



SAVING PETS' LIVES, 24 HOURS A DAY, 7 DAYS A WEEK  
**PET POISON HELPLINE**




## Overview of Rodenticide Classes and Therapy Needs

November 19, 2019

**Renee D Schmid, DVM, DABT**  
*DVM Supervisor, Senior Consulting Veterinarian, Clinical Toxicology*  
 Pet Poison Helpline



www.petpoisonhelpline.com | 3600 American Blvd. W., #725 Bloomington, MN 55431 | Pet Poison Helpline 02018

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## Widget Information

The green "resource" widget contains downloadable presentation slides, instructions on how to download your CE certificate, a link to take our survey, and links to further information about Pet Poison Helpline.



The yellow "certification" widget is where you will be able to download your CE certificate after you have attended the live presentation for 45 minutes.

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## What is Pet Poison Helpline?

- **24/7 animal poison control center**
- **Veterinary & human expertise**
  - 20+ DVMs, 75+ CVTs
    - DABVT, DABT
    - DACVECC
    - DACVIM
  - 10 PharmDs
  - 2 MDs
- **Case fee of \$59 includes**
  - Unlimited consultation
  - Fax or email of case report
- **Educational center**
  - Free webinars (archived)
  - Tox tools
    - Wheel of Vomit
    - Pot of Poisons (toxic plants)
  - Textbook
  - iPhone app
  - Newsletters for vet professionals
  - Free resources for clinics
    - Videos
    - Electronic material
    - Clings

**Email us for more information!**

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Nationwide  
is on your side

Pet Poison Helpline®  
and Nationwide®

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Nationwide® & Pet Poison Helpline®  
working together

Shared mission in highlighting  
the importance of preparing  
for accidents and poisonings in  
small animals

Addressing the cost of veterinary care:  
Nationwide® covers the \$59 Pet Poison Helpline® fee when an insured pet is brought in to your hospital for care

Enabling best medicine:  
Pet owners with Nationwide® spend twice as much on their pets than those without pet insurance

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Complete confidence

- More than 35 years of experience protecting pets
- Pet insurance that offers more coverage than any other pet plan
- Pet insurance plans for every pet and every budget

Coverage includes:

- Accidents and injuries
- Chronic conditions
- Procedures and surgeries
- Common illnesses
- Hereditary conditions
- Holistic and alternative medicines
- Serious illnesses
- Diagnostics and imaging
- Wellness visits

Additional member perks

- 24/7 vet helpline for any pet question
- Fast electronic reimbursements
- Convenient mobile claim submissions
- Discounts and special offers on pet products

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## Overview of Rodenticide Classes and Therapy Needs



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## Today's Goals

- Review:
  - History and EPA regulations of rodenticides
  - Rodenticide packaging
  - Main classes of rodenticides
  - MOA, toxic dose, clinical signs and therapy needs



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## Trivia Fun

- In 2019, the most common call PPH received regarding a potential rodenticide poisoning was for:
  - A: Anticoagulants (combined)
  - B: Bromethalin
  - C: Cholecalciferol
  - D: Zinc Phosphide



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## Rodenticides through the years

Anticoagulant rodenticides

- 1<sup>st</sup> and 2<sup>nd</sup> generation anticoagulants
  - 1<sup>st</sup> generation
    - Moldy sweet clover poisoning in cattle (1921) → Dicoumarol → Coagulopathy
    - Synthesis of dicoumarol and Warfarin (4-hydroxy-coumarin derivative) at UW-Madison (Warfarin: ↑ duration and potency)
    - Warfarin introduced as a rodenticide in 1948
  - 2<sup>nd</sup> generation “Superwarfarins”
    - Newer anticoagulants developed due to ↑ warfarin resistance in rodents (1960s-80s)
    - Examples: Bromadiolone, brodifacoum




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## Rodenticides through the years

**Bromethalin**

- Discovered in the mid 1970s
- Developed for use in warfarin resistant rodents
- Neurotoxin

**Cholecalciferol**

- First used as a rodenticide in 1984
- Alternative to anticoagulants
- Results in hypercalcemia



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## Current EPA regulations

- Regulations for residential use
  - Block bait only (no pellets)
  - No 2<sup>nd</sup> generation anticoagulants
  - Bait stations mandatory
  - Max size: 1lb containers
- Permissible active ingredients
  - 1<sup>st</sup> generation anticoagulants and non-anticoagulants
    - Bromethalin
    - Cholecalciferol
    - Corn cellulose products
    - Zinc Phosphide
- No longer use
  - Bromadiolone, brodifacoum, difenacoum, difethialone



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## Current EPA regulations

- Ag/Professional products
  - Only sold in ag store, tractor/farm equipment store Can purchase on internet sites, i.e. Amazon
  - For use in or around agricultural buildings
  - 2<sup>nd</sup> generation anticoagulants are allowed
    - >8 lb container
  - Non-anticoagulants allowed
    - >4 lb container
  - Blocks, pellets, meal and paste are allowed

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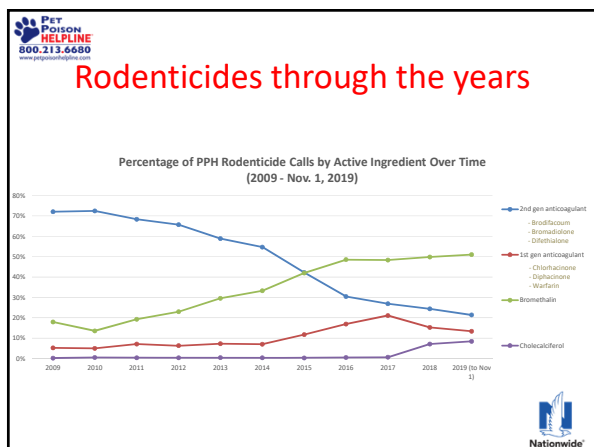
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## Rodenticides

- Anticoagulants
- Bromethalin
- Cholecalciferol
- Phosphides
- Strychnine
- Corn cellulose

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## Anticoagulants

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Warfarin 1<sup>st</sup>

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Diphacinone 1<sup>st</sup>

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Chlorphacinone 1<sup>st</sup>

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Bromadiolone 2<sup>nd</sup>


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Difethialone 2<sup>nd</sup>

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Brodifacoum 2<sup>nd</sup>





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## Anticoagulants

Supplied as:

- Hard blocks
- Pellets
- Soft bait
- Meal/Grain
- Powder
- Liquid





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## Anticoagulants

- Mechanism of action
  - Inhibits vitamin K epoxide reductase
    - Needed to convert Vitamin K epoxide to the reduced form
    - Carboxylation & activation of factors II, VII, IX & X are dependent on reduced vitamin K ≠ synthesis
  - Clotting times remain normal for 12-36 hours until the natural decay of circulating factors occurs





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## Anticoagulants



- Margin of Safety
  - Varies based on active ingredient
- Most narrow to widest margin
  - Brodifacoum
  - Diphacinone
  - Chlorphacinone
  - Difethialone
  - Bromadiolone
- Cats are very resistant to LAACs
- Relay toxicity is rare

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## Anticoagulants

Well absorbed orally

Peak plasma levels within 12 hours

PT elevation seen 36-48 hours

Coagulopathy develops within 48-72 hours

Clinical signs develop as early as 48-72 hours, but often not until 5-7 days

T  $\frac{1}{2}$  varies from 4-12 days

Warfarin T  $\frac{1}{2}$  12-18 hours

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## Anticoagulants Clinical Signs

Lethargy

Pallor

Petechia/Ecchymosis

Increased respiratory rate or effort, dyspnea

Hemoptysis, epistaxis

Hematuria, hematochezia or melena

Hemorrhage to thoracic and/or abdominal cavity

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## Anticoagulants



Photos courtesy of Dr. J Christie, DVM



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## Anticoagulants-Therapy

 EMESIS EVEN SEVERAL HOURS OUT	 +/- ACTIVATED CHARCOAL	 PT 36-48 HOURS AFTER INGESTION	 VITAMIN K1 3-5MG/KG DIVIDED Q 12 HOURS FOR 21-30 DAYS	 PT 36-48 HOURS AFTER FINISHING MEDICATION
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## Rodenticides Audience Poll



All rodenticide baits are color-coded based on the active ingredient.

- True
- False



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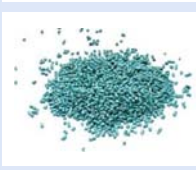


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## Bromethalin

Supplied as:

- 0.01%  
Hard block  
Pellet  
Soft bait
- 0.025%  
Worm/Grub for gophers/moles

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## Bromethalin



- Mechanism of action
  - Uncouples mitochondrial oxidative phosphorylation in the brain and liver mitochondria
  - Causes loss of sodium/potassium ATPase with resultant intracellular edema and degeneration
  - CNS most severely affected
  - Cerebral edema causes increased pressure on nerve axons, decreased nerve conduction → paralysis and death

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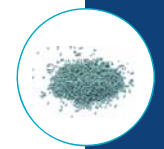
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## Bromethalin

- Toxicity
  - LD50
    - Dogs 2.38-3.65mg/kg
    - Cats 0.54-1.8mg/kg
  - Cats VERY sensitive to toxicity
  - 0.01% bait contains 2.84mg bromethalin/ounce of bait
  - Peak plasma 4-6 hours
  - T<sub>1/2</sub> several days
  - Primarily biliary excretion



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## Bromethalin-Clinical Signs

>LD50 "Convulsant Syndrome"	<LD50 "Paralytic Syndrome"
<ul style="list-style-type: none"><li>Onset of signs within 2-24 hours</li><li>Lethargy</li><li>Ataxia</li><li>Tremors</li><li>Seizures</li><li>Extreme hyperexcitability</li><li>Cerebral edema</li><li>Signs may persist for days with therapy</li><li>Seizures seen less frequently in cats</li></ul>	<ul style="list-style-type: none"><li>Signs delayed by 2-5 days</li><li>Lethargy</li><li>Ataxia</li><li>Hind limb paresis</li><li>Hind limb paralysis</li><li>Seizures as signs progress</li><li>Cerebral edema</li><li>Signs may persist for weeks</li></ul>

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## Bromethalin



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## Bromethalin Therapy

- No antidote
- Induce emesis even several hours after ingestion
- Anti-emetic
- Activated charcoal q 6-8 hours for 24 hours
  - \*Enterohepatic recirculation
- IV fluids
- Monitor Na levels
- If cerebral edema develops
  - Mannitol
  - Elevate head 15-30°
- Methocarbamol for tremors
- Anticonvulsants
- ILE?

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## Cholecalciferol

Supplied as a 0.075% bait

- Hard block
- Soft bait
- Pellet



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## Cholecalciferol

- Mechanism of action
  - Promotes calcium retention
    - ↑ Ca and P absorption from the GIT
    - ↑ Ca reabsorption from the distal tubules
    - ↑ Ca mobilization from the bones
- Toxicity results in
  - Hypercalcemia (total serum calcium and iCa)
  - Hyperphosphatemia
  - Metastatic tissue calcification
- Enterohepatic recirculation occurs



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## Cholecalciferol

Narrow margin of safety	Mild clinical signs	Hypercalcemia
0.06g finished bait/lb animal	0.1mg/kg cholecalciferol	0.5mg/kg cholecalciferol

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### Cholecalciferol Clinical Signs 0.1mg/kg-0.5mg/kg

Anorexia      Transient PU/PD  
Lethargy      Weakness

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### Cholecalciferol Therapy 0.1mg/kg – 0.5mg/kg

Induce emesis      Activated charcoal with cathartic x 1  
Sub q fluids      Baseline labwork  
• Ca/P  
• Renal values  
• PCV/TS

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### Cholecalciferol Clinical Signs >0.5mg/kg

Signs generally develop within 12-36 hours

0-24 hours • PU/PD, hypercalcemia, hyperphosphatemia, dehydration

12-36 hours • Anorexia, vomiting, weakness, lethargy

24-48 hours • Acute renal failure

3-5 days • Depression, frank bloody diarrhea, hematuria, bradycardia, death

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## Cholecalciferol-Lab Findings

- Calcium and phosphorus levels rise 12-72 hours.
  - Healthy Adult Animals:
    - Serum calcium > 12.5 mg/dl
    - Ionized calcium > 1.33-1.4mmol/L or >5.4 mg/dl
- Phosphorus level may increase 12 hours before serum calcium
- Elevations in BUN and creatinine, hyposthenuria
- Calcium-Phosphorus Solubility Index (CPSI)??
  - Soft tissue mineralization may occur when Ca x P >60 in healthy adult animals
  - Use Ca x P cautiously as it may not be an effective indicator in acute toxicity situations
- Can be difficult to assess in growing animals



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## Cholecalciferol Therapy >0.5mg/kg

- Emesis
  - Up to several hours out
- Anti-emetic
- Multi-dose activated charcoal q 6-8 hours x 24 hours
- Cholestyramine
  - Limited data in animals but may be helpful
  - 0.3-1g/kg q 8 hours x 4 days given between charcoal doses
  - Base dose on amount of cholecalciferol ingested
- Baseline labwork
  - CBC, Chemistry, iCa, UA
- IVF 0.9% NaCl 2-2.5x maint
  - Increase calciuresis, prevent dehydration
  - Minimize risk of hypernatremia

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## Cholecalciferol Therapy >0.5mg/kg

- Recheck Ca/P, Renal values, PCV/TS and weight daily for 72 hours
- Consider iCa vs total Ca
- Calcium/Phosphorus elevations
- +/- Increase calcium excretion
  - Prednisone 1mg/kg PO q 12 hours
  - Furosemide 1-2mg/kg q 12 hours PO *Worsens dehydration, less commonly used*
- Phosphate binders for hyperphosphatemia
  - Aluminum hydroxide
- GI protectants if uremia occurs


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## Cholecalciferol Therapy

**>0.5mg/kg**

**Bisphosphonates** *Ideal therapy for hyperCa<sup>++</sup>*

- Decrease serum calcium
  - Inhibit dissolution of calcium hydroxyapatite
  - Inhibit osteoclastic bone resorption
  - Decrease activity of 1-alpha-hydroxylase
- Pamidronate
  - 1.3-2ml/kg IV (diluted in 150-250ml 0.9% NaCl) given over 2-4 hours
  - Decrease in serum calcium in 24-48 hours
  - Repeat in 5-7 days if not responsive or severe rebound



**Salmon calcitonin**

- Expensive, hard to find and less effective
- Rarely recommended

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## Cholecalciferol Therapy




Wean off medications slowly



25% decrease q 3 days only if Ca/P levels remain normal



Generally wean furosemide more rapidly, if used, to minimize dehydration



Treat chronic renal disease if needed

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## Phosphides



- Types:
  - Often 2%, but concentration can vary
  - Pellets
  - Sugar baits
  - Underground stakes
  - Meal
  - Powder
  - Zinc phosphide commonly used in gopher bait "peanuts"
- MOA:
  - Create phosphine gas in acidic stomach environment
  - Gas smells like garlic or rotten eggs
- Toxic dose:
  - LD50 in dogs: 20-50mg/kg

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## Phosphides




**Clinical Signs:**  
Seen as early as 15 minutes after ingestion

- Vomiting
- Lethargy or agitation
- Diarrhea
- Bloat
- Tremors
- Tachypnea
- Seizure
- Pulmonary edema

**Treatment:**

- Liquid antacid – Magnesium or aluminum hydroxide, limits phosphine gas production
- Induce emesis in well-ventilated area
- Activated charcoal with cathartic x 1
- IV fluids as needed for dehydration
- Continue antacids while in clinic
- Anti-emetic
- Symptomatic and supportive care as needed



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## Corn Cellulose/Corn Gluten Meal

- Corn based product
- Designed to cause dehydration and GI obstruction in rodents
- No toxicity concern in dogs or cats






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## Strychnine

- Available as restricted use only in most states
- Underground application
- Rare to see exposure
- Rapid onset
  - Muscle spasm
  - Extensor rigidity
  - Tetanic seizures
- Symptomatic and supportive care



Strychnine laced hamburger to poisoned dogs in southern CA





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## What's New with Rodenticides?

- EPA statement released October 2019
  - Considering registration for **alphachloralose**
- CNS stimulant and depressant
  - Significant, fatal hypothermia
  - Bradycardia and ↓RR
  - Excitement, depression, seizures, coma, death
- Used in the UK and other countries
- Supplied as a paste and placed in a tamper-resistant bait station



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## Alphachloralose

- Comment submitted to EPA regarding safety
- [www.regulations.gov](http://www.regulations.gov)
  - Search alphachloralose

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## Conclusion



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    graph TD
      A[Not all rodenticides are anticoagulants] --> B[The main classes of rodenticides include]
      B --> C[Anticoagulants | Bromethalin | Cholecalciferol]
      C --> D[Bait color and type do not always help narrow down the active ingredient]
      D --> E[If an unknown type of bait is ingested, address decontamination and therapy that would cover the most common types]
  
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.....Blackwell's Five-Minute-Veterinary-Consult-Clinical-Companion.....

### Small Animal Toxicology 2<sup>nd</sup> Edition

Drs. Lynn Hovda, Ahna Brutlag, Robert Poppenga, Katherine Peterson

- Provides concise, bulleted information focused on the most important facts needed when treating a poisoned cat or dog
- Carefully organized for ease of use in an emergency, with important toxicants arranged alphabetically within categories
- Details clinically relevant information on the most common toxicants encountered by small animals
- Presents a wealth of color photographs to aid in plant identification
- Includes 14 new topics to this edition covering cyclosporine A, sleep aids, tacrolimus, bath salts, synthetic marijuana, poisonous lizards, imidacloprid, spring bulbs, and sodium monofluoroacetate

Paperback | May 2016 | 960 pages | 978-1-119-03654-8 | \$109.99 · CAN \$120.99  
[www.wiley.com/go/vet](http://www.wiley.com/go/vet)

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## PPH World: Australia & New Zealand

Pet Poison Helpline is excited to announce our recent expansion into Australia and New Zealand!

Our services are available 24/7 to any veterinary professional in Australia by calling **0011-800-4444-0002** and New Zealand by calling **00-800-444-0002**.

For more information please visit our website:  
<https://www.petpoisonhelpline.com/pphworld>

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**PET POISON HELPLINE**  
800.213.6680  
www.petpoisonhelpline.com

## PPH is Hiring!

- FT & PT CVT/RVT/LVT -daytime & evening, full and part time hours available!
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*NOW HIRING IN MISSOURI & LOUISIANA!*  
Visit our careers page to see all the states we hire in.

Learn all the details of our positions and qualifications by visiting our careers page <https://www.petpoisonhelpline.com/careers/> or emailing [careers@safetycall.com](mailto:careers@safetycall.com).

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## 2020 Webinars Announced

- **February 2<sup>nd</sup>**
  - Essential Oils
- **April 7<sup>th</sup>**
  - Warm Weather Toxins. A Short Review of Timely Woes.
- **June 2<sup>nd</sup>**
  - Hot Topic TBD
- **October 6<sup>th</sup>**
  - Worst of the Worst. Evaluating the Most Dangerous Toxins for Pets.
- **November 10<sup>th</sup>**
  - Hot Topic TBD




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SAVING PETS' LIVES, 24 HOURS A DAY, 7 DAYS A WEEK

**PET POISON HELPLINE**



## Thank you for attending!

[CE credit FAQs](#)

1. **When will I get my CE certificate?** Now! You can download it directly from the On24 platform. Please refer to the green "resource" widget at the bottom of your screen for detailed instructions.
2. **I attended the webinar but wasn't the person who logged in. Can I still get interactive CE credit?** Yes. Send your name and email address to [info@petpoisonhelpline.com](mailto:info@petpoisonhelpline.com) by **1pm central time on Nov. 20, 2019** (strict deadline).
3. **Can I watch the recorded webinar online for CE credit?** Yes. You can receive non-interactive CE credit. Go to the "For Vets" page on our website, [www.petpoisonhelpline.com](http://www.petpoisonhelpline.com) for more info.

Comments? Questions? Email us! [info@petpoisonhelpline.com](mailto:info@petpoisonhelpline.com)

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