results in uncontrolled activity of the central nervous system and death of insects and acarines. The selective toxicity of afoxolaner between insects and acarines and mammals may be inferred by the differential sensitivity of the insects and acarines' GABA receptors versus mammalian GABA receptors.

### Effectiveness:

In a well-controlled laboratory study, NexGard began to kill fleas four hours after initial administration and demonstrated >99% effectiveness at eight hours. In a separate well-controlled laboratory study, NexGard demonstrated 100% effectiveness against adult fleas 24 hours post-infestation for 35 days, and was > 92% effective at 12 hours post-infestation through Day 21, and on Day 35. On Day 28, NexGard was 81.1% effective 12 hours post-infestation. Dogs in both the treated and control groups that were infested with fleas on Day -1 generated flea eggs at 12- and 24-hours post-treatment (0-11 eggs and 1-17 eggs in the NexGard treated dogs, and 4-90 eggs and 0-118 eggs in the control dogs, at 12- and 24-hours, respectively). At subsequent evaluations post-infestation, fleas from dogs in the treated group were essentially unable to produce any eggs (0-1 eggs) while fleas from dogs in the control group continued to produce eggs (1-141 eggs).

In a 90-day US field study conducted in households with existing flea infestations of varying severity, the effectiveness of NexGard against fleas on the Day 30, 60 and 90 visits compared with baseline was 96.0%, 99.7%, and 99.9%, respectively. Collectively, the data from the three studies (two laboratory and one field) demonstrate that NexGard kills fleas before they can lay eggs, thus preventing subsequent flea infestations after the start of treatment of existing flea infestations.

In well-controlled laboratory studies, NexGard demonstrated >97% effectiveness against *Dermacentor variabilis*, >94% effectiveness against *Ixodes scapularis*, and >33% effectiveness against *Rhipicephalus sanguineus* 40 hours post-infestation for 30 days. At 72 hours post-infestation, NexGard demonstrated >97% effectiveness against *Amblyomma americanum* for 30 days.

### Animal Safety:

In a margin of safety study, NexGard was administered orally to 8 to 9-week-old Beagle puppies at 1, 3, and 5 times the maximum exposure dose (6.3 mg/kg) for three treatments every 28 days, followed by three treatments every 14 days, for a total of six treatments. Dogs in the control group were sham-dosed. There were no clinically-relevant effects related to treatment on physical examination, body weight, food consumption, clinical pathology (hematology, clinical chemistry, or coagulation tests), gross pathology, histopathology or organ weights. Vomiting occurred throughout the study, with a similar incidence in the treated and control groups, including one dog in the 5x group that vomited four hours after treatment.

In a well-controlled field study, NexGard was used concomitantly with other medications, such as vaccines, anthelmintics, antibiotics (including topicals), steroids, NSAIDs, anesthetics, and antihistamines. No adverse reactions were observed from the concomitant use of NexGard with other medications.

### Storage Information:

Store at or below 30°C (86°F) with excursions permitted up to 40°C (104°F).

### How Supplied:

NexGard is available in four sizes of beef-flavored soft chewables: 11.3, 28.3, 68 or 136 mg afoxolaner. Each chewable size is available in color-coded packages of 1, 3 or 6 beef-flavored chewables.

NADA 141-406, Approved by FDA

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Duluth, GA 30096-4640 USA

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