

Chapter 1 The Blood Donor

Introduction

Blood donors are vital to the success of any transfusion service, and veterinary blood banks depend on qualified donors to provide the blood necessary to meet the needs of the patients they serve. Donors may be a part of an in-clinic or community-based program, but to attract and maintain owner participation in either program it is essential that the blood donor qualification and donation process be as organized, pleasant, and convenient as possible. Established methods to produce safe products and maintain donor health are essential.

Owner Recruitment

Enlisting owners to volunteer their pet as a blood donor can be as simple as expressing the need. This can be done by mentioning the need for blood donors to clients or could include utilizing social media, websites, and posting notices in the lobby of veterinary clinics. Whether the donor will be part of an in-clinic or community-based program, many veterinary blood donor programs offer incentives to owners as compensation for time spent scheduling donations, transporting their pet to and from donations, or any other related activity (Table 1.1).

Good communication is imperative to the success of any blood donor program, and it is beneficial to define and communicate owner expectations during the blood donor qualification process. Suggestions for the contents of a written participation agreement can be found in Table 1.2. Standardized forms should be completed for enrollment of potential blood donors (Wardrop *et al.*, 2016); see Tables 1.3 and 1.4. Organizing staff members to coordinate and oversee donor recruitment, blood collection, and donor maintenance will streamline and contribute to the overall effectiveness of the blood donor process.

Table 1.1 Incentives to recruit and maintain veterinary blood donors

Free donor vaccines
Free or discounted initial and annual blood donor physical exam
Blood product discount for participants
Dog spa or overnight boarding discount
Grooming services
Free or discounted pet food and/or treats

Table 1.2 Blood donor owner expectations

Obligations and benefits of the blood donor program are pending until the animal is accepted into the program

The owner agrees to bring the donor to phlebotomy location at the scheduled time for x times per year and once per year for the annual blood donor examination

At the end of the year if total number of donations does not exceed x or if the owner withdraws the animal before making at least x donations, the owner may be billed for the general physical exam and blood testing

If a donor's temperament is too difficult for continued phlebotomy on more than one occasion or if the owner is deemed uncooperative, the owner will be notified of their removal from the program. The owner will not be billed for any previous physical exams or blood tests relating to the blood donor program

The physical examination and laboratory tests necessary to qualify and maintain the animal as a blood donor are performed at no cost to the owner

Animals whose physical examination or laboratory results reveal a need for further diagnostic testing and/or medical treatment will not be accepted into the blood donor program. The owner may reapply to the blood donor program after the animal is declared healthy

The owner agrees to use year-round (12 months a year) monthly heartworm and flea preventatives that are approved by the blood donor program (if applicable)

If the cat is housed with dogs or if fleas are noted on the cat at any time, the owner agrees to use year-round (12 months a year) monthly flea preventative approved by the blood donor program as long as the cat is active in the program (if applicable)

Donors will receive annual vaccinations, heartworm preventative and flea/tick prevention treatment products at no cost for as long as they remain in the program (if applicable)

Source: Virginia Maryland College of Veterinary Medicine Teaching Hospital (2012).

It is important to select owners who are interested in the blood donor program and who understand their pet's participation in the program truly saves lives. Conscientious owners will be helpful in maintaining and monitoring the overall health status of the donor so that neither the blood donor nor the blood supply is compromised in any way.

Donor Attributes

While exact donor requirements vary between established blood banks, animals should be healthy and possess an agreeable temperament.

Table 1.3 Canine donor selection criteria questionnaire

Owner name
 Dog name
 Date
 Is your dog between 1 and 8 years old?
 Does your dog weigh more than 50 pounds (lean body condition)?
 What is the breed of your dog?
 Do you give your dog heartworm, flea and tick preventatives year round?
 If the response is no, are you willing to give these preventative year round?
 Has your dog been vaccinated in the past 12 months for distemper, parvovirus, leptospirosis, hepatitis?
 Is your dog currently vaccinated for rabies?
 Is your dog on any medications including NSAIDs, aspirin, vitamins, herbals?
 Has your dog tested positive for Lyme disease?
 Has your dog ever received a blood or plasma transfusion?
 Has your dog ever been pregnant?
 Are you aware of any health problems in your dog?
 Do you travel with your dog?
 Has your dog, its parents or siblings had a bleeding problem?
 Are you staying in this area for the next 1–2 years?
 Are you willing to drop the dog off at the hospital at no charge for the day?
 Are you comfortable with a 3-inch area of hair to be clipped from your dog's neck for each blood draw?

To be completed by clinician or technician:

Does the dog resist being placed on an examination table?
 Does the dog attempt to bite?
 Does the dog have a readily accessible jugular vein?
 Does the dog resist being restrained for jugular venipuncture for 3 minutes?
 Does the animal resist being restrained in lateral recumbency for 2 minutes?
 Does the dog resist venipuncture of the jugular vein?
 Is the dog a likely candidate for the blood donor program?

Source: Virginia Maryland College of Veterinary Medicine Teaching Hospital (2012), Wardrop *et al.* (2016).

Canine Blood Donors

Physical Attributes

Males and non-pregnant females between the ages of 1 and 8 years old who have never had a blood transfusion are ideal blood donors. Clinically normal dogs can donate between 15 and 22 ml of whole blood per kilogram (kg) of body weight every 4–6 weeks without need for iron supplementation (Brown and Vap, 2012; Gibson and Abrams-Ogg, 2012; Schneider, 1995). In order to utilize conventional blood collection systems designed for humans (450 ml whole blood capacity), dogs should weigh at least 23 kg (in lean body condition). To facilitate blood collection and to maintain an aseptic phlebotomy site, donors should possess readily accessible jugular veins that lack thick skin and neck folds. Donors should be calm in nature so that vascular trauma is minimized and so that blood donations can be performed in less than 10 minutes with minimal restraint.

Table 1.4 Feline donor selection criteria questionnaire

Owner name
Cat name
Date
Is your cat between 1 and 8 years old?
Does your cat weigh more than 11 pounds (lean body condition)?
What is the breed of your cat?
Has your cat been vaccinated in the past 12 months for feline viral rhinotracheitis, calicivirus, panleukopenia?
Is your cat currently vaccinated for rabies?
Is your cat on any medications including NSAIDs, aspirin, vitamins, herbals?
Has your cat ever received a blood or plasma transfusion?
Has your cat ever been pregnant?
Are you aware of any health problems in your cat?
Do you travel with your cat?
Has your cat, its parents or siblings had a bleeding problem?
Are you staying in this area for the next 1–2 years?
Are you willing to drop the cat off at the hospital at no charge for the day?
Are you comfortable with a 2" area of hair to be clipped from your cat's neck for each blood draw?
Are you comfortable with sedation and/or anesthesia of your cat?
To be completed by clinician or technician:
Does the cat have a readily accessible jugular vein?
Is the cat friendly and easy to handle?
Is the cat a likely candidate for the blood donor program?

Source: Virginia Maryland College of Veterinary Medicine Teaching Hospital (2012), Wardrop *et al.* (2016).

Utilizing donors who require sedation is discouraged unless exceptional circumstances prevail (Gibson and Abrams-Ogg, 2012).

Vaccination status should be current. Donors should not be receiving any drug therapy, although dogs should be given flea control treatment and those living in heartworm endemic regions must receive prophylaxis.

Laboratory Evaluation

Every blood bank should establish appropriate laboratory testing to qualify blood donors into their donor program. Normal levels of coagulation factors, hemogram and biochemical profile results, along with negative fecal and heartworm disease tests support healthy donor status. Donors should be screened for blood-borne pathogens. The American College of Veterinary Internal Medicine (ACVIN) Consensus Statement (Wardrop *et al.*, 2016) contains an in-depth discussion of both optimal and minimal standards for appropriate blood-borne pathogen testing for canine and feline blood donors in North America; minimal standards for dogs are summarized in Table 1.5. The Consensus Statement also contains recommendations for laboratory evaluation of disease endemic to a particular geographic location.

Table 1.5 Recommendations for laboratory evaluation of canine blood donors for blood-borne pathogens

Minimal standard	Agent
PCR negative	<i>Babesia canis vogeli</i> <i>Babesia gibsoni</i> <i>Bartonella henselae</i> <i>Bartonella vinsonii</i> var. <i>berkhoffi</i> <i>Mycoplasma haemocanis</i>
PCR negative or <i>no screening</i>	Other <i>Babesia</i> spp.
PCR negative or seronegative	<i>Ehrlichia canis</i>
PCR negative or seronegative if serologic testing is more economical or yields a more rapid turnaround time than PCR	<i>Anaplasma phagocytophilum</i> <i>Anaplasma platys</i>
PCR negative in high-risk areas; <i>no screening in low-risk areas</i>	<i>Ehrlichia chaffeensis</i>
PCR negative or seronegative in high-risk areas, <i>no screening in low-risk areas</i>	<i>Ehrlichia ewingii</i>
PCR negative and seronegative in high-risk dogs; <i>no screening in low-risk dogs</i>	<i>Leishmania donovani</i>

PCR, polymerase chain reaction.

Source: Data from Wardrop *et al.* (2016).

Table 1.6 Importance of canine blood groups in veterinary transfusion medicine

Incidence of the blood group antigen in the recipient population
Incidence of naturally occurring antibody or antibodies against a particular blood group antigen
Presence of alloantibody due to previous exposure (i.e., transfusion)
Effect of naturally occurring or alloantibody against the antigen during transfusion

Source: Hale (1995).

During the initial blood donor qualification screen, the donor's blood type should be assessed.

Canine Blood Types

The importance of canine blood groups related to veterinary transfusion medicine is listed in Table 1.6.

Dog blood groups were among the first to be recognized in species other than humans. Early studies recognized that dogs do not have clinically important naturally occurring antibodies, so subsequent experimentation focused on alloantibodies produced after sensitization via blood transfusions (Swisher and Young, 1961) and led to international recognition of seven blood groups termed dog erythrocyte antigens (DEA) (Blais *et al.*, 2007).

Unfortunately, because of the limited availability of blood typing reagents it has not been determined if the currently recognized blood groups are

Table 1.7 Dog erythrocyte antigens

Canine blood group	Antigen phenotypes	Incidence in US	Presence of naturally occurring antibodies
DEA 1.0	1.1	45%	<2%
	1.2	20%	
	1.3		
	Null		
DEA 3	3	6%	<15%
	Null		
DEA 4	4	98%	Rare
	Null		
DEA 5	5	10–15%	8–12%
	Null		
DEA 6	6	100%	Unknown
	Null		
DEA 7	7	40–55%	10–40%
	7'		
	Null		
DEA 8	8	20–40%	Unknown
Dal	Dal	93%	Rare

Source: Hale (2012, 1995).

serologically distinct (Blais *et al.*, 2007). Likewise, the biochemical properties and molecular genetics of dog blood group systems are yet to be thoroughly investigated or well defined (Hale, 1995), so additional canine blood groups will likely be identified as immunohematologic technology improves and new antigens are discovered (Blais *et al.*, 2007).

The DEA canine blood group system is based on eight antigens found on canine erythrocytes (Hale, 2012). These blood groups are inherited independently so more than multiple antigens can be present or absent on the red cells of a given donor. Currently, only DEA 1.1 blood type can be easily identified using point-of-care testing. Six DEA blood groups can be distinguished utilizing more complex laboratory methods but two DEA blood groups can no longer be recognized because of the lack of commercially available antibody.

The current designation for DEA or blood type uses the numeral to indicate positive status. For example, “DEA 1.1,7” indicates that dog red cells express DEA 1.1 and 7 but do not express DEA 3, 4, and 5. When typing for DEA 1.1 only, the blood type is indicated as DEA 1.1-positive or DEA 1.1-negative (Hale, 2012).

A summary of DEA blood groups can be found in Table 1.7.

DEA 1

The DEA 1 system consists of three antigens (1.1, 1.2, 1.3) and a null phenotype. The subtypes of DEA 1 likely result from the difference in the number of antigen molecules on the surface of the red blood cell and variation in the biochemical

composition of the antigen (Hale, 2012). DEA 1.2 antigen appears to be recessive to 1.1 so only a dog that is 1.1 negative can be 1.2 positive (Acierno *et al.*, 2014; Hale, 2012).

DEA 1.1 is the most commonly identified dog blood type but varies among breeds and geographically. Along with 1.2, it is highly antigenic. DEA 1.2 recipients who are transfused with DEA 1.1-positive cells can develop 1.1 antibodies, so dogs that are DEA 1.2 (or 1.3) positive should be transfused with DEA 1.1-negative cells. DEA 1.0 system is most often associated with acute immunological transfusion reactions in dogs.

DEA 3

This antigen has a higher incidence in American-bred greyhounds and Japanese-bred dogs (Hale, 2012). It can be found in only 6% of dogs in the United States and approximately 20% of DEA 3-negative dogs possess naturally occurring anti-DEA 3 (Hale, 1995). Anti-DEA 3 alloantibodies produced as a result of a previous transfusion can cause a delayed transfusion reaction (5–7 days post transfusion), which is significant in transfusion management of patients with non-regenerative anemia (Hale, 2012).

DEA 4

As up to 98% of all dogs are DEA 4 positive and naturally occurring anti-DEA 4 is not reported (Hale, 1995), acute and delayed transfusion reactions have been reported as a result of alloimmunization to DEA 4 (Metzler *et al.*, 2003) but statistically these transfusion reactions rarely occur. This is the only DEA blood group that a “universal donor” possesses.

DEA 5

DEA 5 is another rare canine blood group that occurs in approximately 10–15% of the general population. Approximately 10% of the dog population possesses naturally occurring antibodies to DEA 5. Transfusion of DEA 5-positive cells to a sensitized recipient can lead to a delayed transfusion reaction 5–7 days post transfusion, which is significant in transfusion management of patients with non-regenerative anemia (Hale, 2012).

DEA 7

Unlike the DEA systems described above, DEA 7 not an integral erythrocyte membrane antigen; the antigen is found in circulating plasma and passively attaches to surface of the red blood cells.

DEA 7 is present in 40–55% of the general canine population and naturally occurring anti-DEA 7 is present in 20–40% of DEA 7-negative dogs (Hale, 2012). Low incidence of delayed transfusion reactions has been reported, while acute transfusion reactions are yet to be documented. Because of the potential for

delayed transfusion reaction, DEA 7 status plays an important role in compatibility for transplants or massive blood transfusion.

Selection of Blood Type for Blood Donors

Dog erythrocyte antigens and the prevalence of antibodies against specific DEA antigens should be considered when selecting donors. For transfusion services that supply blood products to clinics in which the majority of transfusions are expected to be once-in-a-lifetime occurrence, the inclusion of all canine blood types in the donor pool may be appropriate (and will broaden the donor base). Conversely, if most recipients are expected to need multiple transfusions or are candidates for transplantation, it may be appropriate to only include specific blood types in the donor pool to in an effort to decrease recipient exposure to foreign red cell antigens.

Feline Blood Donors

Like their canine counterparts, feline blood donors should be friendly and clinically normal.

Physical Attributes

Cats are typically sedated for phlebotomy and can donate between 10 and 12 ml of whole blood/kg body weight every 3–4 weeks (Kohn and Weingart, 2012). They may be supplemented with iron as appropriate. Collecting up to 50 ml of whole blood from a healthy, lean donor weighing more than 5 kg is usually safe (Kohn and Weingart, 2012), but blood donation is not without serious risk so appropriate client communication is essential when qualifying donors. Both males and females can be utilized and only current pregnancy excludes females (Abrams-Ogg, 2000); previously transfused cats should be excluded if alloimmunization has occurred. Cats should be between the ages of 1 and 5 years old and vaccines should be up to date. Strictly indoor cats are preferred so that the risk of disease transmission is minimized. Any other cat within the same household must be 100% indoor and appropriately vaccinated. Flea control should be administered if the potential donor is housed with dogs.

Laboratory Evaluation

Normal levels of coagulation factors, hemogram and biochemical profile results, along with negative fecal and heartworm disease tests support healthy donor status. The ACVIN Consensus Statement (Wardrop *et al.*, 2016) contains an in-depth discussion of both optimal and minimal standards for appropriate blood-borne pathogen testing for feline blood donors in North America; minimal standards are summarized in Table 1.8. The Consensus Statement also contains recommendations for laboratory evaluation of disease endemic to a particular geographic location.

Table 1.8 Recommendations for laboratory evaluation of feline blood donors for blood-borne pathogens

Minimal standard	Agent
PCR negative	<i>Bartonella henselae</i>
PCR negative or seronegative if serologic testing is more economical or yields a more rapid turnaround time than PCR	<i>Mycoplasma haemofelis</i> <i>Anaplasma phagocytophilum</i>
Antigen negative	Feline leukemia virus
Antibody negative	Feline immunodeficiency virus

Source: Data from Wardrop *et al.* (2016).

Table 1.9 Cat blood groups by geographical locations

Location	Group A (%)	Group B (%)	Group AB (%)
Australia	62	36	1.6
Japan	90	10	0
United Kingdom	67.6	30.5	1.9
United States (by region):			
Northeast	99.7	0.3	0
North Central	99.4	0.4	0.2
Southeast	98.5	1.5	0
Southwest	97.5	2.5	0
West Coast	94.8	4.7	0.5

Source: Day (2012), Andrews *et al.* (1992).

Blood type should also be determined during the initial blood donor evaluation.

Feline Blood Types

The feline AB blood group system includes types A, B, and AB. The AB blood group system is controlled by three alleles and characterized by the type and amount of neuraminic acid present on red cells. An additional feline blood group antigen, *Mik*, has also been identified (Weinstein *et al.*, 2007). Feline blood types are geographically related as outlined in Table 1.9.

Cats possess naturally occurring alloantibodies which are formed against the A or B red cell antigen the cat lacks; type AB cats possess no naturally occurring alloantibodies. When present, alloantibodies can be responsible for transfusion reactions and neonatal isoerythrolysis. Anti-A alloantibody in type B cats is usually of high titer and is believed to be induced by exposure to cross-reactive

environmental antigens within the first three months of life after maternally derived antibody is degraded. Anti-A alloantibodies are mainly IgM and cause acute transfusion reactions within seconds of transfusing type A or type AB red cells to a type B cat.

Anti-B alloantibody in type A cats is uncommon and, if present, is invariably of low titer (Day, 2012).

Existing outside the AB system, naturally occurring anti-*Mik*, present in cats lacking the *Mik* antigen, can elicit an acute hemolytic transfusion reaction after an AB matched blood transfusion.

Blood Donor Selection

Qualification of veterinary blood donors utilizing the criteria outlined above should be repeated at least annually (less the donor's blood type) and allows the clinician to evaluate physical exam and laboratory test findings in view of the overall goals of the blood donor program. More frequent retesting for some blood-borne pathogens in endemic areas and in donors with repeated exposure to risk factors may be necessary to insure the safety of the donor pool.

Initial and annual blood donor exams do not eliminate the need to perform a physical exam and minimal lab work prior to phlebotomy.

In human blood banking, donor eligibility is based on medical history and limited physical examination on the day of phlebotomy. Individual units of blood are screened for evidence of infectious disease pathogens for every blood donation. While this protocol is yet to be economically feasible for veterinary blood banks, it remains a gold standard.

Donor Monitoring

Once donors are qualified into the blood donor program, it is necessary to track essential information regarding individual donors, including vaccination status, last annual checkup, and last phlebotomy date.

Scheduling Donors

Contacting owners in advance or placing donors on a routine schedule can be a convenient method to schedule donors for phlebotomy. When contacted, owners should be queried regarding any changes in the donor's health status since the last office visit or blood donation. A standardized pre-phlebotomy questionnaire including any questions that may pertain to any change in health status, such as recent weight loss, acute vomiting or diarrhea, or change in behavior is helpful in accomplishing this task; see Tables 1.10 and 1.11.

Table 1.10 Pre-plebotomy questionnaire for canine blood donors**Since your dog's last blood donation, has your dog:**

- Had any health problems?
- Received a blood or plasma transfusion?
- Been in any fights or received any bites?
- Been sexually active or become pregnant?
- Been on a raw diet?
- Have you noticed fleas or ticks on your dog?
- Have you traveled with your dog?

In the 48 hours after your dog's last blood donation, did your dog:

- Resume a normal activity level?
- Experience any diarrhea, vomiting or lack of appetite?

Today, is your dog:

- Acting normal?
- Receiving heartworm, flea and tick preventative?
- Taking any medications other than heartworm, flea and tick?
- Fasting?

Source: Virginia Maryland College of Veterinary Medicine Teaching Hospital (2012), Wardrop *et al.* (2016).

Table 1.11 Pre-plebotomy questionnaire for feline blood donors**Since your cat's last blood donation, has your cat:**

- Had any health problems?
- Received a blood or plasma transfusion?
- Been in any fights or received any bites?
- Been become pregnant?
- Been outside?
- Have you noticed fleas or ticks on your cat?
- Have you traveled with your cat?

In the 48 hours after your cat's last blood donation, did your cat:

- Resume a normal activity level?
- Experience any diarrhea, vomiting or lack of appetite?

Today, is your cat:

- Acting normal?
- Receiving heartworm, flea and tick preventative?
- Taking any medications other than heartworm, flea and tick?
- Fasting?

Source: Virginia Maryland College of Veterinary Medicine Teaching Hospital (2012), Wardrop *et al.* (2016).

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