National survey on veterinarian-initiated drug use in lactating dairy cows

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On Aug 5, 1992, the US General Accounting Office (GAO), which serves as the investigational arm of the US Congress, issued a report of a 2-year investigation pertaining to drug residues in the nation's milk supply.[1] During the investigation, GAO staff compiled a list of 82 drugs known or believed to be used to treat lactating dairy cows. Of the 82 drugs, 52 were not approved for use in lactating cows, and 33 of the 52 were not approved for use in any food animal species. In the report, the GAO criticized the FDA Center for Veterinary Medicine for allowing extra-label use of drugs by veterinarians. The report stated, "Although FDA intended that extra-label uses under its policy would be rare, several veterinarians who treat dairy cows told GAO that 40 to 85 percent of their dairy cow prescriptions are for extra-label purposes." The report also criticized FDA for requiring states to test milk for only 4 β-lactam drugs, but none of the other 78 drugs identified by GAO investigators.

The GAO investigation did not attempt to determine the frequency with which these 82 drugs are used on dairy farms, nor did it distinguish whether the drugs were provided or prescribed by veterinarians. The following survey was undertaken to provide greater insight into veterinarian-initiated drug usage patterns. The specific objective of this survey was to estimate the relative frequency with which the drugs in the GAO list are used by veterinarians to treat lactating cows, and to identify any patterns in drug use associated with veterinary demographic data.

Materials and Methods

Information was collected by questionnaire mailed to approximately 4,000 veterinarians in the United States. In an effort to target the population of interest (dairy practitioners), the questionnaire was included with the mailing of the February 1993 newsletter of the American Association of Bovine Practitioners. The questionnaire was designed to collect demographic information as well as specific information on the frequency of veterinarians' use of drugs in lactating cows. Respondents were asked to identify the primary state in which they practiced and the year in which they were awarded their doctorate degree in veterinary medicine. They were also asked to provide information about that portion of their practice that involved service to dairy farms. The questions were designed to approximate the percentage of practice dedicated to dairy health-related services, the average herd size serviced, and the number of herds serviced by the practice (Table 1). Failure of the respondent to provide valid demographic information resulted in rejection of that person's entire response to the questionnaire.

Table 1—Demographic variables evaluated in the survey

Variable	Coding	Contents
APHIS region	Integer 1 to 4	APHIS region: 1) Northern; 2) Southeastern; 3) South central; 4) Western
Graduation year	Real 49 to 93	Year (19nn) of graduation from veterinary school
Percent dairy	Integer 1 to 6	Percent of practice committed to dairy: 1) < 10%; 2) 10 to 19%; 3) 20 to 39%; 4) 40 to 59%; 5) 60 to 80%; 6) > 80%
Herd size	Integer 1 to 5	Average herd size (number of cows) for farms that are serviced: 1) 10 to 49; 2) 50 to 99; 3) 100 to 199; 4) 200 to 500; 5) > 500
Number of herds	Integer 1 to 5	Approximate number of herds served: 1) 1 to 30; 2) 31 to 45; 3) 46 to 60; 4) 61 to 80; 5) > 80
R2, R3, R4	Integer 1,0	Regression model dummy variables for APHIS regions 2, 3, and 4
Interaction	Real	Interaction term based on Spearman's rank correlation analysis of data: Percent dairy × Number of herds

The second part of the questionnaire consisted of an alphabetic listing of the 82 drugs reported to be found on dairy farms by the GAO (Appendix 1). For each drug, respondents were asked to indicate how often they prescribed or administered the drug to lactating cows within their practice. Respondents were restricted to selecting 1 of the following 6 frequency-of-use categories for each drug: never; once a year; once a month; once a week; 5 times a week; and more than 5 times a week. Selecting more than 1 category for a given drug or failure to select a single category resulted in the rejection of that response. A response was discarded only if all answers to frequency-of-use questions were rejected.

Although 1 objective of the survey was to estimate veterinarian-initiated extra-label drug use in lactating cows, the questionnaire did not distinguish FDA-approved drugs from those that were not approved for use in lactating cows. This information was intentionally omitted to minimize bias that may have resulted from reluctance to admit to extra-label drug use. Similarly, brand names of products containing the 82 drugs were not included, as these were not specified in the GAO report, and their inclusion could introduce bias into the response.

Statistical analysis—Information from the questionnaires was transferred to an electronic database[a] for purposes of sorting and managing the data. To attain a broader overview of the types of drugs administered or prescribed by veterinarians, drugs were grouped into the following categories of interest: antibiotics, sulfonamides, anthelminthics, anti-inflammatories and tranquilizers/analgesics, nitrofurans, antifungals, antihistamines, antidotes, estrus regulators, vitamins, and miscellaneous drugs (Appendix 2). Within these categories, groups were divided into those approved by the FDA for use in food animals and those not approved for food animal use. Within each group, an "average use score" was computed as:

$$\text{Score}_G = \frac{\Sigma\ \text{Drug Score}_{GN}}{\text{Response}_G}$$

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Table 2—Summary of demographic data from survey respondents

	Region 1	Region 2	Region 3	Region 4	Overall
No. of respondents	468	57	190	99	814
Average graduation year	1976	1976	1977	1976	1976
Percentage dairy in practice	60 to 80% (> 80%)*	40 to 59% (> 80%)	20 to 39% (10 to 19%)	40 to 59% (> 80%)	40 to 59% (60 to 80%)
Herd size	50 to 99	100 to 199	50 to 99	200 to 500	50 to 99
No. of dairy herds	46 to 60 (> 80)	31 to 45 (1 to 30)	31 to 45 (1 to 30)	31 to 45 (1 to 30)	46 to 60 (46 to 60)

*Numbers in parentheses are mode scores. Numbers above those in parentheses are numerical means.

where $Score_G$ = average use score for the respondent for drug category G; Drug $Score_{GN}$ = use score (1 to 6) for drug N in drug category G; and $Respondent_G$ = number of valid responses for drugs in drug category G.

An average use score of 1.00 indicates that the drug is never used or prescribed by any of the respondents, whereas an average use score of 6.00 indicates that all respondents use or prescribe the drug more than 5 times a week. Average use scores were computed for all drug groups for each respondent, and these average use scores were used for analysis. Responses that had missing values for the computed average use score were excluded in the development of the specific analysis for the use score (ie, if a questionnaire had complete data for all drugs except the tranquilizer group, this response was included in all analyses except those for the tranquilizer groups).

Simple descriptive statistics were produced for all variables in the data set. After descriptive statistics were computed, interactions between demographic variables were checked by use of Spearmann's rank correlation analysis.[2] On the basis of the correlation analysis, interaction terms were developed for use in regression models to control for possible confounding between independent variables. Multiple linear regression models were developed for each average use score as the dependent (outcome) variable, and the demographic variables and interaction terms were used as independent variables for the models in the form:

$$\text{Avg Score} = \beta_0 + \beta_1 \text{ Pct Dairy} + \beta_2 \text{ Nherds} + \beta_3 \text{ HerdSize} + \beta_4 \text{ GradYr} + \beta_5 \text{ Region 2} + \beta_6 \text{ Region 3} + \beta_7 \text{ Region 4} + \beta_8 (\text{PctDairy} \times \text{Nherds}) + \varepsilon$$

where β_0 = model Y-intercept; PctDairy = the percent of the practitioner's practice that is dairy herds (β_1 is the estimate for this variable); NHerds = the average number of herds the practitioner sees (β_2 is the estimate for this variable); HerdSize = the average number of cows in the dairy herds the practitioner sees (β_3 is the estimate for this variable); GradYr = the last 2 digits of the year that the practitioner graduated from professional school (β_4 is the estimate for this variable); Region 2 = the practitioner practices in APHIS Region 2 (β_5 is the estimate for this variable); Region 3 = the practitioner practices in APHIS Region 3 (β_6 is the estimate for this variable); Region 4 = the practitioner practices in APHIS Region 4 (β_7 is the estimate for this variable). PctDairy × NHerds = the term included to account for the interaction between PctDairy and NHerds (β_8 is the estimate for this variable). ε = the model error term.

The APHIS region number in these models is handled by 3 dummy variables, each of which can have a value of 0 (not in the region) or 1 (in the region). For example, an observation from region 3 would have a 1 in the region 3 variable and 0 in the region 2 and region 4 variables, and an observation from region 1 would have 0 in all 3 region variables. The models were developed and refined by use of forward stepwise techniques, requiring $P \leq 0.05$ for variables to be included in the model.

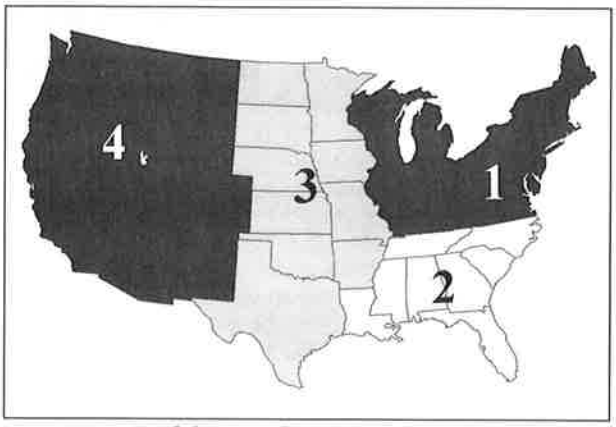

Figure 1—Regional divisions of continental United States that were used for analysis of survey data. Region 1 = Northern; region 2 = Southeastern; region 3 = Central; and region 4 = Western.

Results

Approximately 4,000 surveys were mailed, and 840 responses were returned, of which 26 were rejected because of missing or incomplete demographic data, resulting in a response rate of approximately 20%. Table 2 contains information about the demographic profile of the responding population broken down by APHIS region (Fig 1). Of 814 total respondents, over 57% (468) practiced in region 1 (Northern), followed by 23% (190) in region 3 (South central), 12% (99) in region 4 (Western), and 7% (57) in region 2 (Southeastern). There were no responses from dairy practitioners from the following states: Alaska, Delaware, Hawaii, Massachusetts, Nevada, Rhode Island, and Wyoming. The average year of graduation from veterinary school was 1976. The average percentage of practice devoted to dairy health management was 40 to 59% (most frequently selected response was 60 to 80%). The average herd size was 50 to 99 cows, and the average number of dairy herds serviced by the practice was 46 to 60.

With respect to regional differences in demographic makeup of the respondents (Table 2), regions 1 and 4 had the greatest percentage of practices devoted to dairy health management, regions 2 and 4 had the largest herd sizes, and region 1 had the largest number of herds seen in the practice. Considering the nature of the dairy industry across the United States, the high percentage of dairy practice in the West and North is consistent with dairy production in these regions. Dairy operations in the West, on average, are substantially larger than those located in the North, but the Northern region had a large population of small dairy farms.

Figure 2 shows the average use scores of the major drug groups by their FDA approval status. With the exception of anthelminthics, approved drugs in each category were prescribed more frequently than unapproved drugs. Drug use varied by region, but the differences between regions showed no clear patterns of use by region. Average use scores for the 25 most frequently prescribed drugs are shown in Figure 3. Penicillin G was the drug most often prescribed by dairy practitioners,

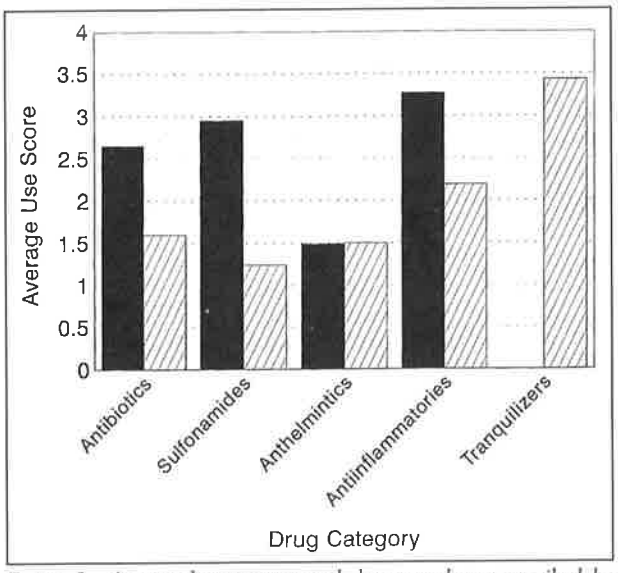

Figure 2—Approved vs unapproved drugs used or prescribed by veterinarians in the treatment of lactating dairy cows. The calculated average use score is indicated on the Y-axis. ■ = Approved, ▨ = Not approved.

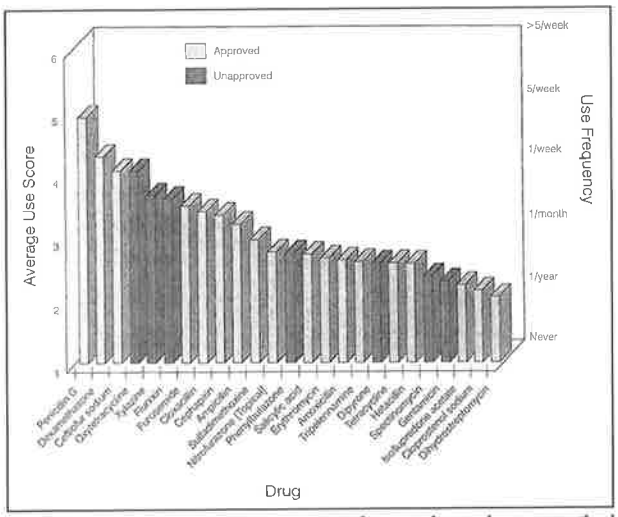

Figure 3—The 25 drugs that are most frequently used or prescribed by veterinarians in the treatment of lactating dairy cows. Light-shaded bars represent drugs approved by FDA for use in lactating cows, and dark-shaded bars represent drugs that are not approved for use in lactating cows. The calculated average use score and the corresponding use frequency are indicated on the left and right Y-axes, respectively.

followed by dexamethasone, cetiofur sodium, and oxytetracycline. All 4 of these drugs had average use scores over 4.0, which means that they were used at least once a week.

Multiple linear regression models were developed for all drug groups in an effort to determine whether any sets of respondent demographic variables were associated with increases in drug use scores. Tables 3 to 7 contain those models with computed R^2 values greater than 10%. Table 3 shows the regression model describing the use of FDA-approved antibiotics. The model indicates that veterinarians who devoted a high percentage of their practice to dairy health management, and those whose practice served a large number of herds, used

Table 3—Multiple linear regression models for average use scores for antibiotics approved for use in food animals

Variable	Coefficient	SEM	F statistic	P value
Intercept	1.4114	0.1190	149.95	0.0001
No. of dairy herds	0.3690	0.0602	37.76	0.0001
Percent dairy in practice	0.1790	0.0291	37.60	0.0001
Interaction term*	−0.0372	0.0119	12.40	0.0005

*Interaction term = Percentage dairy in practice × number of dairy herds.
R^2 = 0.25.

Table 4—Multiple linear regression models for average use scores for antibiotics not approved for use in food animals

Variable	Coefficient	SEM	F statistic	P value
Intercept	1.1827	0.0361	1072.95	0.0001
Percentage dairy in practice	0.0193	0.0090	4.58	0.0327
No. of dairy herds	0.0572	0.0106	28.85	0.0001
APHIS region 2	−0.1215	0.0481	6.37	0.0118
APHIS region 4	−0.1154	0.0377	9.36	0.0023

R^2 = 0.14.

Table 5—Multiple linear regression models for average use scores for anti-inflammatory drugs approved for use in food animals

Variable	Coefficient	SEM	F statistic	P value
Intercept	0.8178	0.3054	7.17	0.0076
Graduation year	0.0181	0.0038	22.65	0.0001
Percentage dairy in practice	0.0915	0.0293	9.79	0.0018
No. of dairy herds	0.2463	0.0327	56.82	0.0001

R^2 = 0.19.

Table 6—Multiple linear regression models for average use scores for anti-inflammatory drugs not approved for use in food animals

Variable	Coefficient	SEM	F statistic	P value
Intercept	1.9010	0.0452	1770.04	0.0001
Interaction term*	0.0246	0.0025	94.91	0.0001
APHIS region 4	−0.2116	0.0730	8.41	0.0038

See Table 3 for key.
R^2 = 0.14.

FDA-approved antibiotics with greater frequency than did veterinarians servicing fewer herds and devoting less time to dairy practice. The model supported assumptions that were inherently obvious, in that the more dairy cows that veterinarians see in the course of practice, the more frequently they will prescribe drugs for those animals.

The multiple linear regression model describing the use of unapproved antibiotics in lactating cows is in Table 4. The average use pattern was similar to that observed for FDA-approved antibiotics. Veterinarians who devoted a high percentage of their practice to dairy health management, and whose clientele included a large number of farms, used unapproved antibiotics with greater frequency than did veterinarians servicing fewer herds and devoting less time to dairy practice. The use of unapproved antibiotics was lower in the Southeastern and Western regions (regions 2 and 4, respectively), compared with the Northern and south Central regions (regions 1 and 3, respectively).

Tables 5 and 6 present the multiple linear regression models describing the use of FDA-approved and unap-

Table 7—Multiple linear regression models for average use scores for tranquilizers and analgesics not approved for use in food animals

Variable	Coefficient	SEM	F statistic	P value
Intercept	2.1368	0.0997	459.51	0.0001
Percentage dairy in practice	0.2072	0.0257	64.80	0.0001
No. of dairy herds	0.1306	0.0287	20.68	0.0001

$R^2 = 0.21$.

proved anti-inflammatory drugs, respectively. Similar to antibiotic use patterns, a direct correlation between the percent of practice devoted to dairy health management, the number of dairy herds serviced, and the frequency of use of FDA-approved anti-inflammatory drugs was observed. In addition, the frequency of approved anti-inflammatory drug use appears to be greater in more recent graduates than in their older counterparts. As shown in Table 4, veterinarians in region 4 (Western) were less likely to prescribe unapproved anti-inflammatory drugs than were veterinarians in the other 3 regions.

The multivariable linear regression model describing the use of unapproved tranquilizers or analgesics in lactating cows is presented in Table 7. Once again, the frequency of use was directly related to the percent of practice devoted to dairy health management and to the number of herds serviced by the practice. Because there are no tranquilizer or analgesic drugs approved by the FDA for use in lactating cows, all of the drugs in this category are considered unapproved.

Discussion

Of the 82 drugs discovered on dairy farms by GAO investigators, 57 were used or prescribed less than once a year (average use score ≤ 2.00) by the 814 veterinarians who participated in this survey, whereas the other 25 drugs were used more frequently (Fig 3). Of those 57 drugs, 18 were virtually never used or prescribed (average use score ≤ 1.10); however, for every drug listed in the questionnaire, at least 1 respondent indicated some use.

The drugs used or prescribed most often by veterinarians were antibiotics, followed by anti-inflammatory drugs and tranquilizer or analgesic drugs. Within these categories, FDA-approved drugs were preferred over unapproved drugs, with the exception of the tranquilizer or analgesic drugs. Xylazine was used most often by respondents, averaging between once a month and once a week. Average use frequency of other tranquilizers (butorphanol and acepromazine) was less than once a year. There are no tranquilizer or analgesic drugs approved for use in lactating cows, and the frequent use of these drugs (primarily xylazine) most likely represents a conscious decision by the practitioners to adhere to ethical and humane standards of practice in accordance with extra-label drug use privileges.

The average use scores for FDA-approved antibiotics exceeded those of unapproved antibiotics (Fig 2). This indicates that veterinarians were more likely to prescribe FDA-approved antibiotics over unapproved antibiotics. Penicillin G was the drug most frequently prescribed by dairy practitioners and, except for oxytetracycline, the 5 most prescribed antibiotics were all FDA-approved β-lactams. From the standpoint of food safety, this finding is particularly important because all grade A milk sold in the United States is tested for the presence of β-lactam drugs. Oxytetracycline was the fourth most frequently prescribed drug in the survey. Oxytetracycline is approved for use in beef and nonlactating dairy cattle, but is not approved for use in lactating cows, except as a feed additive. Because milk is not required to be routinely tested for tetracyclines, it is the responsibility of the practitioner to ensure that adequate withholding times are observed when cows are treated with oxytetracycline.

Aside from oxytetracycline, the use of unapproved antibiotics by dairy practitioners appeared to be low. Spectinomycin and gentamicin were used or prescribed at a frequency between once a month and once a year. All other unapproved antibiotics are used or prescribed at a frequency less than once a year. Aminoglycoside and related aminocyclitol antibiotics are likely to be selected by veterinarians because of their activity against gram-negative organisms. However, their usefulness in the treatment of mastitis caused by gram-negative organisms is somewhat questionable,[3] and the potential for their use to result in violative tissue residues has prompted the American Association of Bovine Practitioners to pass a resolution in October 1994, calling for a voluntary moratorium on the use of aminoglycosides in cattle.

Of the sulfonamides, sulfadimethoxine was used or prescribed most frequently (once a month). Other sulfonamides were used at frequencies less than once a year by dairy practitioners, and more than 70% of respondents indicated that they never use unapproved sulfonamides in lactating cows. Sulfadimethoxine is the only available sulfonamide approved for use in lactating cows. All other sulfonamides listed in the questionnaire are prohibited from use in lactating cows under FDA's extra-label drug use policy (CPG 7125.06). Although trimethoprim is a dihydrofolate reductase inhibitor and not a sulfonamide, it is marketed only in combination with other sulfonamides, particularly sulfadiazine or sulfamethoxazole. Sulfonamides were added to the list of drugs prohibited in lactating cows in FDA's extra-label drug use policy in July 1992, approximately 6 months before this survey was conducted. It is possible that those veterinarians who indicated using unapproved sulfonamides were referring to use of these drugs in the months prior to the newly instituted prohibitions.

Next to the antimicrobial drugs and xylazine, the nonsteroidal anti-inflammatory drugs (NSAID) were prescribed most frequently by dairy practitioners. This finding is consistent with survey results reported by Kopcha et al,[4] in which 93% of food animal practitioners (1,325 of 1,424 respondents) indicated using NSAID. Dairy practitioners reported more frequent use of NSAID than did beef practitioners, and flunixin was the most frequently prescribed NSAID followed by phenylbutazone and dipyrone.[4] This same relative use pattern was observed in the present survey. Kopcha et al[4] also found that use of NSAID was more frequent among veterinarians who were awarded their degrees after 1969 than among earlier graduates. This age-related phenomenon was observed in the present survey, and may reflect a growing aware-

ness of the role of inflammation in the pathogenesis of infectious diseases, including mastitis.[5-7] Presently, there are no NSAID approved for use in food animals, and the increased use of these drugs among recent graduates suggests that drug availability may not be keeping pace with advances in veterinary medicine. Overall, the use frequency of FDA-approved anti-inflammatory drugs was greater than that for unapproved products (Fig 2); however, unapproved use of flunixin was reported at a frequency between once a month and once a week (Fig 3). Of greater concern, however, is the use of dipyrone. This NSAID is not approved by FDA for use in any animal species and its approval for use as a human drug was withdrawn by FDA as a result of its potentially toxic effects.[8,9] Regulatory initiatives to remove this unapproved drug from commerce and greater efforts to educate private practitioners as well as dairy producers about the potential hazards of anti-inflammatory use may be necessary as the use of these drugs becomes more common.

Anthelminthics were used or prescribed infrequently by dairy practitioners. Every anthelminthic listed in the questionnaire was prescribed less than once a year, on average, by respondents. The infrequent use of anthelminthics in lactating cows likely results from the knowledge by practitioners that such treatment is of questionable value in the overall health or productivity of mature cows.[10] Nonetheless, use of unapproved anthelminthics exceeded the use of FDA-approved drugs, except in region 2 (Southeastern). Furthermore, the anthelminthic most often used or prescribed was ivermectin, a drug that is excreted in milk for several days after dosing.[11] Educational efforts targeted at dairy practitioners or stronger label warnings would likely reduce the use of ivermectin in lactating cows.

Although the results of this survey do not dispute that some veterinarians may prescribe unapproved drugs to the extent indicated in the GAO report, the results indicated that, overall, dairy practitioners greatly prefer to prescribe FDA-approved over unapproved drugs (ie, of the 10 most prescribed drugs, 7 are approved, and of the 25 most prescribed drugs, 18 are approved). Furthermore, the results of the survey indicate that, with the single exception of oxytetracycline, the overwhelming majority of unapproved drugs prescribed by veterinarians are nonsteroidal anti-inflammatories and analgesics or tranquilizers, all of which are intended for humane purposes to reduce pain. Use of these unapproved drugs in dairy practice likely reflects an ethical commitment to the patient, as there are no FDA-approved drugs within this class of compounds.

Appendix 1

Alphabetic list of 82 drugs found on dairy farms by the General Accounting Office investigators

Acepromazine	Levamisole
Adenosine monophosphate	Lincomycin
Amikacin	Methacycline
Ammonium sulfate	Methocarbamol
Amoxicillin	Methylene blue
Ampicillin	Minocycline
Apramycin	Morantel tartrate
Bacitracin	Neomycin
Benzathine penicillin	Neostigmine
Betamethasone acetate	Nitrofurazone
Butorphanol tartrate	Novobiocin
Carbamoylcholine chloride	Oxytetracycline
Cephapirin	Penicillin potassium
Cetiofur sodium	Penicillin G
Chloramphenicol	Phenylbutazone
Chlorobutanol	Pralidoxime
Chlorothiazide	Prednisolone
Chlorpheniramine	Prednisone
Chlortetracycline	Progesterone
Cloprostenol sodium	Pyrilamine maleate
Clorsulon	Salicylic acid
Cloxacillin	Sodium salicylate
Coumaphos	Spectinomycin
D-panthenol	Sulfachlorpyridazine
Demclocycline	Sulfadiazine
Dexamethasone	Sulfadimethoxine
Dihydrostreptomycin	Sulfamerazine
Dipyrone	Sulfamethazine
Doxapram	Sulfamethoxazole
Doxycycline	Sulfamethizole
Erythromycin	Sulfanilamide
Flunixin meglumine	Sulfapyridine
Furosemide	Sulfaquinoxaline
Gentamicin	Sulfathiazole
Glycopyrrolate	Tetracycline
Griseofulvin	Thiabendazole
Hetacillin	Trichlormethazide
Hydrochlorothiazide	Trimethoprim
Isoflupredone acetate	Tripelennamine
Ivermectin	Tylosin
Kanamycin	Xylazine

(Continued on page 352)

Appendix 2

Specific drugs in drug groups

Drug group	Approved?	Specific drugs
Antibiotics	Yes	Amoxicillin, ampicillin, cetiofur sodium, cephapirin, chlortetracycline, cloxacillin, dihydrostreptomycin, erythromycin, hetacillin, neomycin, novobiocin, penicillin G, tetracycline, and tylosin
	No	Amikacin, apramycin, bacitracin, benzathine penicillin, chloramphenicol, demclocycline, doxycycline, gentamicin, kanamycin, lincomycin, methacycline, minocycline, oxytetracycline, penicillin potassium, and spectinomycin
Sulfonamides	Yes	Sulfadimethoxine
	No	Sulfachlorpyridazine, sulfadiazine, sulfamerazine, sulfamethazine, sulfamethizole, sulfamethoxazole, sulfanilamide, sulfapyridine, sulfaquinoxaline, sulfathiazole, and trimethoprim
Anthelminthics	Yes	Coumaphos, morantel tartrate, and thiabendazole
	No	Clorsulon, ivermectin, and levamisole
Anti-inflammatories	Yes	Dexamethasone and isoflupredone acetate
	No	Betamethasone acetate, dipyrone, flunixin meglumine, phenylbutazone, prednisolone, and prednisone
Tranquilizers	No	Acepromazine, butorphanol tartrate, and xylazine
Nitrofurans	Yes	Nitrofurazone
Antifungals	No	Griseofulvin
Antihistamines	Yes	Tripelennamine
	No	Pyrilamine maleate and chlorpheniramine
Antidotes	No	Methylene blue and pralidoxime
Estrus regulators	Yes	Cloprostenol sodium
	No	Progesterone
Vitamins	No	d-panthenol
Miscellaneous	Yes	Chlorothiazide, furosemide, hydrochlorothiazide, salicyclic acid, and trichlormethazide
	No	Adenosine monophosphate, ammonium sulfate, carbamoylcholine chloride, chlorobutanol, doxapram, glycopyrrolate, methocarbamol, neostigmine, and sodium salicylate

[a]dBase III, Borland International Inc, Scotts Valley, Calif.

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