

## Egg residue considerations during the treatment of backyard poultry

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In recent years, backyard poultry flocks have become increasingly popular in urban areas throughout the United States. Results of a 2010 USDA study<sup>1</sup> of 4 US cities (Denver, Los Angeles, Miami, and New York) indicated that 1% of households surveyed owned chickens and another 4% of households surveyed were planning on owning chickens within the next 5 years. The increase in the number of small poultry flocks in urban areas has led to an increase in the demand for veterinary services for those flocks, and veterinarians whose clientele is usually limited to companion animals now find themselves treating these food animals and shouldering the responsibilities that come with that.

Numerous challenges are associated with the treatment of backyard poultry flocks. There are a limited number of drugs approved for use in laying hens in the United States, and the few drugs that are approved were designed for administration to birds in large commercial operations, which makes their administration to individual birds or a small number of birds tedious. Consequently, veterinarians often end up administering drugs to backyard poultry in an extralabel manner. Unfortunately, the extralabel use of most of those medications is hindered by the availability of only a limited number of pharmacokinetic studies on drug residues in eggs. This is compounded by the fact that owners of backyard poultry flocks are likely to consider their birds pets and are agreeable to or demand more complex treatment regimens than those traditionally used in commercial flocks. The purpose of the digest reported here is to provide veterinarians with summary background information on appropriate drug use in modern backyard poultry flocks. A more in-depth guide<sup>2</sup> is available elsewhere.

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### ABBREVIATIONS

CPG	Compliance policy guide
FARAD	Food Animal Residue Avoidance and Depletion Program
GFI	Guidance for industry
MRL	Maximum residue limit
VFD	Veterinary feed directive

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### Definition of Poultry

The Poultry Products Inspection Act defines poultry as any domesticated bird. The USDA interprets that definition as including domestic chickens, turkeys, ducks, geese, and guinea fowl. Major food-producing species of poultry include turkeys and chickens. The US Center for Veterinary Medicine, a branch of the FDA, has a list of definitions for the various classes of chickens and turkeys<sup>3</sup> (Table 1). Any poultry species not considered a major food-producing species (ie, poultry species other than chickens and turkeys) is by exclusion considered a minor food-producing species of poultry. In this digest, the term poultry is used to refer to any avian species that has the potential for its meat, eggs, offal (ie, internal organs of an animal that are used as food), by-products (ie, feathers), or manure to directly or indirectly enter or influence any portion of the human food chain.

### Legalities of Treating Backyard Hens

Generally, eggs produced by the hens of backyard flocks are not subjected to regulatory testing. However, veterinarians need to be cognizant that, according to AMDUCA, any detectable drug residue in the eggs of a hen that was treated with a drug for which a residue tolerance for eggs has not been established by the FDA is a violation. Although drug residues in eggs are not a regulatory issue when those eggs are consumed only by the owner of the treated hen, they can become a liability issue if those eggs are sold or given away because it represents entry of an adulterated product into the human food chain.

### Drug Residues in Eggs

Anytime a drug is systemically administered to a hen, its ovary, follicles, and oviduct are exposed to that drug, and there is the potential for drug residues in eggs

Table 1—Class definitions for chickens and turkeys established by the US FDA.<sup>3</sup>

Species	Class	Definition
Chicken	Eggs	From in ovo until hatching.
	Laying hens (layers)	Hens that produce eggs for human consumption.
	Chicks	A chicken immediately after hatching until it is able to survive in an ambient-temperature environment (ie, is no longer brooded).
	Broiler chickens (broilers, fryers, or frying chickens)	Meat-type chickens typically grown to an age of 35–49 d and marketed with a weight of approximately 1.8–3.2 kg (4–7 lb).
	Roasters (roasting chickens)	Meat-type chickens marketed with a weight of approximately 2.7–4.1 kg (6–9 lb).
	Replacement chickens Breeding chickens	Chickens intended to become laying hens or breeding chickens. Sexually mature male or female chickens of any type intended for the production of fertile eggs; the eggs are not intended for human consumption.
Turkey	Eggs	From in ovo until hatching.
	Laying hens (layers)	Hens that produce eggs for human consumption.
	Poults	A turkey immediately after hatching until it is able to survive in an ambient-temperature environment (ie, is no longer brooded).
	Growing turkeys	Turkeys for meat purposes that are typically grown for approximately 17 (female) or 22 (male) wk; this class may be further divided into heavy or light turkey strains.
	Finishing turkeys Replacement turkeys Breeding turkeys	Turkeys intended for meat production during the last 2–4 wk of growth. Turkeys intended to become laying hens or breeding turkeys. Sexually mature male or female turkeys intended for the production of fertile eggs; the eggs are not intended for human consumption.

produced during the period immediately after drug administration. Understanding the physiology of egg formation is key to understanding how drug residues in eggs occur.

In hens, follicles undergo 3 phases of development into eggs. Phase 1 follicles, or white follicles, are the smallest follicles; they are immature and contain no carotenoids.<sup>4</sup> Phase 2, or the intermediate stage of egg development, occurs between 6 and 2 weeks before the egg is laid. During this phase, yolk formation is begun; egg yolk material (lipoprotein) is formed in the hen's liver and transported in the bloodstream to the ovary where it is deposited within the developing follicle. Phase 3 is the final stage of egg development and begins between 14 and 10 days before the egg is laid. During this phase, there is rapid accumulation of yolk lipoproteins, and this phase is believed to be the most important for the deposition of drug residues within the yolk. As the yolk begins to develop, lipoproteins are deposited in a sphere as a series of thin layers or rings, which get subsequently larger and thicker as the follicle matures and the mass of the yolk becomes larger. The rings of lipoprotein deposited around the yolk during phase 3 are the largest and thickest, and if contaminated with a drug, the most likely to contribute to a detectable drug residue in the egg after it is laid.<sup>5,6</sup> Although drug residues are most likely to be detected in eggs that were in phase 3 of follicular development (ie, within 14 days of being laid) when the drug was administered to the hen, it is theoretically possible that any developing eggs that were within 6 weeks of being laid (ie, phase 2 and phase 3 follicles) when a drug was systemically administered to the hen could contain drug residues.

Results of studies<sup>6–8</sup> that evaluated residue uptake by eggs in laying hens following administration of ampicillin emphasize the importance of the egg yolk as a deposition site for drug residues. Ampicillin has a short plasma half-life in chickens. Laying hens that received 1 dose of ampicillin (40 mg/kg, IM) had undetectable plasma concentrations of the drug within 24 hours after administration; however, ampicillin

residues were detected in the yolks of the eggs laid by those hens for up to 6 days after drug administration.<sup>7</sup> Because ampicillin is quickly eliminated from plasma, it appears that ampicillin is transported by the circulation to developing follicles (eggs) immediately or shortly after administration and that residues are deposited in the yolks of multiple follicles in the developmental stream.<sup>7,8</sup> Given that up to 10% of the human population is allergic to penicillin,<sup>9</sup> detection of ampicillin residues in the yolks of eggs for a prolonged period after that short-acting drug is administered to laying hens is sobering. Additionally, detection of ampicillin residues in eggs that were laid when the hen had undetectable plasma concentrations of the drug indicates that once a drug is deposited into the egg yolk it is sequestered there, whereas concentrations of drugs in other tissues generally achieve equilibrium with the blood. Drugs with a plasma half-life that is longer than that of ampicillin or that are stored in tissues such as the fat or liver and then subsequently released into the circulation will likely result in egg residues for a longer period.<sup>6</sup>

Albumen can also serve as a storage site for drug residues within eggs. In fact, many drugs are preferentially deposited in either the albumen or yolk.<sup>10</sup> However, because the entire albumen content in an egg is produced within 24 hours after ovulation, the potential for persistent drug residues is less than that for the yolk, which develops over several weeks.

### FDA-approved Drugs for Laying Hens

Administration of a drug approved for use in laying hens at the labeled dose and route of administration and adherence to the appropriate withdrawal time is the most practical method for ensuring that eggs produced by treated hens will not contain illegal residues. In the United States, there are currently 8 drugs approved by the FDA for use in laying hens (amprolium, bacitracin, erythromycin, hygromycin B, nystatin, tylosin, nitarosone, and proparacaine hydrochloride; **Table 2**).<sup>11</sup> All

Table 2—List of drugs approved by the FDA for use in laying hens in the United States as of September 2015.<sup>11</sup>

Active ingredient	Egg tolerance concentration (ppm)	NADA or ANADA	Trade name
Amprolium	4.0–8.0	012–350 013–149 200–488 013–663 200–463 200–496	Corid 25% type A medicated article and Amprovine 25% Corid 9.6% oral solution and Amprovine 9.6% solution Ampromed P for poultry Cocciprol oral solution Amprolium-P 9.6% oral solution Amprolium 9.6% solution, Corid 9.6% oral solution, and AmproMed P for poultry
Bacitracin	0.5	046–920 046–592  098–452 200–223	Baciferin–10, Baciferin–25, Baciferin–40, and Baciferin–50 BMD 30, BMD 50, and BMD 60 type A medicated article; BMD 50 granular A; and BMD 30 granular A Albac 50 type A medicated article Albac 50 type A medicated article
Erythromycin Hygromycin B	0.025 0	010–092 011–948 140–443 013–388 010–918	Gallimycin 100P and Gallimycin 50 Hygromix 2.4 Hygromix 1.6 premix and Hygromix 0.6 premix Hygromix-Tylan Premix Hygromix 8
Nystatin Tylosin	0 0.2	012–680 015–166 140–680 012–491 013–162 098–431 013–388 046–415  200–484	Pharmastatin-20* Tylan 100 Premix Tylan 5, 10, 20, and 40 Premix Tylan 100 and Tylan 40 Tylan Premix No. 10 Tylan 10 Premix Hygromix-Tylan Premix Tylosin 5, 10, 20, and 40 type A medicated article and CO-OP Tylan 10 mix Tylovet 100
Nitarosone Proparacaine hydrochloride	0.5 —	007–616 009–035	Histostat-50 (will be withdrawn Fall 2015) Ophthaine Solution

Laying hens treated with any of these drugs in accordance with the label directions will have a 0-day egg withdrawal time.  
 \*Not currently manufactured.  
 ANADA = Abbreviated new animal drug application. NADA = New animal drug application.  
 — = Not established.

of those products are currently available on an over-the-counter basis; however, erythromycin, hygromycin B, and tylosin are generally administered in the feed or water and will be affected by the FDA VFD, which may change their availability.

Sometimes it is difficult to discern from the label whether a drug is approved for use in laying hens because of inconsistencies in the labeling of approved products, especially those approved by the FDA several years ago. If a drug label states that it is approved for “chickens, all classes” and does not state “do not use in laying hens” and has a tolerance listed for eggs, then it can be assumed that the drug is approved for use in laying hens. Drug label information and established tolerance concentrations for residues in meat and eggs intended for human consumption can be found on the FDA Animal Drugs<sup>11</sup> and the FARAD VetGram<sup>12</sup> websites.

Generally, a pharmaceutical company will not expend the resources necessary to obtain FDA approval for use of a drug in laying hens unless it can be used by commercial layer operations. From a practical standpoint, a drug needs to have an egg withdrawal time of 0 days to obtain FDA approval for use in laying hens. This is 1 reason why there are so few products approved for use in laying hens. However, it also means that all drugs that have been approved by the FDA for use in laying hens have an egg withdrawal time of 0 days when administered in accordance with the label directions.

### Extralabel Use of Medicated Feeds

The FDA policy regarding the extralabel use of medicated feeds in minor species is currently outlined in CPG 615.115.<sup>13</sup> This CPG provides guidelines for the extralabel use of medicated feeds in minor food animal species (ie, poultry species other than chickens and turkeys) under specific circumstances. Although this CPG is not a law, it provides FDA field inspectors regulatory discretion on whether to take action against a veterinarian or producer. To fulfill the stipulations outlined in CPG 615.115,<sup>13</sup> all requirements for extralabel drug use specified within AMDUCA must be met in addition to the following:

- The prescribing veterinarian must provide a written recommendation that includes the medical rationale for use of the medicated feed and is dated < 3 months prior to administration of that feed. A copy of this recommendation is to be kept on file for 1 year by both the veterinarian and producer and is to be made available to FDA inspectors upon request.
- The medicated feed that is used must be approved by the FDA for use in a major food animal species (eg, chickens or turkeys).
- The formulation of the medicated feed cannot be changed (ie, the formulation cannot be altered to meet the nutritional requirements of the minor poultry species).

By January of 2017, CPG 615.115 will likely be withdrawn and replaced with GFI #209 and #213.<sup>14,15</sup> The proposed purpose of GFI #209 is to limit the use of medically important antimicrobials in food-producing animals and increase veterinary oversight of antimicrobial use in those animals. Its companion document, GFI #213, outlines the processes necessary to comply with GFI #209 including the withdrawal of products with nontherapeutic labels from the market and the reclassification of products with therapeutic labels as either VFD or prescription drugs. Consequently, some classes of antimicrobials that are administered in feed or drinking water and have only production use claims (eg, antimicrobials that are administered solely as growth promotants) will no longer be available. The remaining products that are approved for therapeutic purposes will be available by prescription or VFD only. Products that are currently labeled for both production and therapeutic use will have the production claims removed from the labels and be available by prescription or VFD only.

### **Extralabel Use of Drugs Approved for Laying Hens in Countries Other Than the United States**

Because there are so few drugs approved by the FDA for use in laying hens in the United States, veterinarians who treat backyard poultry frequently resort to extralabel drug use. Use of a medication that is available in the United States and contains an active ingredient that is approved for use in laying hens in another country allows veterinarians to prescribe a withdrawal interval that, if adhered to by the client, will likely ensure that subsequent eggs produced by treated hens are safe for human consumption. However, the number of drugs approved for use in laying hens in countries other than the United States is likewise limited<sup>16-19</sup> (Table 3). Also, from a regulatory standpoint, adherence to an egg withdrawal interval for a non-FDA-approved drug that is based on an MRL established by a regulatory agency in a foreign country will not guarantee that a violative drug residue will not be detected if eggs undergo regulatory testing in the United States. That is because the tolerance concentration for non-FDA-approved drugs administered in an extralabel manner in the United States is zero (ie, detection of any drug residue is considered a violation). Veterinarians should be aware that tolerance concentrations for FDA-approved drugs are not always numerically similar to foreign standards such as the MRL.

### **Extralabel Use of FDA-approved Drugs That Are Not Labeled for Laying Hens**

Frequently, drugs approved for use in laying hens by the FDA or an equivalent regulatory agency in a foreign coun-

try are not appropriate for the condition that requires treatment, and the only alternative is to use another drug in an extralabel manner. The results of multiple studies conducted to evaluate the pharmacokinetics of various drugs in laying hens and the deposition of those drugs in eggs have been reviewed,<sup>20</sup> and that review may help veterinarians determine the egg withdrawal interval required for specific drugs or classes of drugs. It is important to note that the pharmacokinetic studies evaluated in that review<sup>20</sup> were conducted in healthy birds, and clinical abnormalities such as dehydration, kidney or liver impairment, gastrointestinal disease, and sepsis will affect drug clearance from laying hens and potentially result in violative residues in eggs. Once a treatment regimen is chosen, FARAD can be contacted for a recommendation for an egg withdrawal interval.<sup>21</sup>

### **Prohibited Drugs**

Frequently, FARAD receives calls about the legality of the use of drugs that are prohibited from use in food-producing animals for animals that are considered pets by their owners. Veterinarians should be aware that the FDA considers all chickens to be food-producing animals, regardless of whether owners consider their chickens pets.<sup>22</sup> Despite an owner's assurance that an animal will never enter the human food chain, the future is always unknown, and the prescribing veterinarian could be held liable if eggs containing violative residues of prohibited drugs enter the human food chain. For example, in a worst-case scenario, a bird treated with an antimicrobial that is prohibited from use in food animals could inadvertently convey bacterial resistance against that antimicrobial to other birds in a flock that

Table 3—List of drugs approved for use in laying hens in select countries as of May 2015.

Country	Drugs approved for use in laying hens
Australia <sup>16</sup>	Bacitracin Chlortetracycline Levamisole Lincomycin-spectinomycin soluble powder Neomycin sulfate Piperazine Tylosin
Canada <sup>17</sup>	Amprolium Chlortetracycline Neomycin Oxytetracycline Penicillin G potassium Piperazine
Ireland <sup>18</sup>	Chlortetracycline Colistin Erythromycin Flubendazole Phenoxymethylpenicillin potassium Phoxim Tiamulin Tylosin
United Kingdom <sup>19</sup>	Amprolium Colistin Erythromycin Fenbendazole Flubendazole Phenoxymethylpenicillin potassium Tiamulin Tylosin

are producing eggs for human consumption by direct contact or exposure to commingled excrement. Direct transference of antimicrobial-resistant bacteria between birds and humans is also a concern, especially because the number of human infections caused by poultry-associated *Salmonella* spp in the United States has been increasing annually.<sup>23</sup>

The complete list of drugs prohibited by the FDA from use in food-producing animals in the United States has been summarized<sup>24</sup> (Table 4) and can be found on the FARAD website.<sup>21</sup> Of those drugs, 3 are relevant to poultry practice (the prohibition of the extralabel use of cephalosporins and fluoroquinolones and the prohibition of the use of all antiviral medications).

**Prohibition of extralabel use of cephalosporins in major food-producing animals**—Prohibition of the extralabel use of cephalosporins in major food-producing animals was enacted by the FDA in April 2012.<sup>25</sup> Cephalosporins are commonly used to treat various infections in human patients. To preserve the effectiveness and limit the development of antimicrobial resistance to cephalosporins, the FDA outlined specific circumstances in which cephalosporins can be administered in an extralabel manner to food-producing animals. Cephalosporins can be used in an extralabel manner only to treat a major food animal species (turkeys, chickens, pigs, and cows) for an unlabeled disease; all other label directions such as the species, dose, route of administration, and treatment duration must be followed.<sup>25</sup>

Currently, the only cephalosporin approved for use in poultry is ceftiofur sodium, which is approved for use in day-old chicks and turkey poults to control early deaths associated with *Escherichia coli*.<sup>11</sup> Theoretically, ceftiofur sodium could be used to treat day-old chicks and poults for a condition other than control of early deaths associated with *E coli* as long as the labeled dose, route of administration, and treatment duration were followed. Prior to the FDA prohibition of the extralabel use of cephalosporins in food-producing animals, ceft-

iofur sodium was administered in ovo. In ovo administration of ceftiofur sodium or any cephalosporin is now prohibited.

Prohibition of the extralabel use of cephalosporins applies only to major food-producing species. Therefore, poultry species other than chickens and turkeys can be judiciously treated with cephalosporins in an extralabel manner in accordance with AMDUCA.

**Prohibition of fluoroquinolones**—The extralabel use of fluoroquinolones in food-producing animals was prohibited by the FDA in 1997.<sup>26</sup> Poultry approvals for sarafloxacin and enrofloxacin were withdrawn in 2001<sup>27</sup> and 2005,<sup>28</sup> respectively. At that time, the prevalence of fluoroquinolone-resistant *Campylobacter* spp isolated from specimens obtained from poultry and human patients was increasing,<sup>29</sup> and the ban was enacted to curtail the development of further fluoroquinolone-resistant bacterial strains and preserve the effectiveness of fluoroquinolones for the treatment of human infections. Since the ban on the extralabel use of fluoroquinolones in food-producing animals was enacted, the number of fluoroquinolone-resistant *Campylobacter* spp isolated in the United States has remained fairly stable, and the ban is deemed a success because the prevalence of fluoroquinolone-resistant bacterial strains has continued to increase in other parts of the world.<sup>30</sup> Additionally, the number of fluoroquinolone-resistant *Salmonella* spp isolated from retail meat has remained fairly low since the ban on fluoroquinolones was enacted.<sup>31</sup>

**Prohibition of antiviral medications**—In accordance with a World Health Organization recommendation, the antiviral drug classes of amantanes such as amantadine and rimatidine and the neuraminidase inhibitors oseltamivir and zanamivir are prohibited from use in chickens, ducks, and turkeys.<sup>24</sup> Prohibition of the use of those drugs in poultry was enacted to preserve their effectiveness for the treatment of influenza in human patients.

Table 4—List of drugs prohibited by the FDA from extralabel use in food-producing animals\* in the United States as of April 2015.<sup>24</sup>

Drug or drug class	Special considerations
Adamantane and neuraminidase inhibitors Cephalosporins	Prohibited from extralabel use in chickens, turkeys, and ducks. Except for cephalosporins in all classes of cattle, pigs, chickens, and turkeys. Restrictions regarding the extralabel use of cephalosporins in all production classes of major food-producing species (cows, pigs, chickens, and turkeys) include: extralabel use for the purpose of disease prevention is not allowed; extralabel use that involves an unapproved dose, treatment duration, frequency, or route of administration is not allowed; and extralabel use is not allowed in unapproved species and production classes. Extralabel use of cephalosporins is not restricted in minor food-producing species (eg, all species of poultry other than chickens and turkeys).
Chloramphenicol	—
Clenbuterol	—
Diethylstilbesterol	—
Fluoroquinolones	Extralabel use of all fluoroquinolones is prohibited in all food-producing species.
Furazolidone	—
Glycopeptides	All agents such as vancomycin.
Nitrofurazone	—
Nitroimidazoles	All agents such as dimetridazole, ipronidazole, and metronidazole.
Phenylbutazone	Prohibited from extralabel use in female dairy cattle ≥ 20 mo old.
Sulfonamides	Prohibited from extralabel use in lactating dairy cattle, except for approved uses of sulfadimethoxine, sulfabromomethazine, and sulfamethoxyypyridazine.

\*All chickens, regardless of use or status as a pet, are considered food-producing animals by the US FDA.  
— = Not applicable.

## FARAD Poultry Statistics

During the 5-year period from September 2009 through September 2014, FARAD received approximately 18,000 requests for withdrawal intervals for various drugs, of which just under 10% pertained to poultry. The 10 drugs for which withdrawal intervals for poultry were most frequently requested were summarized (Table 5). From September 2013 to September 2014, the number of requests for information regarding tylosin increased, whereas the number of requests for information regarding piperazine decreased, compared with those for the previous 5 years.

**Meloxicam**—Meloxicam is not approved for use in poultry in the United States or any other country. Although meloxicam is frequently administered to poultry, to our knowledge, there have been no studies performed to investigate the incidence or duration of meloxicam residues in the eggs of treated hens.

**Fenbendazole**—In the United Kingdom, fenbendazole oral suspension is approved for treatment of gastrointestinal nematodes in laying hens at a dose of 1 mg/kg (0.45 mg/lb), PO, for 5 days with a 0-day egg withdrawal and 6-day meat withdrawal.<sup>19</sup> Because fenbendazole is approved for laying hens in the United Kingdom, there is an MRL for residues of fenbendazole and its metabolites in eggs. Because it is not approved for use in laying hens in the United States, the detection of any fenbendazole residues in eggs is considered a violation, and the egg withdrawal period established for fenbendazole in the United Kingdom should be extended to ensure that drug residues in the eggs of treated hens are depleted below the detection limits of the USDA Food Safety and Inspection Service. Currently, FARAD recommends an egg withdrawal interval of 17 days for hens following oral administration of fenbendazole (1 mg/kg).

**Ivermectin**—Depletion of ivermectin residues in the eggs of treated hens has been investigated in only a couple of studies.<sup>32,33</sup> Given the limited studies<sup>32,33</sup> and data available, FARAD cannot provide a blanket withdrawal interval recommendation, and individuals are directed to submit a withdrawal interval request to FARAD.

**Sulfamethoxazole and trimethoprim and amoxicillin**—Few studies have been performed to investigate residues of sulfamethoxazole and trimethoprim<sup>34–38</sup> and amoxicillin<sup>39,40</sup> in the eggs of laying hens. Given the limited studies<sup>34–40</sup> and data available, FARAD cannot provide a blanket withdrawal interval recommendation for eggs, and individuals are directed to submit a withdrawal interval request to FARAD.

**Sulfadimethoxine**—Various studies<sup>41–47</sup> have been conducted to evaluate the depletion of sulfadimethoxine residues in eggs of treated hens. However, to our knowledge, sulfadimethoxine is not currently approved for use in laying hens in any country.

**Tetracyclines**—Chlortetracycline is approved for use in laying hens in Australia and Ireland.<sup>16,18</sup> In Australia, chlortetracycline is labeled for use in the drinking water of chickens at doses up to 60 mg/kg (27 mg/lb) for ≤ 5 days with a 0-day egg withdrawal.<sup>16</sup> In Ireland, a medicated feed containing chlortetracycline can be fed to laying hens at a dose of 20 to 25 mg/kg (9 to 11 mg/lb) for 5 to 7 days with a 4-day egg withdrawal.<sup>18</sup> In the United States, the egg withdrawal interval for hens following treatment with chlortetracycline needs to be extended from those established in Australia and Ireland to allow residues time to deplete below detection limits.

Multiple studies<sup>48–60</sup> have been performed to evaluate depletion of oxytetracycline residues in the eggs of treated hens. In Canada, oxytetracycline soluble powder is approved for use in the drinking water of laying hens at concentrations ranging from 50 to 112 mg/L (190 to 424 mg/gal) with 60-hour to 5-day egg withdrawal intervals, respectively.<sup>16</sup> Those withdrawal intervals should be extended in the United States because oxytetracycline is not approved for use in laying hens; therefore, oxytetracycline must be undetectable in all eggs destined for human consumption.

To our knowledge, doxycycline is not approved for use in laying hens in any country. Although multiple studies<sup>10,50,61–63</sup> have been performed to evaluate the depletion of doxycycline in the eggs of treated hens, at this time, FARAD cannot provide a blanket withdrawal interval recommendation for eggs, and individuals are directed to submit a withdrawal interval request to FARAD.

Table 5—List of the 10 drugs for which FARAD most frequently received requests for egg withdrawal intervals between September 2009 and September 2014.

Drug	No. of requests received by FARAD	No. of published studies performed to evaluate drug depletion in the eggs of treated hens*
Meloxicam	117	0
Fenbendazole	93	1
Ivermectin	73	2
Amoxicillin trihydrate; clavulanate (potassium)	73	2
Sulfamethoxazole; trimethoprim	49	4 (sulfamethoxazole); 2 (trimethoprim)
Sulfadimethoxine	43	13
Dipiperazine sulfate; piperazine hydrochloride	39	1
Doxycycline	37	5
Enrofloxacin†	37	14
Oxytetracycline hydrochloride	33	18

\*Published studies found in the FARAD citation database as of July 2015. †Enrofloxacin is prohibited from extralabel use in food animals in the United States. There are currently no FDA-approved enrofloxacin medications labeled for use in poultry.

**Piperazine**—To our knowledge, only 1 study<sup>64</sup> has been published evaluating the depletion of piperazine in the eggs of treated hens. In Australia and Canada, piperazine is approved for 1-time use in laying hens at doses ranging from 130 to 200 mg/kg (59 to 91 mg/lb) with a 0-day egg and meat withdrawal.<sup>16,17</sup>

**Tylosin**—Some products that contain tylosin are approved by the FDA for use in laying hens (Table 2), and when those products are used in accordance with the label directions, there is a 0-day egg withdrawal.<sup>11</sup> However, all of those products will be affected by GFI #209 and #213, which may result in label changes or affect their availability in the future. Tylosin is also approved for use in laying hens in Australia, Ireland, and the United Kingdom,<sup>16,18,19</sup> and multiple studies<sup>58,65–70,a</sup> have been performed to evaluate the depletion of tylosin residues in the eggs of treated hens.

**Enrofloxacin**—Extralabel administration of fluoroquinolones such as enrofloxacin to food-producing animals is prohibited by the FDA,<sup>24</sup> yet it is not unusual for FARAD to receive requests for withdrawal information for enrofloxacin in poultry. It is likely that many of those requests are from companion animal veterinarians who may not recall that enrofloxacin is prohibited from use in food-producing animals.

## Summary

The purpose of this digest was to provide US veterinarians guidance on the responsible treatment of backyard poultry flocks. The treatment of backyard poultry can be a daunting task for veterinarians because only limited resources are available; however, it is likely to become an increasingly common task owing to the increasing popularity of backyard poultry throughout the United States, especially in urban and suburban areas. Although backyard poultry flock owners may consider their birds pets, the FDA considers them food-producing animals, and veterinarians should follow all regulations that pertain to food-producing animals when administering or prescribing drugs to those birds. The lack of FDA-approved drugs for use in laying hens frequently necessitates the use of drugs in an extralabel manner in backyard poultry. Unfortunately, information regarding the depletion of drug residues in eggs from hens treated with various drugs in an extralabel manner is sparse or lacking, and veterinarians need to be cognizant of this issue, especially when the eggs from treated hens are intended for human consumption.

- a. Marth JL, Burnett TJ, Kiehl DE, et al. Metabolism and residue decline of [<sup>14</sup>C]tylosin in tissues and eggs of laying hens (abstr). *Abstr Pap Am Chem Soc* 2001;221:AGRO 64.

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