Pet owners provide a more reliable weight estimate for dogs compared to veterinary professionals in an emergency setting

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OBJECTIVE
To determine the accuracy of pet owners, veterinary technicians, house officers (interns and residents), and attending clinicians at estimating dog weights in a veterinary emergency room.

ANIMALS
272 dogs weighing over 2 kg presenting to the emergency room between June 1 and July 29, 2022.

METHODS
Pet owners, veterinary technicians, house officers, and attending clinicians recorded the dogs’ weight estimations on individual data collection cards. Pet owners were also asked to estimate their dogs’ weight during the triage period. The dogs’ actual weights were then obtained and recorded.

RESULTS
Pet owners were more accurate than veterinary professionals at providing weight estimates for dogs. Weight estimates were accurate to within 10% of the dogs’ actual weights for 67.9% (181/267) of pet owners. Forty-one percent (112/270) of attending clinicians, 35.3% (95/269) of house officers, and 35.4% (96/271) of veterinary technicians’ weight estimates were within 10% of the dog’s actual weight. There was no difference noted in the length of veterinary experience and ability to closely estimate the patient’s weight. Overall, veterinary professionals were more likely to closely estimate the weight of large dogs compared to small dogs.

CLINICAL RELEVANCE
The pet owner is most likely to provide an accurate weight for dogs and questions about the dog’s weight should be directed to the client for situations in which a weight cannot be rapidly obtained.

Keywords: veterinary emergency and critical care, pet owners, weight estimation, emergency room, weight

Canine patients often present to the emergency room (ER) in critical condition, necessitating immediate interventions to stabilize the dog. In many instances, especially with nonambulatory large-breed or critically ill dogs, there might not be a practical opportunity to obtain an accurate weight before life-saving medications are administered or cardiopulmonary resuscitation is initiated. Medication doses are based on patient weight and can be harmful or ineffective if inaccurately calculated. While drug and fluid doses should always be based on measured weight, patient weight estimates are required when a weight cannot be quickly obtained. Thus, accurate weight estimation is critical for calculating drug doses, determining rates of fluid replacement, and selecting correct equipment sizes in dogs that need to be emergently resuscitated. The ideal weight estimation method should be accurate, reliable, quick to obtain, easy to use, and readily available.1

In human patients, parent-, guardian-, or self-reported weight estimation has been found to be the most accurate method when a patient is unable to be weighed in an emergency setting.2–6 Medical personnel have been reported to be less accurate at
weight estimation than the patient or the parents of the patient, but their assessment is used when a patient or parent is unable to provide an estimation.\textsuperscript{3,4} In 1 study\textsuperscript{5} evaluating the accuracy of weight estimation in human patients, 91% (935/1,028) of patients’, 78% (885/1,135) of nurses’, and 59% (457/775) of physicians’ weight estimates were within 10% of the patient’s actual weight. In addition, several studies concluded that patients (or adult parents/guardians) are generally accurate in estimating their true weight while health-care workers showed only moderate accuracy.\textsuperscript{2,4,5} Other weight estimation methods have been described in human patients, especially in children for which actual patient weights are more important than adults due to the wider variation in weights. These methods include the use of mathematical formulas, weight tapes, applications, age, and length-based methods with or without habitus adjustments. A systemic review of these methods concluded that parent estimation and length-based adjustments for body habitus are the most accurate methods to predict children’s body weight.\textsuperscript{1}

There are a few studies evaluating weight estimation in horses, donkeys, pigs, and cattle using visual estimation, weight tapes, and body weight estimation formulas with inconsistent results.\textsuperscript{7–13} Recently, a study\textsuperscript{14} evaluated weight estimation accuracy by clinicians, nurses, and students in dogs and cats and concluded that veterinary professionals are not reliable estimators of patient weight in the ER. However, pet owners were not surveyed during this study to assess their ability to estimate their pets’ weights. Compared to cats, dogs have a wider variation of size and weight estimation is more challenging. The objective of the present study was to determine the accuracy of pet owners, veterinarians, and veterinary technicians at estimating the weights of dogs in the ER. We hypothesized that pet owners would provide the most reliable weight estimate for dogs and that veterinary professionals with more experience would be more accurate than those with less experience.

**Methods**

**Study design and inclusion criteria**

This prospective observational study was performed in the ER at the University of Florida. Data were collected between June 1, 2022, and July 29, 2022, and entered directly into data collection cards that were specifically designed for the study. The eligibility of dogs enrolled in the study was determined by availability of the individual organizing data collection (NB) in the ER. Dogs with a weight < 2 kg or dogs that were unable to have their weight measured using a standard scale were excluded from the study. Dogs that were triaged through the isolation ward were also excluded. Veterinary technician, house officer (rotating interns, emergency and critical care interns, and emergency and critical care residents), and attending clinician (board-certified critical care specialists and emergency doctors) participants were excluded if they had measured the patient’s weight or overheard or otherwise knew of the patient’s weight before having the opportunity to fill out a data collection card.

**Ethical approval and consent**

Approval from the IACUC was deemed unnecessary by the committee since vertebrate animals were not manipulated. The study was subject to review under the University of Florida Institutional Review Board and approved as exempt. The questions asked to pet owners were questions that are asked as part of a normal patient history, so separate client consent was not required.

**Procedures and data collection**

For each dog enrolled in the study, a veterinary technician, house officer, and attending clinician were asked to fill out a provided data collection card. Individuals were enrolled in the study if they were working on a shift during which data were being collected. The data collection card contained the following information: the dog’s name, medical record number, and signalment; the staff member’s first and last name; the staff’s estimate of the patient’s weight; whether the dog was touched/carried by the staff participant; and the staff’s length of veterinary experience (in years). Each staff member used a new data collection card for each dog and was asked to record an estimate of the patient’s weight (kg) in writing (without audibly verbalizing it) so as not to bias other members of the ER team who were also participating. Each dog had a weight estimate provided by a veterinary technician, house officer, and attending clinician.

The client was asked about the length of time they had owned their dog (in years) and the weight estimate of their dog while in the ER lobby or a private room away from members of the ER staff participating in the study. The dogs were then weighed in the triage area of the ER on either a small scale for dogs < 5 kg (BD-585 Feline/Puppy Scale; Tanita) or large scale for dogs > 5 kg (VET330WH; Detecto).

The dog’s actual weight was recorded on the data collection cards after participant estimations were recorded. The information from the data collection cards was then imported into an Excel spreadsheet (Microsoft Corp).

Average percent errors in weight estimation, calculated as the absolute difference between estimated and actual weight divided by actual weight and then converted into a percentage, were calculated for the technician, house officer, attending clinician, and pet owners. The absolute percentage error was calculated as the absolute value \((\text{estimated value – actual value}) / \text{actual value}\). Each participant weight estimation was assigned an accuracy category based on how close the estimation was to the patient’s true weight. Accuracy categories were as follows: within 5%, within 10%, within 20%, and above 50%. The dogs were distributed into 3 weight groups: small (< 5 kg), medium (5 to 10 kg), and large (> 10 kg) for the purpose of evaluating the effect of the size of the patient.
on the accuracy of weight estimates. The estimation bias was determined as the difference between the estimated weight and the actual weight.

**Statistical analysis**

Statistical analyses were performed using SAS software (version 9.4 release TS1M7; SAS Institute Inc.). Normally distributed data were reported as mean (± SD). Spearman rank correlation (signified by \( r_s \)) was used to measure the strength of association between 2 variables because of an outlier and non-normally distributed data. Correlation coefficient (\( r_s \)) ranges from –1 to 1. The absolute values of \( r_s \) were categorized as weak (\( r_s = 0 \) to 0.39), moderate (\( r_s = 0.4 \) to 0.59), strong (\( r_s = 0.6 \) to 0.79), or very strong (\( r_s = 0.8 \) to 1). Mann-Whitney U and Kruskal-Wallis tests were used to compare the estimation bias difference between experienced and less experienced staff members and among the patient weight groups. A one-way repeated-measures ANOVA was used to compare the estimation bias among veterinary technicians, house officers, and attending clinicians. Estimation bias was evaluated using square root transformation to meet normality assumption. A \( P \) value of < .05 was considered significant.

**Results**

Between June 1, 2022, and July 29, 2022, 1,235 cases were seen through the Emergency Service at the University of Florida; 1,020 cases were excluded because they were feline patients, the individual organizing data collection (NB) was not working when those cases were evaluated, or the dogs weighed < 2 kg. Thus, 267 dogs were enrolled in the study for a total of 272 visits. Mixed-breed dogs were the most represented (n = 90), followed by Chihuahuas (14) and Labrador Retrievers (10). There were 141 male dogs, 125 female dogs, and 1 dog whose sex was sexually altered. The mean age was 6.44 years (± 4.44 years; range, 0.03 to 18 years). The mean actual weight of the dogs was 18.67 kg (± 13.11 kg; range, 2.05 to 62.3 kg). Two hundred sixty-seven pet owners, 28 house officers, 35 veterinary technicians, and 14 attending clinicians participated in the study. There were 267 pet owner estimations, 270 attending clinician estimations, 269 house officer estimations, and 271 veterinary technician estimations.

The most accurate weight estimations were made by pet owners, followed by attending clinicians, house officers, and finally veterinary technicians (Table 1). The pet owner’s estimation was more accurate than other estimators in absolute percent error (\( P < .0001 \) for each comparison), but there was no statistical difference between the other estimators. Pet owners were able to estimate dogs’ weight within 10% of the actual body weight about 68% (181/267) of the time and provided estimates greater than 50% of the dogs’ body weight about 3% (9/267) of the time (Table 2). Pet owners were more likely to underestimate their dog’s weight while the veterinary staff were more likely to overestimate the weight.

On average, attending clinicians had the longest years of experience, while pet owners had owned their dog for a median of 5 years (Table 1). Dogs carried by house officers (\( P = .0076 \)) and veterinary technicians (\( P = .0005 \)) had more accurate weight estimates than those for dogs that were not carried. There was no significant difference observed between whether or not the dog was carried by an attending clinician (\( P = .06 \)).

There was a significant difference among the weight estimators in the technician, house officer, and attending clinician weight estimate bias (\( P < .0001 \) for all 3 groups). Veterinary technicians were more likely to accurately estimate the weight of large dogs (12.8% absolute percentage error) compared to medium dogs (19.8% absolute percentage error; \( P = .0058 \)), while there was no difference between small

### Table 1—Accuracy of body weight estimates grouped by the groups described in Table 1, stratified on the basis of whether the estimates were within 5%, 10%, 20%, or > or < 50% of the actual measured body weights for 271 dogs that presented to an emergency room.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Median length of veterinary experience or years pet owned (y)</th>
<th>Absolute mean deviation from dog's actual weight (kg)</th>
<th>Average percent error</th>
<th>Absolute average percent error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet owners</td>
<td>5.85</td>
<td>1.69</td>
<td>-1.05%</td>
<td>10.28%</td>
</tr>
<tr>
<td>Veterinary technicians</td>
<td>10.36</td>
<td>3.29</td>
<td>5.19%</td>
<td>20.01%</td>
</tr>
<tr>
<td>House officers</td>
<td>5.71</td>
<td>2.94</td>
<td>5.67%</td>
<td>20.19%</td>
</tr>
<tr>
<td>Attending clinicians</td>
<td>13.52</td>
<td>2.70</td>
<td>4.85%</td>
<td>17.41%</td>
</tr>
</tbody>
</table>

### Table 2—Percentages of body weight estimates provided by the groups described in Table 1, stratified on the basis of whether the estimates were within 5%, 10%, 20%, or > or < 50% of the actual measured body weights for 271 dogs that presented to an emergency room.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Within 5% of actual body weight</th>
<th>Within 10% of actual body weight</th>
<th>Within 20% of actual body weight</th>
<th>&gt; or &lt; 50% of actual body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet owners</td>
<td>47.19% (126/267)</td>
<td>67.79% (181/267)</td>
<td>86.89% (232/267)</td>
<td>3.37% (9/267)</td>
</tr>
<tr>
<td>Veterinary technicians</td>
<td>17.34% (47/271)</td>
<td>35.42% (96/271)</td>
<td>61.25% (166/271)</td>
<td>5.16% (14/271)</td>
</tr>
<tr>
<td>House officers</td>
<td>18.59% (50/269)</td>
<td>35.31% (95/269)</td>
<td>59.85% (161/269)</td>
<td>6.30% (17/269)</td>
</tr>
<tr>
<td>Attending clinicians</td>
<td>22.59% (61/270)</td>
<td>41.48% (112/270)</td>
<td>69.62% (188/270)</td>
<td>4.44% (12/270)</td>
</tr>
</tbody>
</table>
The results of the present study supported the hypothesis that pet owners would provide the most reliable weight estimate in dogs presenting to the ER that may be unable to have their weight obtained immediately. This finding is similar to what is reported in children in the ER who are unable to be immediately weighed, where parents have been shown to be a more reliable source of an estimated weight than the medical staff.\(^{4,5}\) This finding is most relevant in veterinary emergency and critical care facilities, where critically ill dogs requiring emergent care, such as cardiopulmonary resuscitation, analgesia, and fluid resuscitation, may not be able to be weighed immediately. Since the owner of the dog is often present at the time of patient presentation, it is reasonable to make the client’s estimation of their dog’s weight standard information obtained at the time of patient triage.

Approximately 89% (232/267) of pet owners were able to estimate their pet’s weight within 20% of the actual body weight compared to an average of 64% (515/810) of the estimations made by the veterinary staff. The authors believe that for most emergency interventions in dogs, regardless of body weight, a 10% to 20% overestimation or underestimation is unlikely to produce harmful clinical consequence. However, this may not be true of drugs that have a narrow therapeutic index such as aminoglycosides, digoxin, warfarin, and rifampin. Most drugs with a narrow therapeutic index do not need to be provided in the immediate emergent period, and an actual patient weight should be obtained before those drugs are administered. It is important to consider that underdosing an intervention (eg, fluids and analgesia) may fail to produce the desired physiologic endpoint. While the impact of a ≥50% difference in the estimated weight is relative to the actual body weight of the dog (ie, large-breed dogs are more likely to be impacted than small-breed dogs), it was uncommon for any group to underestimate/overestimate the dog’s weight by over 50%.

In contrast to our hypothesis, length of veterinary experience did not have an association with the ability to accurately estimate a dog’s body weight. While attending clinicians, with the longest average veterinary experience, were better skilled at weight estimation than the rest of the veterinary staff, there was no statistically significant association between length of experience and accuracy of weight estimation. Inability to detect a significant difference between length of experience and weight estimation in this study may be due to factors such as small number of veterinary staff represented in the study, variation in individual’s abilities to make estimations, and weight estimation not being a skill practiced or assessed in veterinary medicine. In addition, to the authors’ knowledge there are no formal classes in the veterinary curriculum that test the ability to estimate weight, as this is not a core competency expected of veterinary professionals. The findings of this study are similar to those in studies of people in which there is no correlation between the years of experience of the estimator and the estimated weight.\(^{6,15}\) This may present an opportunity for formal training of weight estimation.

Carrying the dog appeared to increase the accuracy of weight estimation for veterinary technicians and house officers, although this was not demonstrated for attending clinicians. Wolf et al.\(^{14}\) investigated the effect of body condition score (BCS) and hair coat length in weight estimation of dogs and cats in...
an emergency department. In that study, as the BCS increased, dogs’ weights were underestimated by veterinary students while veterinarians and veterinary technicians overestimated cats with higher BCS. The results of the study also suggested that weights were overestimated for lower-weight dogs with longer hair coats and underestimated for higher-weight dogs with longer hair coats. While BCS and hair coat length were not investigated in the present study, it is possible that carrying the dog compensates for the effect of hair coat length and BCS, hence leading to a more accurate weight estimate.

The direct correlation between length of pet ownership and ability of the pet owner to accurately estimate the pet’s weight is also interesting to note. This may highlight the effect of the human-animal bond and how pet owners pay attention to details of their pets’ health care. Pet owners are often asked to recall this information in other animal-related situations (ie, housing, grooming, boarding, etc). They may recall weight based on medications, such as heartworm and flea and tick preventives given monthly, that are specifically prescribed a dedicated weight range. It would have been insightful to ask owners on what they based their estimates (previous veterinary visit, medication, or complete guess). This also highlights a potential limitation to this study in that some of the pet owners seen through the emergency service came in as referrals from other veterinary hospitals. Dogs may have been weighed that day or within the week, leading to more accurate weight estimations made by pet owners. Future studies may investigate the effect of body condition and hair coat types and period between previous veterinary care and presentation on weight estimates by pet owners and veterinary staff.

In summary, the results of the present study suggest that the client provides the best weight estimates for dogs, and this should be considered as part of the initial triage history obtained from the client when a dog is critically ill and unable to be immediately weighed in the ER. Veterinary professionals may still provide an estimated weight and may not harm the patient if emergency interventions are needed for most emergent drugs with a wide therapeutic range.

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Disclosures

The authors have nothing to disclose. No AI-assisted technologies were used in the generation of this manuscript.

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