

# Twelve Clusters of U.S. Transfusion-Associated *Babesia microti* Cases, 1979–2009\*.

Table 1. Twelve Clusters of U.S. Transfusion-Associated *Babesia microti* Cases, 1979–2009\*

Cluster	State (Year) of Transfusion	Case Type	Case Characteristics	Data on <i>Babesia</i> Case†	Comments About Recipients Other Than Case-Patients‡
7 single-donation clusters§					
A	RI (2004)	Index	Preterm infant	Smear/PCR-positive	Another preterm corecipient of RBCs was treated empirically
		Corecipient	Preterm infant	Smear/PCR-positive	—
B	RI (2006)	Index	Preterm infant	Smear-positive	No additional information
		Corecipient	Preterm infant	PCR-positive	—
C	VA (2009)	Index	Preterm infant	PCR-positive	—
		Corecipient	Preterm infant	Smear/PCR-positive	No other corecipients (Lookback: recipient of RBCs donated 3 mo earlier tested negative)
D	NY (1997)	Corecipient	Preterm infant	Smear/PCR-positive	—
		Index	Full-term infant	Smear/PCR-positive	Platelet corecipient (age 11 y) and 2 preterm corecipients of RBCs tested negative
E	NY (1999)	Corecipient	Preterm infant	Smear/PCR-positive	(Lookback >1 y earlier: RBC recipient tested negative; platelet recipient died s3 wk after transfusion)
		Index	Age 70 y; GI bleeding	Smear/PCR-positive	—
F	CT (2006)	Corecipient	Age 28 y; SCD	PCR-positive	Platelet corecipient reportedly was asymptomatic and was not tested (Lookback: "no adverse outcomes" reported for recipients associated with 2 previous donations)
		Index	Neonate	"Proven infection"	—
G	MN (2008)	Index	Age 32 y; SCD	"Proven infection"	No additional information
		Corecipient	Age 92 y; asplenic	Smear/PCR-positive	—
5 multidonation clusters					
H	MN (1999)	Lookback (July donation)	Age 78 y; GI bleeding	PCR-positive	Double RBC donation: both recipients became infected and are listed here
	MN (1999)	Lookback (September donation)	Age 80 y	PCR-positive	—
	MN (1999)	Index (November donation)	Age 68 y; surgery	Smear/PCR-positive	Platelet corecipient (age 81 y) tested negative about 6 mo after transfusion
I	NY (2002)	Lookforward (January donation)	Age 67 y; surgery	Seropositive	RBC corecipient (age 73 y) died 2 d after transfusion
		Lookback (March donation)	Age 78 y; surgery	PCR-positive	(Further lookback: recipient associated with December 2001 donation tested negative)
J	NY (2003)	Index (May donation)	Age 80 y; cirrhosis	Smear-positive	No corecipients
		Lookback (October donation)	Age 52 y; surgery	Seropositive	(Further lookback: no information about recipient of RBCs donated in August)
K	MA (2004)	Index (December 2003 donation)	Age 74 y; carcinoma	Smear-positive	No additional information
		Lookback (August donation)	Age 83 y; surgery	Seropositive	(Status of other recipients of RBCs donated in 2007: 2 died; 1 tested negative; 1 lost to follow-up)
L	FL (2008)	Index (February 2008 donation)	Age 83 y; GI bleeding	Smear/PCR-positive	No corecipients
	MN (2008)	Index (August donation)	Age 61 y; leukemia	Smear/PCR-positive	No corecipients (lookback: RBC recipient associated with May donation tested negative)
	MN (2008)	Lookforward (October donation)	Age 53 y; surgery	Seropositive	No corecipients

CT = Connecticut; FL = Florida; GI = gastrointestinal; MA = Massachusetts; MN = Minnesota; NY = New York; PCR = polymerase chain reaction; RBC = red blood cell; RI = Rhode Island; SCD = sickle cell disease; VA = Virginia; WI = Wisconsin.

\*The 12 identified clusters encompass 30 cases (1 per row) linked to 19 donations by the 12 implicated donors; the 30 cases include 12 index and 18 nonindex cases (11 in corecipients, 5 detected in lookback investigations, and 2 from lookforward investigations). One case was linked to whole blood–derived platelets (cluster H; fourth donation) (5); the other 29 were linked to RBC components. Among infants with available data, the smallest transfused volume was approximately 8 mL. In 2 multidonation clusters (J and K), case-patients were identified in 2 states. In cluster J, both donations were in Maine, by a donor probably exposed in Massachusetts; in cluster K, a Wisconsin resident also donated in Florida. Five of 12 implicated donors had parasitologically confirmed infection, on the basis of testing an original unit segment (B, C, D, and G) or subsequent specimens (H); the donor linked to cluster H still had demonstrable parasitemia, by PCR analyses, 4 mo after the fourth donation, 10 mo after exposure (5). For cluster A's donor, a segment was available but results of PCR analyses were negative.

†"Seropositive" is noted only for the 4 nonindex cases that were not parasitologically confirmed; The reciprocal antibody titers ranged from 256 to 1024 in *B. microti* indirect fluorescent antibody testing.

‡For recipients other than case-patients, "tested negative" denotes seronegativity, at a minimum.

§ 18 cases (13 in infants and 5 in adults); 2–3 cases per cluster.

|| 12 cases (all in adults); 1 case per donation; 2–4 donations per cluster.

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# Characteristics of U.S. Transfusion-Associated *Babesia microti* Cases, Stratified by Type and Class (n= 159 Total Cases, Including 141 Index Cases), 1979–2009\*.

**Table 2. Characteristics of U.S. Transfusion-Associated *Babesia microti* Cases, Stratified by Type and Class (n = 159 Total Cases, Including 141 Index Cases), 1979–2009\***

Variable	All Cases (n = 159)	Stratification of All Cases, by Type (n = 159)		Stratification of Index Cases, by Class (n = 141)		
		Index Cases (n = 141; 89%)	Nonindex Cases (n = 18; 11%)	Definite Cases (n = 61; 43%)	Probable Cases (n = 57; 40%)	Possible Cases (n = 23; 16%)
<b>Age at diagnosis, n</b>	157	139	18	60	56	23
Median age (range; IQR), y†	65 (<1–94; 39–78)	66 (<1–94; 44–79)	34 (<1–83; <1–70)	69 (<1–94; 27–81)	65 (<1–92; 45–78)	67 (<1–87; 53–77)
Patients age <1 y, n (%)‡	18 (11)	11 (8)	7 (39)	9 (15)	1 (2)	1 (4)
Patients age ≥1 y to <50 y, n (%)	33 (21)	30 (22)	3 (17)	11 (18)	16 (29)	3 (13)
Patients age ≥50 y, n (%)	106 (68)	98 (71)	8 (44)	40 (67)	39 (70)	19 (83)
<b>Male sex, n/n (%)</b>	78/156 (50)	73/138 (53)	5/18 (28)	25/60 (42)	33/55 (60)	15/23 (65)
<b>State of transfusion§</b>						
<i>B. microti</i> -endemic state, subtotal n (%)	138 (87)	122 (87)	16 (89)	44 (72)	57 (100)	21 (91)
Northeast (CT, MA, NJ, NY, or RI), n	118	108	10	—	—	—
Upper Midwest (MN or WI), n	20	14	6	—	—	—
Other state, subtotal n (%)	21 (13)	19 (13)	2 (11)	17 (28)	0	2 (9)
Eastern state, n	17	15	2	—	—	—
Not an eastern state, n	4	4	0	—	—	—
<b>Year of transfusion</b>						
Median (range)	2005 (1979–2009)	2005 (1979–2009)	2004 (1997–2009)	2005 (1980–2009)	2006 (1979–2009)	2005 (1993–2009)
By period, n (%)						
1979–1984	4 (3)	4 (3)	0	3 (5)	1 (2)	0
1985–1989	3 (2)	3 (2)	0	2 (3)	1 (2)	0
1990–1994	6 (4)	6 (4)	0	1 (2)	4 (7)	1 (4)
1995–1999	24 (15)	19 (14)	5 (28)	9 (15)	5 (9)	5 (22)
2000–2004	31 (20)	26 (18)	5 (28)	13 (21)	9 (16)	4 (17)
2005–2009	91 (57)	83 (59)	8 (44)	33 (54)	37 (65)	13 (57)
<b>Month of symptom onset or diagnosis, n§</b>	—	128	—	56	52	20
Median (range)	—	Sep (Jan–Dec)	—	Aug (Jan–Dec)	Oct (Jan–Dec)	Sep (Jan–Dec)
<b>Interval from transfusion to diagnosis, n   </b>	—	114	—	53	50	11
Median (range; IQR), d	—	42 (14–230; 34–53)	—	43 (22–230; 35–52)	42 (14–225; 34–58)	42 (14–54; 21–52)
<b>Parasitologically confirmed infection, n (%)¶</b>	153 (96)	139 (99)	14 (78)	61 (100)	55 (96)	23 (100)
<b>Surgical splenectomy, subtotal n**</b>	32	32	0	11	12	9
Past history, n	17	17	0	8	8	1
Peritransfusion, n	12	12	0	2	2	8
≥1 mo after transfusion, n	3	3	0	1	2	0
<b>Underlying condition or context for transfusion (≥1 per patient), n</b>						
Hematologic disorder, subtotal n	39	37	2	11	20	6
Hematologic cancer	14	14	0	3	7	4
Sickle cell disease	11	9	2	4	5	0
Thalassemia major	7	7	0	1	3	1
Other hematologic disorder	7	7	0	1	5	1
Cardiovascular surgery or procedure	22	20	2	8	7	5
Gastrointestinal disease, bleeding, or surgery	19	17	2	8	6	3
Trauma with posttraumatic splenectomy**	8	8	0	2	2	4
Solid-organ transplantation†	5	5	0	1	4	0
Other surgery, procedure, or trauma	13	9	4	7	2	0
Newborn or complications of prematurity	16	9	7	8	1	0
Carcinoma	13	13	0	5	6	2
Other medical reason or diagnosis	14	14	0	9	3	2
Not specified	10	9	1	2	6	1
<b>All-cause mortality, n (%)‡‡</b>	28 (18)	27 (19)	1 (6)	11 (18)	12 (21)	4 (17)
<b>Blood donor, n (%)§§</b>	136 (86)	118 (84)	18 (100)	61 (100)	57 (100)	0
Parasitologically confirmed, subtotal n	24	24	0	22	2	0
PCR-positive unit segment, n	12	12	—	12	0	0

CT = Connecticut; IQR = interquartile range; MA = Massachusetts; MN = Minnesota; NJ = New Jersey; NY = New York; PCR = polymerase chain reaction; RI = Rhode Island; WI = Wisconsin.

\* Data are number of cases/patients, unless otherwise noted. Diagnosis refers to babesiosis. Transfusion and blood donor refer to those associated with a case. Percentages might not total 100% because of rounding.

† Because a lower proportion of patients with index vs. nonindex cases were younger than 1 y of age ( $P = 0.001$ ), the age distributions for index vs. nonindex patients were significantly different ( $P = 0.009$ ), but not if the age comparison was limited to adults ( $P = 0.3$ ).

‡ See Methods section and Figure 2. The category "eastern state" consists of Delaware, Florida, Indiana, Maryland, New Hampshire, North Carolina, Ohio, Pennsylvania, and Virginia. The category "not an eastern state" consists of California, Texas, and Washington.

§ If both were known and were different, the earlier month was specified. Data for the kidney donor (see text) were not included in analyses of month of diagnosis or interval to diagnosis.

|| See Figure 3 regarding index patients. Among nonindex patients (Table 1), the interval to diagnosis depended on host factors, type of recipient (corecipient vs. other), and various aspects of the investigations. Although most of the ascertained nonindex patients who were adults reportedly were asymptomatic, clinical information in such regard typically was anecdotal or unspecified. In some investigations, other recipients could not be tested because they had already died.

¶ Index cases were known or presumed to be parasitologically confirmed, with the exception of 2 cases classified as probable transfusion cases: the case in the kidney donor (see text) and a case diagnosed in retrospect, after recovery (30).

\*\* The data constitute minimum numbers of case-patients. Among the 12 known to have undergone splenectomy during the peritransfusion period, the contexts were trauma ( $n = 8$ ) or abdominal surgery for other reasons ( $n = 4$ ). The cases in the 3 patients known to have undergone posttransfusion splenectomy include 1 definite case (the index case of cluster I [25]; Table 1) and 2 probable cases, including the first described transfusion case (14).

†† Three received a kidney (living related [31], living unrelated, or cadaveric), 1 received a heart (29), and 1 underwent bilateral lung transplantation.

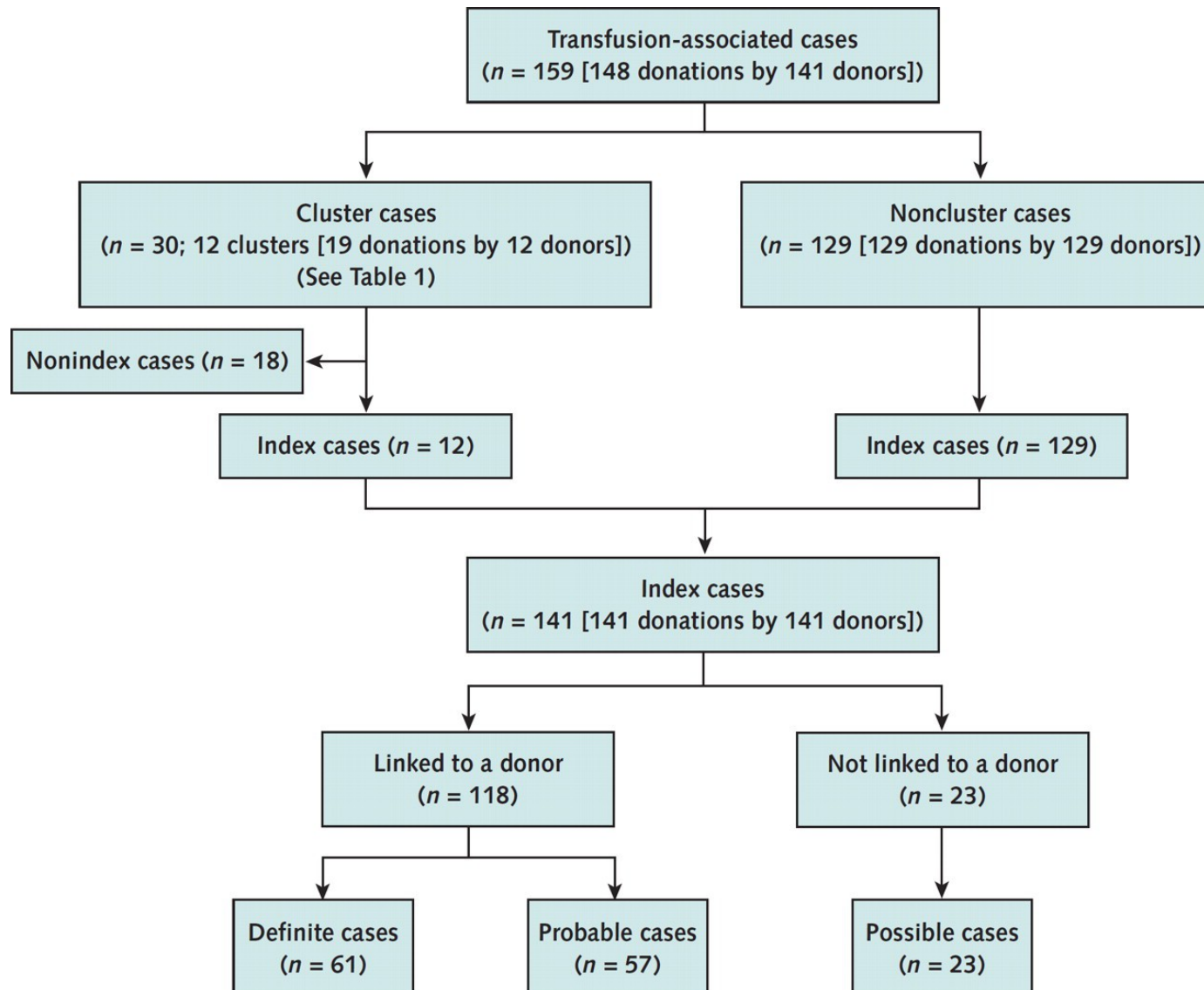
‡‡ Although outcome data were unavailable for some patients, we assumed that no other case-patients died in the short term. The patients known to have died include 2 cluster-associated infants whose gestational ages were 23 and 24 wk, 2 (of 5) patients ≥90 y of age, and 6 (of 32) patients known to have undergone surgical splenectomy.

§§ In at least 4 case investigations, more than 1 donor had laboratory evidence of infection, typically 1 of whom was the most plausible on the basis of laboratory or epidemiologic data. However, the possibility of receipt of more than 1 contaminated unit could not be excluded.

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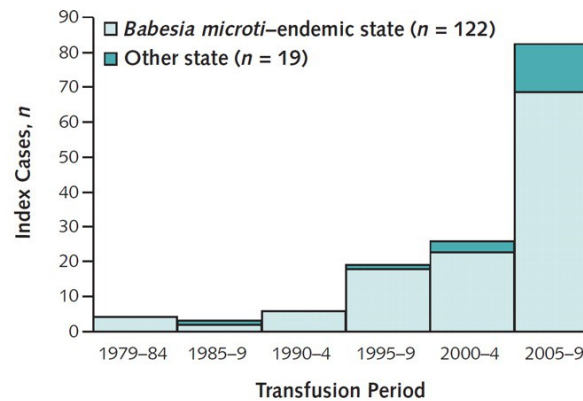
**Stratification of 159 U.S. transfusion-associated *Babesia microti* cases, 1979–2009. By type of case (cluster vs. not; index vs. not) and by class of index case (definite, probable, or possible).**



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# Distribution of U.S. transfusion-associated *Babesia microti* index cases, 1979–2009. By period and state of transfusion (n = 141 cases).



Cases, n

## Endemic states\*

Massachusetts	2			2	12
New York	2			7	10
Connecticut		1	4	7	1
Minnesota		1	1	1	
Rhode Island			1	1	8
New Jersey				2	1
Wisconsin					1

## Other states†

New Hampshire‡	1				
Maryland§				1	2
Pennsylvania					1
Texas					1
Washington					1
Ohio					2
Indiana					1
Delaware					1
North Carolina					1
California					1
Florida					2
Virginia§					1

Total index cases  
per period

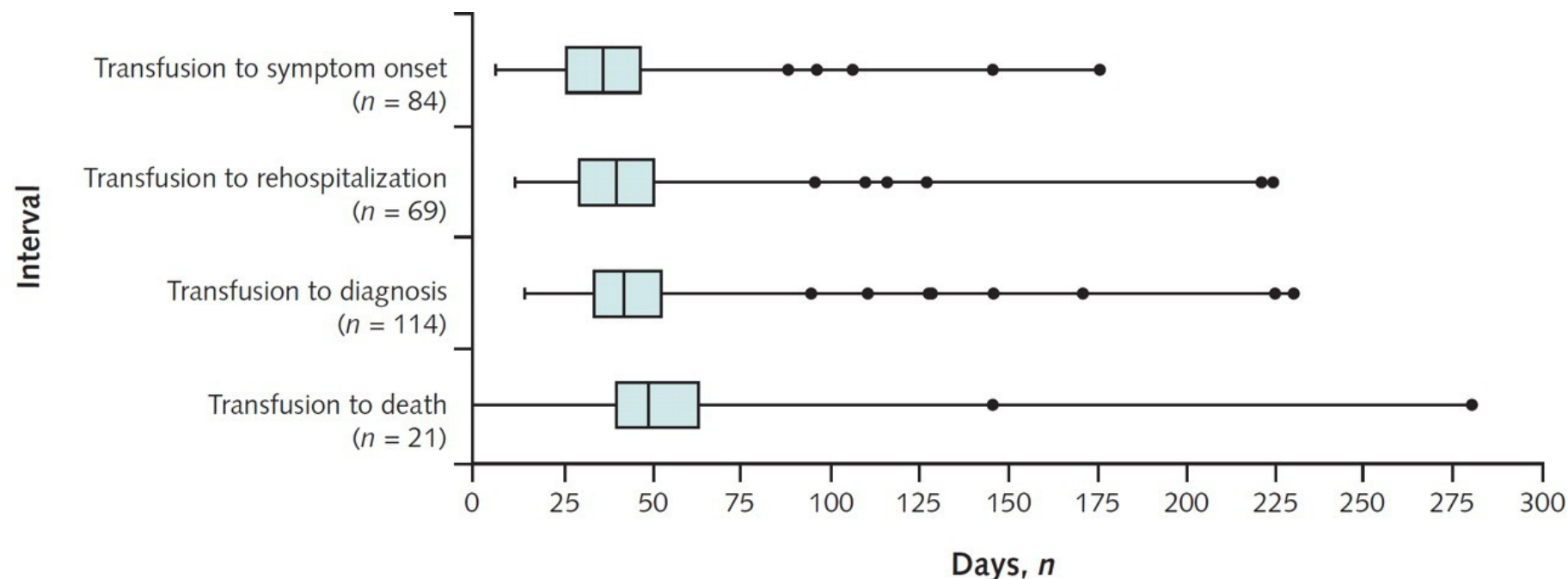
4 3 6 19 26 83

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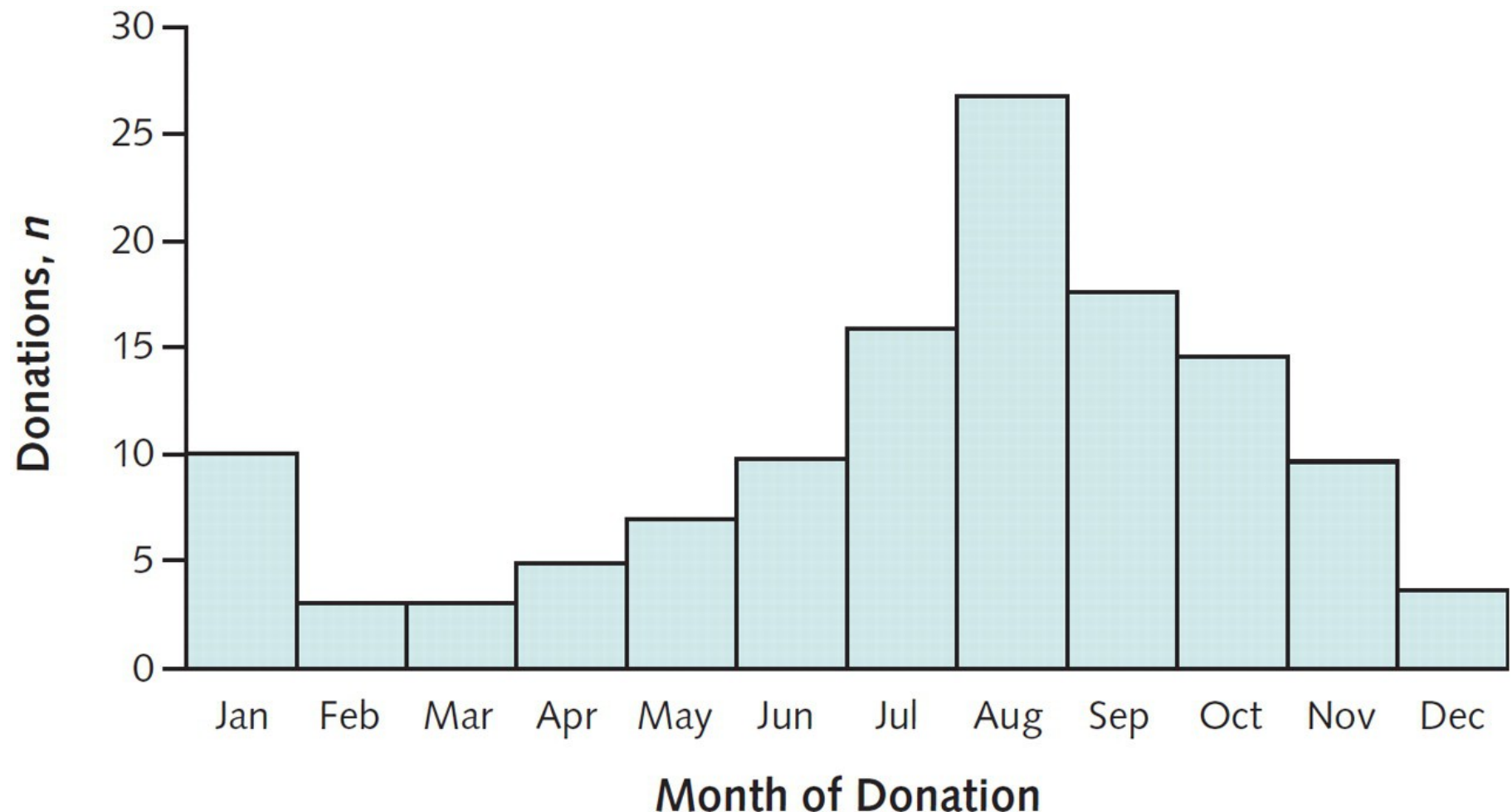
**Box-and-whisker plots of the distributions of time from transfusion to various events for U.S. transfusion-associated *Babesia microti* index cases, 1979–2009. The data are limited to the subsets of the 141 index patients for whom particular intervals were rel...**



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**Distribution by month of the blood donations associated with U.S. *Babesia microti* transfusion cases (n = 128 of 148 total donations), 1979–2009. The month of donation was known or estimable for 128 of 148 donations (by 141 donors) associated with transmissio...**



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