

Source of acquisition as a risk factor for disease and death in pups

Janet M. Scarlett, DVM, PhD; John E. Saidla, DVM; Roy V. H. Pollock, DVM, PhD

Summary: Data were obtained and analyzed for 2,144 pups examined at 65 veterinary hospitals in the northeastern United States to determine whether there were significant differences in the frequency of disease and death among pups acquired from private owners, Societies for the Prevention of Cruelty to Animals/pounds, breeders, or pet stores. All health problems reported by owners and veterinarians in the first 2 weeks of ownership were tabulated.

The prevalence of serious disease among pups (resulting in death, euthanasia, return, or extensive treatment) was < 4% for all sources and did not differ significantly between pet stores and other sources. Pups from pet stores had more respiratory tract disease, but fewer fleas and parasites of the intestinal tract. Data supplied by the veterinarians indicated that the risk of intestinal tract diseases was significantly ($P \leq 0.01$) higher among pups from pet stores and Societies for the Prevention of Cruelty to Animals/pounds, compared with those from private owners. The prevalence of reported behavioral and congenital problems did not differ among the 4 sources.

Numerous articles in newspapers¹⁻³ and trade journals⁴ and special segments of television shows have implied that a high percentage of pups purchased from pet stores are seriously ill. Most of those reports are based on anecdotal accounts of people who have purchased sick or congenitally afflicted pups from pet stores. There are few population-based data to support such claims. Scientific studies have included descriptions of specific problems identified in pups,⁵ a survey of intestinal tract parasitism among pups from 14 pet stores in Atlanta,⁶ a description of the health of pups from 3 northern California pet stores,⁷ and an evaluation of congenital defects in pups from a single Califor-

nia pet store.⁸ Most of the studies lacked comparative data regarding pups from other sources (eg, breeders, private owners), were based on a small number of pups, or were confined to a small sample of stores or to only one aspect of health (eg, intestinal tract parasitism).

Several states are considering or have already enacted legislation to address a perceived higher-than-expected incidence and severity of disease among pups purchased from pet stores. Members of the pet industry, however, have disputed the need for further control, pointing out that few data exist regarding the frequency and severity of illness in pups purchased from any source. In the absence of comparative data, the benefit of control programs directed at only one source is impossible to ascertain.

The purposes of the study reported here were to compare the frequency of various signs of disease (eg, cough, diarrhea) in pups acquired from pet stores, breeders, private owners, and Societies for the Prevention of Cruelty to Animals (SPCA)/pounds during the first 2 weeks after their acquisition, and to determine the cumulative incidence of serious disease (eg, requiring euthanasia, return, or extensive treatment), death, and returns for these pups.

Materials and Methods

To obtain a cross-section of pups from various sources, pups were included in the study when admitted for care at private veterinary hospitals. Each hospital enrolled pups in the study for approximately 5 months.

Hospital selection—To ensure that the study would include sufficient numbers of pups from pet stores, veterinary hospitals were selected for their proximity to retail pet outlets. Hospitals that were within a 10-mile radius of pet stores selling at least 10 pups/wk were selected from lists of members of the American Animal Hospital Association (AAHA). In those areas where there were no AAHA-affiliated hospitals, members of the AVMA were used. The pet stores were identified from lists of members of the Pet Industry Joint Advisory Council in the

From the Department of Clinical Sciences (Scarlett) and Office of Continuing Education (Saidla), College of Veterinary Medicine, Cornell University, Ithaca, NY 14853, and SmithKline Beecham Animal Health, 812 Springdale Dr, Exton, PA 19341 (Pollock).

Supported by a grant from The Pet Industry Joint Advisory Council.

northeastern United States (including New York, Massachusetts, New Jersey, Connecticut, and Pennsylvania).

All hospitals included were sent a letter briefly explaining the study, inviting their participation, and alerting them to a forthcoming telephone call from a study representative. During the telephone conversation, the study protocol was explained further, questions were answered, and a visit to the practice was scheduled. All hospitals were visited by study representatives. The study protocol was explained in detail to veterinarians and their support staff to encourage their enthusiastic participation. A project director was assigned to call each clinic weekly to check on progress, answer questions, and encourage continued cooperation.

To minimize bias toward preconceived notions, the explanation of the study to participants emphasized our interest in the general health of pups, rather than the comparison of frequency of disease among pups from various sources.

Pup selection—The staff at each hospital was instructed to invite participation of all owners of pups < 19 weeks old that had been owned < 3 weeks. Each hospital received a log to record persons who declined to participate. Pups were enrolled between July 1989 and May 1990.

Data collection—Each owner was asked to complete a 2-page questionnaire about themselves and their pup. The questionnaire requested demographic information (eg, owner's name, address, telephone number, pup's name, place it was acquired, sex); any signs of illness or problems with the pup; and a brief description of the pup's diet. Owners completed the form while waiting to be seen by the veterinarian. A physical examination form was completed by the veterinarian after examining the pup.

Data were collected pertaining to the first 2 weeks of ownership after purchase. If a pup had not yet been owned for 2 weeks at the time of the veterinary visit, the owner was called (after a minimum of 2 weeks had passed) to assess the pup's health since the visit. This period was selected for study, because signs of infectious disease during this period were most likely to be associated with the pup's source. A second veterinary physical examination form was obtained for pups that were returned to the veterinary hospital for any problem during the observation period.

Participating hospitals returned the owner questionnaires and physical examination forms in preaddressed envelopes to the study office, usually on a weekly basis.

Data handling and interpretation—The data were entered into a data base manager⁹ and edited and analyzed using SAS.¹⁰ Because signs were identified on the owner form, and to a lesser extent on the veterinary form, data for several signs were

combined in the analysis to examine risk for respiratory and intestinal tract diseases. Also, because veterinarians had been asked to estimate the cause of the diarrhea (dietary, infectious, parasitic, or unknown), diarrhea was examined separately in the analysis by its perceived causes. Owners were not asked to identify the species of intestinal tract parasites, but veterinarians often did so. External parasites, behavioral problems, and congenital malformations were reported by owners and veterinarians. The prevalence of undescended testes and hernias was calculated separately.

Although the proportion data reported by the owners or veterinarians was a measure of prevalence (ie, the proportion of pups with signs of disease during a 2-week period [owners] or at a point in time [veterinarians]), the acute transient nature of many of the signs (eg, cough, vomiting, diarrhea) during the 2-week period suggested that these estimates also could be interpreted as cumulative incidence (ie, they represented the risk of developing signs). The terms, incidence or risk, are used in conjunction with the acute signs to describe the cumulative incidence for this reason.

Analysis—Frequency of disease, euthanasia, death, or return of pups from various sources were compared by use of the χ^2 test of independence.¹¹ Only *P* values ≤ 0.01 were considered significant in light of the multiple comparisons, using the Bonferroni adjustment.¹² For comparisons of 2 frequency estimates (whether incidence or prevalence) where 1 or more of the expected values were < 5, Fisher exact test was used.¹³ Comparisons of proportions among all sources not exceeding 1% were made by use of the variance test of the homogeneity of the Poisson distribution.¹¹

Because the age distribution of pups from various sources varied and disease risk or prevalence can vary by age, multivariate analyses controlling for age were performed for respiratory and intestinal tract illnesses, and for internal parasites, using unconditional logistic regression.¹⁴ The multivariate models also enabled us to evaluate several risk factors (eg, sex, purebred status, cost) simultaneously. In the models for intestinal tract disease, the variable indicating the presence/absence of intestinal tract parasites was included a priori.

The models were built by use of guidelines provided by Hosmer and Lemeshow.¹⁴ All main effects were evaluated by first using a backward stepwise approach. Each variable (other than source) was removed and its significance evaluated, using the likelihood ratio test.¹⁴ Those variables that were significant were retained. As each variable was removed, the coefficients for the remaining variables were compared with those estimates in the full model to assess the need to retain the variables to control confounding. After the main effects were identified, all possible second-order interactions were added and their significance was assessed sim-

Table 1—Demographic characteristics of pups from various sources

	Private owner n = 722 (%)	Pet store n = 591 (%)	Breeder n = 629 (%)	SPCA/ pound n = 202 (%)
Purebred				
Yes	55	91	99	1
No	45	9	1	99
Cost				
None	35	1	2	7
\$1 to \$75	16	3	1	87
\$76 to \$299	34	19	40	5
\$300+	12	76	56	0
Other*	2	1	1	1
Sex				
Male	49	49	51	43
Female	51	51	49	57
Breed (%)				
Mixed breed	45	9	1	99
Labrador Retriever	8	4	9	0.5
German Shepherd Dog	4	2	6	0
Golden Retriever	6	6	9	0
Cocker Spaniel	4	12	5	0
Rothweiler	2	1	5	0
Shetland Sheepdog	1	4	4	0
Beagle	2	1	2	0
Lhasa Apso	2	5	2	0
Shih Tzu	2	3	4	0
Siberian Husky	1	1	2	0
Other	23	52	51	0.5

* Gift, source was known.

Table 2—Prevalence (%) or cumulative incidence (%)* of owner-reported signs of disease for pups acquired from various sources during the first 2 weeks of ownership†

Disease	Private owner n = 722	Pet store n = 591	Breeder n = 629	SPCA/ pound n = 202
Persistent cough	2*	29 ^b	5*	11 ^c
Pneumonia	0.6	1	0.3	0.5
Diarrhea	17*	21*	17*	31*
Intestinal parasites	36*	17 ^b	26*	32 ^{a,c}
Earmites	4*	9*	67 ^{a,b}	2*
Fleas	26*	13 ^{a,c}	16*	257*
Congenital problems‡	0.7	0.5	0.2	0
Behavioral problems§	3	3	3	5

*Cumulative incidence of persistent cough, pneumonia, and diarrhea are listed; prevalence estimates are provided for the remaining conditions (see text).
†Percentages with different superscripts are significantly ($P \leq 0.01$) different from one another. ‡Includes hypodontia, collapsing trachea, pro- and brachygnathism, luxating patellas, and cardiac murmurs. §Includes aggressiveness, timidity, excessive barking, and destructiveness.

ilarly, using the likelihood ratio test. Odds ratios and 95% confidence intervals were estimated for significant ($P \leq 0.05$) risk factors in these multivariate models. Pups from private owners were selected as the baseline of comparison among pups from various sources; data for pups < 7 weeks old were used for comparisons to other age groups.

Results

Seventy-one eligible hospitals were invited to participate, of which 67 agreed and were visited. Sixty-five (91%) of these contributed a total of 2,212 pups. Sixty-eight pups were acquired from sources (eg, gift, stray) other than the 4 sources of

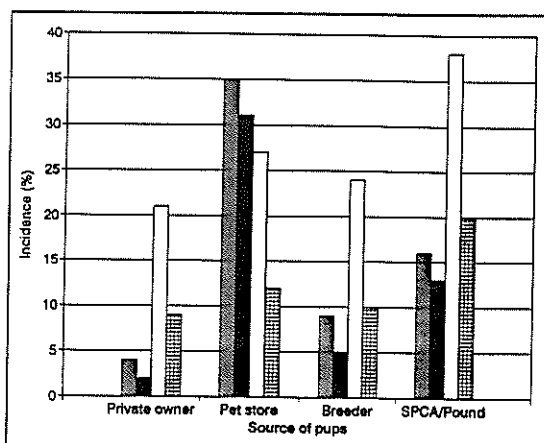


Figure 1—Owner- and veterinarian-reported cumulative incidence of respiratory tract and intestinal tract signs among pups from various sources. Within the veterinary and owner data, the frequencies of respiratory tract disease were all significantly ($P \leq 0.01$) different from one another. The frequency of intestinal tract disease among pups from SPCA/pounds was significantly ($P \leq 0.01$) higher than among pups from each of the other sources in the owner- and veterinarian-reported data. □ = Owner-reported respiratory tract signs; □ = owner-reported intestinal tract signs; ■ = veterinarian-reported respiratory tract signs; □ = veterinarian-reported intestinal tract signs; and SPCA = Societies for the Prevention of Cruelty to Animals.

interest and were excluded from evaluation, leaving 2,144 pups for analysis. The mean number of pups per hospital was 34, with a range of 2 to 100. The distribution of pups by cost, sex, purebred status, and breed varied by their source of acquisition (Table 1). Private owners placed their pups in new homes at the earliest mean age (8 weeks), with pet stores selling theirs at a mean age of 11 weeks and the other sources at approximately 9 weeks. Pups from pet stores were examined by a veterinarian within a mean of 6 days, 2 to 3 days earlier than those from other sources.

Owner-reported signs—The proportions of pups with respiratory tract, intestinal tract, and parasitic diseases differed significantly among the various sources. Owners reported that more than one-third of the pups from pet stores had signs of respiratory tract disease, an incidence almost 9 times higher than that reported for pups from private owners (4%); 4 times higher than that for pups from breeders and more than twice the incidence of respiratory tract signs reported for pups originating from SPCA/pounds (Fig 1). The most prominent respiratory tract sign among pups from pet stores was persistent cough (29%), presumably associated with kennel cough (Table 2). The signs were infrequently associated with serious disease, however. Only 1% of pups from pet stores had pneumonia and only 6 of 591 (1%) of owners reported fever in conjunction with the respiratory tract signs.

Signs of intestinal tract disease were significantly ($P \leq 0.01$) higher among pups from SPCA/pounds, compared with those for each of the other

Table 3—Prevalence (%) or cumulative incidence (%)* of veterinarian-reported signs of disease in pups from various sources during the first 2 weeks of ownership†

Disease	Private owner n = 722	Pet store n = 590	Breeder n = 629	SPCA/ pound n = 202
Persistent cough	0.7*	19*	3*	6*
Pneumonia	0	0.2	0	0
Diarrhea (all causes)	9*	11*	8*	19*
Diarrhea (not dietary) (not parasites)	3*	8*	5*	9*
Parvovirus suspected	0.1*	0.7*	0.5*	0.5*
Intestinal parasites	26*	7*	16*	22 ^{a,c,d}
Roundworms	22*	4*	12*	18 ^{a,c}
Hookworms	4*	1*	4*	4*
Tapeworms	2*	2*	3*	3*
Earmites	2*	6*	5 ^a	1 ^{a,c}
Fleas	9*	3*	6*	10*
Congenital‡ Hernias (umbilical and inguinal)	2	2	2	0.5
Cryptorchidism (among males)	3	2	2	2

*Prevalence estimates are listed for all parasites and congenital conditions; for other signs, cumulative incidence is listed. †Includes hypodontia, stenotic nares, luxating patellas, prognathism, brachygnathism, various limb malformations, and cardiac murmurs.
See Table 2 for key.

sources (Fig 1). Diarrhea was the most prominent sign of intestinal tract disease reported by owners (Table 2).

Pups from pet stores had the lowest prevalence of intestinal tract parasites, whereas pups from private owners had a significantly ($P \leq 0.01$) higher frequency of these parasites, compared with pups from other sources, with the exception of those from SPCA/pounds.

Fleas were least commonly reported on pups from pet stores and breeders, with prevalence estimates one-half to two-thirds those from other sources (Table 2). In contrast, ear mites were more common among pets from pet stores, compared with those from private owners and SPCA/pounds. Other external parasites (mange mites, ticks, chyltiella) were rarely reported. Congenital defects were infrequently identified, and although the prevalence of perceived behavioral problems ranged between 3 and 5%, it did not differ significantly for pups from various sources.

Veterinarian-reported signs/diagnoses—The incidence of respiratory and intestinal tract signs reported by veterinarians were lower than those reported by owners (Fig 1), but the pattern was the same. The most common respiratory tract sign in pups from pet stores was a persistent cough, frequently diagnosed as canine infectious tracheo-bronchitis (kennel cough). Veterinarians reported only 1 case of pneumonia (in a pup from a pet store) among the 2,144 pups in the study.

Diarrhea (without regard to cause) was significantly ($P \leq 0.01$) more common in pups from the SPCA/pounds than in those from other sources (Table 3). Diarrhea believed to be unrelated to diet

or parasites was more common in pups from pet stores and SPCA/pounds, although the rates were $< 10\%$. Nine of the 2,144 pups were suspected to have parvovirus.

Pups from pet stores had intestinal tract parasites (roundworms and hookworms) less frequently than those from each of the other sources (Table 3). The prevalence of intestinal tract parasites (particularly of roundworms) was lower for pups from breeders, compared with that of pups from private owners.

Diagnosis of fleas was less common for pups from pet stores, whereas diagnosis of ear mites was more common, compared with that for pups from private owners and SPCA/pounds (Table 3).

The prevalence of hernias and cryptorchidism was $\leq 2\%$ for pups from all sources and did not differ by source. Other congenital defects were least frequently reported in pups from SPCA/pounds; the difference was significant ($P \leq 0.01$), when compared with pups from pet stores.

Multivariate models of owner- and veterinarian-reported disease—Purebred status and cost were not associated with any of the diseases examined. Controlling for age, pups originating from pet stores had an almost 11 times greater risk of owner-reported respiratory tract signs, compared with pups from private owners (Table 4). For data reported by veterinarians, the odds ratio for respiratory tract disease was 18.5. Pups from SPCA/pounds and breeders were at significantly ($P \leq 0.05$) higher risk of respiratory tract problems than were those from private owners, but still at significantly ($P \leq 0.05$) lower risk than pups from pet stores. Pups 10 to 12 weeks old were at highest risk of respiratory tract disease.

The risk factors associated with intestinal tract signs differed between the owner- and veterinarian-reported data. In the owner-reported data, male pups had about a one-third higher risk vs female pups, whereas in the veterinary data, there was no association with sex of the pup.

Risk of intestinal tract disease varied by age differently within the various sources of acquisition. Pups ≤ 6 weeks old that were acquired from SPCA/pounds had 4.5 times the risk of pups of the same age coming from private owners; they also were at higher risk than older pups from SPCA/pounds. Pups from pet stores were at highest risk of intestinal tract signs when 10 to 12 weeks old, and were at significantly ($P \leq 0.05$) higher risk than pups the same age from private owners. Similarly, pups 7 to 9 weeks old from private owners had a significantly ($P \leq 0.05$) lower risk of intestinal tract signs, compared with pups from each of the other sources. Intestinal tract parasites increased the risk of intestinal tract signs 2.4 and 3 times in the owner- and veterinarian-supplied data, respectively.

In the data from veterinarians, the risk by age of intestinal tract disease was the same for pups

Table 4—Multivariate models of risk factors for owner-reported and veterinarian-reported signs of respiratory and intestinal tract diseases and intestinal parasites in pups during the first 2 weeks of ownership

Signs of disease	Risk factor	Owner-reported		Veterinarian-reported		
		Odds ratio	95% CI	Odds ratio	95% CI	
Respiratory tract*	Source					
	Private owner	1.0	—	1.0	—	
	Pet store	10.6†	6.9 to 16.4	18.5†	10.1 to 33.7	
	Breeder	2.1†	1.3 to 3.3	2.8†	1.4 to 5.4	
	SPCA/pound	4.1†	2.4 to 7.0	7.4†	3.7 to 14.7	
	Age					
	≤ 6 weeks	1.0	—	1.0	—	
7 to 9 weeks	0.9	0.6 to 1.3	1.5	0.8 to 2.7		
10 to 12 weeks	1.7†	1.1 to 2.7	2.5†	1.4 to 4.5		
13 to 18 weeks	1.3	0.8 to 2.1	1.7	0.9 to 3.2		
Intestinal parasites‡	Source					
	Private owner	1.0†	—	1.0	—	
	Pet store	0.4†	0.3 to 0.6	0.2†	0.2 to 0.4	
	Breeder	0.7†	0.6 to 0.9	0.6†	0.5 to 0.8	
	SPCA/pound	0.9	0.6 to 1.2	0.9	0.8 to 1.3	
	Age					
	≤ 6 weeks	1.0	—	1.0	—	
7 to 9 weeks	0.7†	0.5 to 0.9	0.7†	0.6 to 1.0		
10 to 12 weeks	0.7†	0.5 to 0.9	0.8	0.6 to 1.1		
13 to 18 weeks	0.6†	0.4 to 0.9	0.6†	0.3 to 0.9		
Intestinal tract§	Male vs female	1.3†	1.0 to 1.6	—	—	
	Intestinal worms	2.4†	1.9 to 3.0	—	—	
	Source X Age interaction (see below)					
Risk factor	Age at acquisition					
Source	≤ 6 weeks	7 to 9 weeks	10 to 12 weeks	13 to 18 weeks	Odds ratio	95% CI
Private owner	1.0	0.6	0.6	0.7	1.0	—
Pet store	0.8	1.0	1.6*	1.1	2.4†	1.6 to 1.6
Breeder	1.2	1.0	0.8	0.9	1.4	1.0 to 2.1
SPCA/pound	4.5†	1.4	0.9	1.2	3.0†	1.9 to 4.7
Intestinal tract parasites (present vs absent)					3.0†	2.2 to 4.1
Age						
≤ 6 weeks old					1.0	—
7 to 9 weeks old					0.7†	0.5 to 1.0
10 to 12 weeks old					0.5†	0.3 to 0.8
13 to 18 weeks old					0.5†	0.3 to 0.9

*Includes pups with ocular and nasal discharge persistent cough, pneumonia, nasal discharge and fever, sneezing or sinus infection (owner reported); persistent cough, kennel cough, upper respiratory tract infection, or pneumonia (veterinarian-reported). †P ≤ 0.05. ‡Individual intestinal parasites were not specified by owners; individual species were combined for this analysis of the veterinarian-reported data. §Vomiting, diarrhea, (owner-reported) plus parvovirus, enteritis, colitis (veterinarian-reported).
CI = confidence interval.

from all sources. Pups from pet stores and SPCA/pounds were at 2.4 and 3 times greater risk, respectively, than those from private owners. Pups ≤ 6 weeks old were at highest risk of intestinal tract signs.

Pups acquired from private owners were 2.5 to 5 and 1.4 to 1.7 times more likely to have intestinal tract parasites, compared with pups from pet stores and breeders, respectively, after controlling for age differences among the groups. Irrespective of source, pups ≤ 6 weeks old had the highest odds ratio for intestinal tract parasites.

Deaths, euthanasia, returns, and other owners—The frequency of returns from private owners, pet stores, breeders and SPCA/pounds was 7, 10, 16, and 25/1,000, respectively, but these frequencies were not statistically different. Veterinarians recommended the return of 2 additional pups obtained from pet stores, but the owners elected to treat the pups. Both pups were suspected as having parvovirus and required prolonged treatment; the

pet store selling 1 of these pups paid the veterinary costs involved. If these pups had been returned, the frequency of return for pups from pet stores would have increased to 14/1,000, but would still not have been statistically different from the frequencies for other sources.

Death and euthanasia rates also did not differ significantly among sources. Two pups died accidentally within the first 2 weeks, but were not included in the calculations. The total losses from death, euthanasia, and returns were 8, 20, 19, and 35 (per 1,000) from private owners, pet stores, breeders, and SPCA/pounds, respectively. The combined death, euthanasia, and return frequency was lower ($P = 0.05$) among pups from private owners, compared with that for SPCA/pound pups, but did not differ from those from other sources. If the frequencies of death, euthanasia, and return are estimated only for pups with reported diseases, or behavioral or congenital problems (ie, excluding pups returned for nonhealth reasons), pups from

pet stores and SPCA/pounds had about equal risk (22 and 25/1,000 pups, respectively), compared with approximately 11/1,000 among pups from private owners and breeders. These differences were not statistically significant. Interestingly, 9 new owners gave their pups away within the first 2 weeks (4, 0, 4, and 1 had acquired the pups from private owners, SPCA/pounds, pet stores, and breeders, respectively). The frequency of not keeping a pup for any reason (including death, euthanasia, and return) was not significantly different among the sources (14, 27, 21, and 35/1,000 for private owners, pet stores, breeders, and SPCA/pounds, respectively).

Illness was the most common reason for death and euthanasia, as well as for returning a pup to its source. Perceived behavioral problems or congenital defects were the other most common reasons for giving up a new pup. Other reasons included the development of allergies among family members, too much work, and landlord objections.

Discussion

Data from this study indicated that the risk of acquiring a fatally ill pup (one that dies or must be euthanatized) or one that will be returned (for any reason) within the first 2 weeks of ownership is low $\leq 4\%$, irrespective of where it is acquired. Pups from SPCA/pounds had the highest risk, followed by those from pet stores and breeders, whereas pups from private owners were at lowest risk.

Although the risk of respiratory tract disease was higher for pups obtained from pet stores, serious disease (eg, pneumonia, fever, distemper, or death) was rare and the incidence did not differ significantly among sources. Owners reported 6 cases of pneumonia among pups from pet stores, only one of which was verified by the veterinary data. Over half of the cases of respiratory tract disease involved persistent cough, frequently diagnosed by the veterinarians as kennel cough. Diagnoses of kennel cough probably were underreported in the veterinary data, because kennel cough did not appear as a specific diagnosis on the study form, and veterinarians may have checked persistent cough without entering a more specific diagnosis in the "other" category. In surveys, open-ended "other" categories frequently result in underreporting of data.¹⁵

The high incidence of respiratory tract disease among pups from pet stores was not surprising, because these pups have been stressed by weaning, shipping, and handling and then congregated in the broker's facility during shipping, and in the pet store, enhancing both the risk of exposure and infection. Hird et al⁷ also found respiratory tract disease (specifically kennel cough) to be the most frequent cause of illness among pups from pet stores. These investigators reported a frequency of kennel cough (veterinarian-reported) of approximately 40% among pups from 1 California pet

store (following 1 after purchase examination) and 30% among pups from another store (within the first 2 weeks of purchase). Despite differences in the approach to estimating frequency in our study vs Hird et al's study, the 31% incidence of respiratory tract disease we observed was within the range (24 to 35%) observed by Hird et al, and the 19% incidence of persistent cough in our veterinarian-supplied data was lower. The frequency of respiratory tract disease among pups from private owners in both studies was similar (Hird et al, 1.9% for kennel cough; our study, 2% for respiratory disease, and 0.7% for persistent cough). Fortunately, kennel cough generally is self-limiting and rarely results in life-threatening complications.^{16,17} This was consistent with the low mortality and incidence of pneumonia among pups from pet stores.

As would be expected on the basis of exposure and stress, pups from SPCA/pounds had the second highest incidence of respiratory tract disease, followed by those from breeders and, at lowest risk, those from private owners. These frequencies were all significantly different from each other, and despite some differences between the owner- and veterinarian-reported data, the trends were the same.

Respiratory tract disease is difficult to prevent in groups of mammals of most species. Vaccines against parainfluenza, adenovirus type II, and *Bordetella bronchiseptica* are available and can be used in young pups to reduce the incidence of respiratory tract disease.¹⁶ Vaccination of bitches for these agents shortly before breeding and subsequent vaccination with intranasal vaccines (eg, parainfluenza, *Bordetella*) of young pups before shipping and after arrival in the pet store or shelter should reduce the incidence of respiratory tract disease in pups from pet stores and SPCA/pounds. Because currently available vaccines are imperfect and no vaccines exist for many respiratory tract disease agents (eg, mycoplasma, reoviruses),¹⁷ respiratory tract disease cannot be completely controlled among pups in high-risk environments.

Irrespective of the source, pups 10 to 12 weeks old had the highest risk of respiratory tract disease. The opportunity for exposure coinciding with loss of maternal antibodies probably explain this high-risk period.

The high incidence of intestinal tract disease among pups from SPCA/pounds and pet stores, compared with those from private owners, probably reflects increased risk of exposure associated with aggregating pups from various backgrounds.

Owners reported twice as much intestinal tract disease as did veterinarians. This probably is because the owner-volunteered data pertained to the entire 2-week period following acquisition, whereas the veterinary estimates were collected at one point in time. In other words, most of the veterinary data represent only signs that were present or reported by the owner during a single examination (95% of pups had 1 examination only). Because the exam-

ination was completed approximately 6 to 9 days after acquisition, most of the veterinary data pertained to a shorter observation period than that supplied by the owner. The difference also may reflect thresholds for reporting; episodes that the owners perceived as diarrhea or vomiting of sufficient severity to report may have been unknown or not considered important enough to be reported by the veterinarians.

The risk by age of intestinal tract disease was constant across all sources in the veterinary data, probably because of the smaller number of pups with intestinal tract signs. In the owner-supplied data, an age effect was observed and surprisingly, males were more likely to have had signs of intestinal tract disease than females. The reason for this latter observation among the owner-reported data is unknown.

Common causes of vomiting and diarrhea in pups include diet,¹⁸ intestinal parasitism,^{18,19} infectious agents (eg, parvovirus, coronavirus, campylobacteriosis)^{16,18} and, potentially, stress. A higher risk for signs of intestinal tract disease among pups from pet stores and SPCA/pounds was evident, even after controlling for the presence of roundworms, hookworms, and tapeworms. The stress of shipping or moving pups undoubtedly is greater among pups from pet stores and SPCA/pounds. Likewise, pups from these sources are more likely to have experienced changes of diet before adoption and to have been exposed to common infectious agents (eg, coronaviruses, rotaviruses). To what extent these factors explain the increased incidence of intestinal tract signs in these pups is unknown. It seems likely, however, that stress, changes of diet, other parasites, and differences in exposure all contribute.

As was true for respiratory tract disease, severe gastrointestinal tract disease was rare, a finding also reported by Hird et al.⁷ Only 9 cases of parvovirus were reported among the 2,144 pups; there was no statistical difference among sources.

The veterinarian-reported data regarding the prevalence of roundworms were consistent with the observations of Hird et al,⁷ which indicated a higher frequency of these parasites among pups from private owners, compared with those from a pet store. It should be noted, however, that the veterinary estimates in our study are almost certainly underestimates of the true prevalence of intestinal tract parasitism, because common methods of fecal examination in clinical practice do not facilitate giardial cyst or trophozoite identification^{19,20}; coccidial cysts can be easily overlooked²⁰; and other potentially important parasites, such as cryptosporidiosis, require special strains for identification.^{18,20} It seems unlikely that the underreporting varied by source, however, because the comparative relationships among sources were identical in the veterinarian- and owner-provided data.

Other studies^{6,7} in pups from pet stores have identified prevalence estimates for giardia ranging between 25 and 46% and for coccidia ranging between 9 and 18%, suggesting considerably higher frequencies than were apparent in our study. Findings in the study by Hird et al⁷ also suggested that pups from pet stores were more likely to suffer from giardiasis and coccidiosis, compared with those from private owners. The discrepancies among studies also may reflect geographic differences in parasite frequency.

The low prevalence of parasitism attributable to roundworms, hookworms, and tapeworms in pups from pet stores vs pups from the other sources almost certainly reflects the effect of preventive health programs (anthelmintic treatment). The prevalence of intestinal tract parasitism among pups from private owners and even professional breeders was highest, indicating that veterinarians need to increase their efforts to educate private and professional breeders regarding transmission and prevention of intestinal tract parasites.

Flea control was superior in pet stores and among breeders, compared with that by private owners and SPCA/pounds. Although pups from pet stores had the lowest prevalence of fleas and intestinal tract parasites, the stores had the poorest record for ear mite control. Interestingly, pups from breeders had a prevalence similar to those among pups from pet stores. The data suggested that breeders supplying pet stores and selling pups directly should improve their ear mite control efforts. On arrival at pet stores, pups with ear mites are unlikely to complete the necessary treatment regimen before sale, even if the mites are identified and treatment begun. Control efforts, as well as prompt identification and treatment, could reduce the likelihood of sale of pups with ear mites.

Congenital problems were reported rarely by the owners, probably because they failed to recognize them or did not consider them of sufficient importance to mention. Despite a lower prevalence of hernias and other congenital abnormalities among SPCA/pound pups, the prevalence estimates across sources did not vary statistically.

The congenital malformation prevalence estimates in our study represent minimal estimates; the estimates are low because many congenital problems could not be diagnosed in the time and age-frame sampled, there was underreporting in the "other" category, and a failure to diagnose conditions (eg, Collie eye anomaly) requiring equipment or professional expertise that may not be present in general veterinary practice. Ruble and Hird⁸ reported an overall prevalence of congenital defects of 15.1% among 1,679 pups presented to a pet store in a 2-year period. No comparison was made to other sources, however. This compares to 7% for all defects reported in our study.

Although purebred status and cost were not significantly associated with any of the conditions

examined in the multivariate analysis, this result may be misleading, because these factors were strongly correlated with source and, therefore, difficult to study independently.

Only clients seeking veterinary care for their pups, regardless of source, had their pups included in our study. In a 1987 survey,²⁰ 78% of dog owners (irrespective of the age of the dog) had sought veterinary care within the past year and 84% had a veterinarian. It seems likely that the proportion of owners seeking veterinary care for their newly acquired pup is higher than 78%, as people in most sources encourage owners to have it examined and vaccinated quickly after acquisition. If the percentage of new owners who failed to have their pups examined by a veterinarian was not too large and occurred randomly across sources, biased comparisons would be unlikely. If, however, owners of pups from the various sources differentially sought initial veterinary care, the prevalence estimates and their comparisons may be biased. One could speculate, for example, that sick pups from pet stores were returned directly to the store more frequently than pups from private owners, or, alternatively, that expensive sick pups from pet stores were preferentially admitted for veterinary attention before being returned to the store, compared with pups from other sources. Other factors such as emotional attachment, cost of veterinary care, and availability of free veterinary examinations undoubtedly influenced decisions to return sick pups directly to their source or to present healthy pups for veterinary care. Unfortunately, the extent and effect of these influences on the study results cannot be discerned.

There were few data regarding clients that declined to participate. Despite a request to each clinic to keep a log of clients declining to participate, the logs were incomplete, and sporadically returned. Although anecdotal reports suggested that refusals were uncommon, it was impossible to quantify client refusals, characterize their reasons for not participating, and attempt to assess the impact on the results of the study. The data suggested that the reasons were highly variable (eg, in a hurry, children present, other pets, "didn't want to") and unlikely to have resulted in serious unidirectional biases.

Some misclassification undoubtedly resulted between the designation of private owner vs breeder. The differences in frequency of disease between pups from breeders and private owners, however, were distinct, which suggested that misclassification was not common and that real differences in disease risk existed.

Findings in our study indicated that there was not an ideal source from which to acquire a pup. The risk of serious disease, resulting in death, euthanasia, return, or expensive treatment was low across all sources. Pups from pet stores were more likely than those from other sources to have some signs of illness, particularly a persistent cough, but

were less likely to have common intestinal tract parasites and fleas. Similarly, pups from SPCA/pounds came from an environment of higher stress and exposure, compared with pups from private owners and breeders, and had a higher commensurate risk of disease, although not usually serious.

Health considerations, along with issues of cost, desire for a purebred dog, desire for a dog with show quality, proximity of source, guarantees, and so forth are part of the decision on where to acquire a pup. Regardless of which source is selected, a prospective owner's first line of defense is to research the source (eg, asking for names of previous purchasers, evaluating overall husbandry) and evaluate the appearance and health of the pup, its sire and dam (if available) and other litter- or store-mates. A thorough veterinary examination should be obtained as soon as possible. Healthy and unhealthy pups can be acquired from any of the sources surveyed in this study.

References

1. Yorkin N. The pet-store controversy; how sick is the doggy in the window? *Los Angeles Times* (Sunday Home Edition) 1989 Dec 3:34.
2. Flynn J. 'Pup mills' accused of breeding diseases. *San Francisco Chronicle*, 1989 Aug 27:1 (section B).
3. Editorial. Use laws to protect dogs and buyers. *USA Today* 1990 Mar 21:10 (section A, col 1).
4. Randolph M. "Pup mills": laws regulating dog breeders lack teeth. *Pet Vet* July-August 1990;34-38.
5. Eugster AK, Sikwa T. Rotaviruses in diarrhetic feces of a dog. *VM SAC* 1979;74:817-819.
6. Stehr-Green JK, Murray G, Schantz PM, Wahlquist SP. Intestinal parasites in pet store pups in Atlanta. *Am J Public Health* 1987;77:345-346.
7. Hird DW, Ruble RP, Reagor SG, et al. Morbidity and mortality in pups from pet stores and private sources: 968 cases (1987-1988). *J Am Vet Med Assoc* 1992;201:471-474.
8. Ruble RP, Hird DW. Congenital abnormalities in puppies from a pet store: 253 cases (1987-1988). *J Am Vet Med Assoc* 1993;202:633-636.
9. *R: base user's manual*. Redmond, Wash: Microrim Inc, 1987.
10. *SAS user's guide: statistics, version 5 edition*. Cary, NC: SAS Institute Inc, 1985;403-432.
11. Snedecor GW, Cochran WG. *Statistical methods*. Ames, Iowa: Iowa State University Press, 1989;124-125, 199-200.
12. Bailar JC, Mosteller F. *Medical uses of statistics*. Waltham, Mass: NEJM Books, 1986;218-219.
13. Fleiss JL. *Statistical methods for rates and proportions*. New York: John Wiley & Sons, 1981;19-32.
14. Hosmer DW, Lemeshow S. *Applied logistic regression*. New York: John Wiley & Sons, 1989;82-91, 420-445.
15. Dillman DA. *Mail and telephone surveys: the total design method*. New York: John Wiley & Sons, 1978;88-89.
16. Greene CE. Canine infectious tracheobronchitis. *Infectious diseases of the dog and cat*. Philadelphia: WB Saunders Co, 1990;259-287, 874-875.
17. Moise NS. Viral respiratory diseases. *Vet Clin North Am Small Anim Pract* 1985;15:919-928.
18. Zimmer J, Pollock RVH. Esophageal, gastric, and intestinal disorders of young dogs and cats. *Vet Clin North Am Small Anim Pract* 1987;17:641-662.
19. Georgi JR, Georgi ME. *Canine clinical parasitology*. Philadelphia: Lea & Febiger, 1992;60-61, 82-85.
20. Troutman CM. *The veterinary services market for companion animals*. Schaumburg, Ill: American Veterinary Medical Association, 1988;22.