An investigation of feline immunodeficiency virus (FIV) and feline leukaemia virus (FeLV) management practices in Australian shelters

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Abstract

Feline immunodeficiency virus (FIV) and feline leukaemia virus (FeLV) are retroviruses that can cause a range of clinical disease in infected cats and are commonly screened for in many Australian shelters. This paper reports the results of a survey of Australian shelters about their management practices for the screening of FIV and FeLV infection. Of the 39 shelters contacted, 17 responses (44%) were received. All 17 shelters reported routinely testing cats for FIV infection, with six shelters surveyed (35%) performing follow-up FIV testing following a positive point-of-care (PoC) test result. Ten shelters surveyed (59%) reported routinely testing for FeLV infection, with three of these shelters (30%) performing follow-up FeLV testing following a positive PoC result (these three shelters also performed follow-up FIV testing). FIV-positive cats were rehomed under certain conditions in thirteen shelters (76%), compared to only one shelter that rehomed FeLV-positive cats (of the ten shelters that screened for FeLV infection). While many shelters routinely screened for FIV and FeLV infection, many were unaware of the inaccuracies associated with PoC testing. Increased awareness about the variation in PoC test kit performance between different manufacturers, and the need for follow-up testing following a positive FIV or FeLV result, will prevent unnecessary euthanasia due to incorrect diagnosis of a retroviral infection.

1. Introduction

Feline immunodeficiency virus (FIV) and feline leukaemia virus (FeLV) are horizontally transmissible retroviruses that infect domestic cats (*Felis silvestris catus*) worldwide. Both FIV and FeLV infection can cause clinical disease, including neoplasia (most commonly lymphoma), chronic inflammatory disease, and a range of bacterial and viral infections due to generalised immunosuppression [1,2,3]. Consequently, current guidelines recommend that all cats be tested for FIV and FeLV infection prior to rehoming, including all shelter cats [4].

Shelters (and private clinicians) usually screen for FIV infection using point-of-care (PoC) antibody test kits [4]. FIV PoC test kits vary with regards to which target FIV antigen is used

in the test membrane for antibody capture, and, partly for this reason, sensitivity and specificity vary between FIV test kits [5,6]. Additionally, the accuracy of FIV PoC testing is affected by FIV vaccination, with some kits able to distinguish FIV-vaccinated and FIV-infected cats (e.g. Witness®, Zoetis Animal Health, Lyon, France; and Anigen Rapid®, BioNote, Gyeonggi-do, Korea), and some kits unable to make this differentiation (e.g. SNAP Combo®, IDEXX Laboratories, Westbrook, ME, USA; and Abaxis Rapid®, Abaxis, Union City, CA, USA), meaning FIV-vaccinated cats test FIV-positive irrespective of infection status [7,8]. Consequently, in jurisdictions where FIV vaccination is practiced (currently Australia, Japan and New Zealand), Witness® or Anigen Rapid® are recommended for screening of FIV infection, and follow-up testing with the other test kit not used (i.e. Witness® or Anigen Rapid®), instead of FIV PCR testing, is a fast, economical and accurate method to confirm FIV-positive results [7]. This recommendation is particularly pertinent in a shelter scenario, where the FIV vaccination status of cats is often unknown, resources are limited, and a false-positive FIV test result may lead to unnecessary euthanasia [9].

Shelters (and private clinicians) also initially screen for FeLV infection using PoC test kits. However, unlike for FIV infection, FeLV PoC test kits detect viral antigen instead of anti-FeLV antibodies. Although all currently available FeLV PoC test kits detect the same antigen (capsid protein p27), differences in test kit sensitivity and specificity between manufacturers still exist. In one study, SNAP Combo® had 100% sensitivity and specificity and outperformed Witness®, Anigen Rapid® and VetScan Rapid® [6]. However, another study reported that SNAP Combo® produced more false-positive FeLV results than Witness® and Anigen Rapid® [10]. Follow-up testing for FeLV infection, usually by a proviral PCR assay, is recommended since in most countries (including Australia) the prevalence of FeLV is low and the resulting positive predictive value (PPV) of PoC test kits is relatively low [10,11]. Incorrect diagnosis of FeLV infection in shelters, like FIV infection, has serious consequences since many FeLV-positive cats are euthanased [9].

It is unknown how many shelters in Australia routinely screen the estimated 150,000 cats surrendered each year for FIV and/or FeLV infection [12], and how many Australian shelters routinely rehome FIV-positive and/or FeLV-positive cats. The aim of the current study was to review feline retroviral testing practices in Australian shelters, and in particular to investigate whether Australian shelters are following recommendations with regards to retroviral testing in areas where FIV vaccination is practiced and where FeLV prevalence is low.

2. Materials and Methods

In total, 39 shelters in Australia that rehome surrendered and/or stray cats were approached via email and post (March-August 2018) to participate in the study. Data regarding the annual number of stray/surrendered cats received by each shelter was generally unavailable, so selection was based on the authors' personal awareness of shelters. At least one shelter in each state/territory of Australia was approached to give a representative sample of shelters. Additionally, since the prevalence of FIV and FeLV infection varies within Australia, we surmised protocols for FIV/FeLV testing might also vary within Australia [13].

The survey design was based on a previous internal survey performed by the Royal Society for the Prevention of Cruelty to Animals (RSPCA) and included both open-ended and closed-ended questions. The survey contained three sections: FIV testing (10 questions), FeLV testing (10 questions) and general questions (6 questions). The first two sections included questions regarding testing practices for FIV and FeLV infection, the person/s responsible for testing protocols, and in-house adoption protocols regarding FIV-positive and FeLV-positive cats. Some closed-ended questions gave the opportunity for the respondent to add comments if they chose. The general section included questions about which FIV/FeLV PoC test kits were used and whether any information was given to clients by the shelter when a retroviral-positive cat was rehomed (if rehoming of FIV/FeLV-positive cats was permitted by the shelter).

Completed surveys were returned to the primary researcher (LB) by post and statistics were calculated manually using Microsoft Excel. For qualitative answers, responses were grouped by the primary researcher based on the use of similar key words before analysis was performed.

Ethics approval was granted by the University of Sydney human ethics committee (Approval number 2018/002).

3. Results

Of the 39 shelters that were contacted, 17 (44%) completed and returned surveys for analysis. Nine of the 17 responses (53%) were received from different RSPCA shelters.

3.1. FIV Testing

All 17 shelters reported testing some cats for FIV infection. The criteria for testing cats (respondents could give more than one answer) included cats with fight wounds (10/17, 59%), entire cats (10/17, 59%), all cats awaiting rehoming (8/17, 47%), cats with signs of FIV-associated disease (5/17, 29%), male cats (5/17, 29%) and kittens born to a FIV-positive queen (2/17, 12%) (Figure 1). Follow-up FIV testing following a positive FIV PoC test kit result was performed in six shelters (6/17, 35%). Of the six shelters that performed follow-up FIV testing, one shelter used PCR testing (FIV RealPCR®, IDEXX Laboratories, East Brisbane, Queensland, Australia), one used a second PoC test kit made by a different manufacturer (Witness® followed by Anigen Rapid®), and four shelters did not specify their protocol for follow-up testing. The minimum age for FIV testing was two months-of-age in one shelter (1/17, 6%), four months-of-age in two shelters (2/17, 12%), six months-of-age in eight shelters (8/17, 47%) and one year-of-age in four shelters (4/17, 24%). Two shelters answered that they had no minimum age requirement for FIV testing (Figure 2). FIV infection was diagnosed 'sometimes' in eight shelters surveyed (8/17, 47%), 'often' in five shelters (5/17, 29%) and 'rarely' in the other four shelters (4/17, 24%). No shelters responded that FIV infection was 'never' diagnosed or 'very often' diagnosed (Figure 3). For cats not tested for FIV infection prior to adoption, six shelters (6/17, 35%) included a FIV waiver for 'all cats', and two shelters (2/17, 12%) included a FIV waiver for 'some cats' (although the criteria for which cats had a waiver included in their adoption was not stated). Nine shelters (9/17, 53%) did not include a FIV waiver on untested cats for new owners to sign at the point of adoption.

All shelters stated that veterinarians were primarily responsible for FIV testing (17/17). Other staff members listed as also being responsible for FIV testing (respondents could give more than one answer) included veterinary nurses (9/17, 53%) and trained staff/animal attendants (4/17, 24%). Shelter staff responsible for deciding the outcome of a FIV-positive cat (respondents could give more than one answer) included the shelter manager (12/17, 71%), adoption team (7/17, 41%), veterinarians (7/17, 41%) and the behaviour team (1/17, 6%). Thirteen shelters stated that they adopted FIV-positive cats under specific conditions, including (respondents could give more than one answer) that the cat be kept completely indoors (6/13, 46%), there were no other identifiable medical or behavioural issues (5/13, 38%), the cat was not aggressive (4/13, 31%) and the cat was not to be housed with any other cats (2/13, 15%) (Figure 4). The remaining four shelters reported that all FIV-positive cats were euthanased.

3.2. FeLV Testing

Of the 17 survey responses received, ten shelters (10/17, 59%) reported testing some cats for FeLV infection. Of these ten shelters, criteria for FeLV testing included due to concurrent FIV testing (i.e. dual FIV/FeLV kits; 3/10, 30%), cats that presented in poor health (3/10,

30%) and all cats awaiting rehoming (3/10, 30%). One shelter reported not having specific criteria for FeLV testing (Figure 1). All three shelters from Western Australia performed FeLV testing compared to seven shelters in the rest of the country, which was not significantly different (3/3 *versus* 7/14; $P = 0.23$; two-tailed Fisher's exact test). Follow-up FeLV testing following a positive PoC test kit result was performed in three of the shelters that tested for FeLV infection (3/10, 30%), with these shelters representing three of the six shelters that performed follow-up FIV testing. Of the three shelters that performed follow-up FeLV testing, one used PCR testing, while the other two shelters did not specify their protocol for follow-up FeLV testing. The minimum age for FeLV testing was six months-of-age in seven shelters (7/10, 70%), cats older than one year-of-age in one shelter (1/10, 10%), and two shelters did not have a minimum age for FeLV testing (2/10, 20%) (Figure 2). FeLV infection was 'rarely' diagnosed in eight shelters (8/10, 80%), 'sometimes' diagnosed in one shelter (1/10, 10%) and 'never' diagnosed in one shelter (1/10, 10%). No respondents answered that FeLV infection was diagnosed 'often' or 'very often' (Figure 3). Of the ten shelters that performed FeLV testing, one shelter (10%) included an indemnity waiver at the point of adoption for cats not tested for FeLV infection, while the other nine shelters (90%) did not include a FeLV waiver for cats not tested for FeLV infection. The remaining seven shelters that did not perform any FeLV testing were not prompted to answer this question.

All respondents listed veterinarians as being primarily responsible for FeLV testing (10/10, 100%). Other staff members listed as also being responsible for FeLV testing (respondents could give more than one answer) included veterinary nurses (4/10, 40%) and trained staff/animal attendants (1/10, 10%). The decision about the adoptability of a FeLV-positive cat (respondents could give more than one answer) was made by the attending veterinarian (5/10, 50%), shelter manager (4/10, 40%) or the animal services team (2/10, 20%). Of the ten shelters that screened for FeLV infection, nine responded that all FeLV-positive cats were euthanased (9/10, 90%), while one shelter (1/10, 10%) considered permanently fostering a FeLV-positive cat if a single cat household was available.

3.3. General questions

Witness® was the most commonly used PoC test kit for FIV/FeLV screening (14/17, 82%). Anigen Rapid® was the second most commonly used test kit (6/17, 35%), followed by SNAP Combo® (2/17, 12%), SensPERT® (1/17, 6%; Rhone Ma, Petaling Jaya, Selangor, Malaysia), Speed Duo® (1/17, 6%; Virbac Animal Health, Carros, France) and other/unknown (1/17, 6%). Respondents could tick multiple answers if they used a variety of different test kits for screening.

All shelters surveyed provided new cat owners at the point of adoption with general husbandry advice including recommendations for indoor confinement (17/17, 100%) and regular vaccination (11/17, 65%). However, specific advice about the prevention of FIV and FeLV infection was only provided to new owners by eight shelters (8/17, 47%). Of these eight shelters, four solely provided verbal information (4/17, 24%), three solely provided written information (3/18, 18%), and one shelter provided both verbal and written information (1/17, 6%).

4. Discussion

This study is the first to report the diagnostic and management practices of Australian shelters for FIV and FeLV infection. Given there are no current Australian guidelines for shelters to follow regarding retroviral testing, the results of this study serve as a baseline of current shelter practices in Australia and help identify areas that need awareness and further education of shelter staff.

Criteria for FIV testing were associated with sex, age and clinical presentation. In particular, entire cats and the presence of fight wounds were common reasons for FIV testing. Given that FIV transmission is usually by the deposition of virus-laden saliva beneath the skin during fighting [9,13,14], this finding confirmed that respondents were proficient at identifying and testing cats at higher risk of FIV infection, which in turn increases the PPV and therefore accuracy of PoC testing. However, only 35% of shelters responded that they performed follow-up FIV testing following a positive FIV PoC test result, either by PCR testing or testing with a different brand of test kit. Of particular concern were the two shelters that used SNAP Combo® for initial FIV screening, since this test kit is unable to differentiate FIV-vaccinated and FIV-infected cats [7], and only one of these two shelters reported performing follow-up testing following a positive FIV result (using a second FIV PoC kit). Given that Australia is a country where FIV vaccination is practiced, this result means that FIV-vaccinated cats may be being incorrectly diagnosed as FIV-infected by some shelters and unnecessarily euthanased.

FIV-positive cats were rehomed from 76% of shelters surveyed (13/17) under specific conditions. These conditions included being kept entirely indoors, having no concurrent medical conditions, not being aggressive, and being rehomed as a single cat household. There is a growing body of literature to suggest that some FIV-infected cats can live a relatively normal life [15]. In one study, FIV-infected cats housed in low stress environments developed fewer diseases associated with FIV infection (e.g. lymphoma) over a 22-month period than FIV-infected cats group-housed in a presumably more stressful environment

[16]. Two other studies, including an Australian study, have reported no difference in survival times between FIV-infected and FIV-uninfected cats [17,18]. With more education, perhaps the four shelters from the current study that reported not rehoming FIV-positive cats might consider altering their rehoming policies.

The finding that fewer shelters tested for FeLV infection compared to FIV infection was unexpected since it was assumed most shelters in Australia used combination FIV/FeLV PoC test kits. However, given the low prevalence of FeLV infection in Australia compared to FIV infection (approximately 2% *versus* 15%) [13], and the limited resources of many shelters, it is perhaps understandable why seven shelters reported not screening for FeLV infection. Of the ten shelters that routinely screened for FeLV infection, ill-health was the main reason given for testing, due to the strong disease association with FeLV infection [1,11,19]. However, of concern was the finding that follow-up FeLV testing was only done by 30% of shelters that routinely performed FeLV screening, despite 90% of these shelters reporting that all FeLV-positive cats were euthanased. Only one shelter described a policy which allowed FeLV-positive cats to be considered for permanent fostering as single cat households, with medication provided by this shelter. False-positive FeLV results are particularly a concern in countries with low disease prevalence (e.g. Australia) due to the reduced PPV of screening tests [10,11]. Interestingly, all three shelters that performed follow-up FeLV testing also performed follow-up FIV testing, suggesting the presence of policy makers at these facilities that were up-to-date with recent recommendations about retroviral testing. Further education of other shelters about the possibility of incorrectly diagnosing (and euthanasing) cats on the basis of a single PoC test kit result, therefore, needs to be pursued.

Although all shelters recommended indoor confinement as general advice to new adopters, only 47% (8/17) provided verbal or written information regarding the prevention of FIV and FeLV infection. Given that cats with outdoor access are at increased risk of contracting these viruses, educating new adopters about the importance of confinement (including modular pet parks) may help with compliance, and therefore, prevention of new cases of FIV/FeLV infection [4]. A study investigating the education of human patients in hospitals found that giving both verbal and written information at the time of hospital discharge (rather than one or the other) improved the retention of knowledge [20]. Shelters should consider giving information regarding FIV and FeLV infection in multiple formats to all adopters to improve community education and reduce the prevalence of both retroviral infections in Australian cats.

Like many surveys, one of the weaknesses of the current study was the response rate (17/39, 44%). Another flaw of the current study was that shelters without FIV or FeLV testing protocols were not recruited for the survey, and council pound facilities were also not recruited. Council pounds receive more cats annually than shelters in Australia [12], and anecdotally do not test for FIV/FeLV infection, meaning that our results may not accurately represent the views and policies of all animal rehoming facilities in Australia. Although nine of the 17 survey responses were from the same organisation (the RSPCA), this organisation is run independently in each state/territory, and there can also be regional differences between shelters within states/territories (e.g. depending on the availability of veterinarians). Some confusion was noted in survey responses, and future studies should refine the wording of questions to avoid confusion and ensure all relevant information is captured. For example, in response to the question "What happens when a cat returns a positive result?", some shelters answered by outlining their adoption policies for FIV/FeLV infected cats, while others responded with their follow-up testing policy (or lack thereof) or the need for further health checks. Finally, future surveys should investigate the housing conditions of cats in shelters, in particular whether group-housing of cats is practiced. FIV is commonly transmitted through bite wounds, and FeLV usually transmitted through close contact (although FeLV transmission through bite wounds also occurs) [4,11,14,21,22]. Given that many shelters (41%) reported not routinely testing for FeLV infection, it is possible that Australian shelters are unknowingly putting cats at risk of FeLV infection by group-housing FeLV-uninfected cats with undiagnosed FeLV-infected cats.

5. Conclusion

This study provided useful insights into the varying protocols for FIV and FeLV testing and management between different Australian shelters. Some shelters, but not all, seemed cognisant of recent research regarding the prevalence of FIV and FeLV infection in Australia and recommendations for feline retroviral testing. FIV and FeLV PoC test kits should be selected based on which are most accurate under Australian conditions (particularly due to FIV vaccination). In addition, encouraging more shelters to perform follow-up testing for FIV and FeLV infection will reduce unnecessary euthanasia of misdiagnosed cats.

6. Acknowledgements

We are extremely grateful to all of the shelters in Australia who responded to our questionnaire, as well as RSPCA Australia for their support and guidance with this project.

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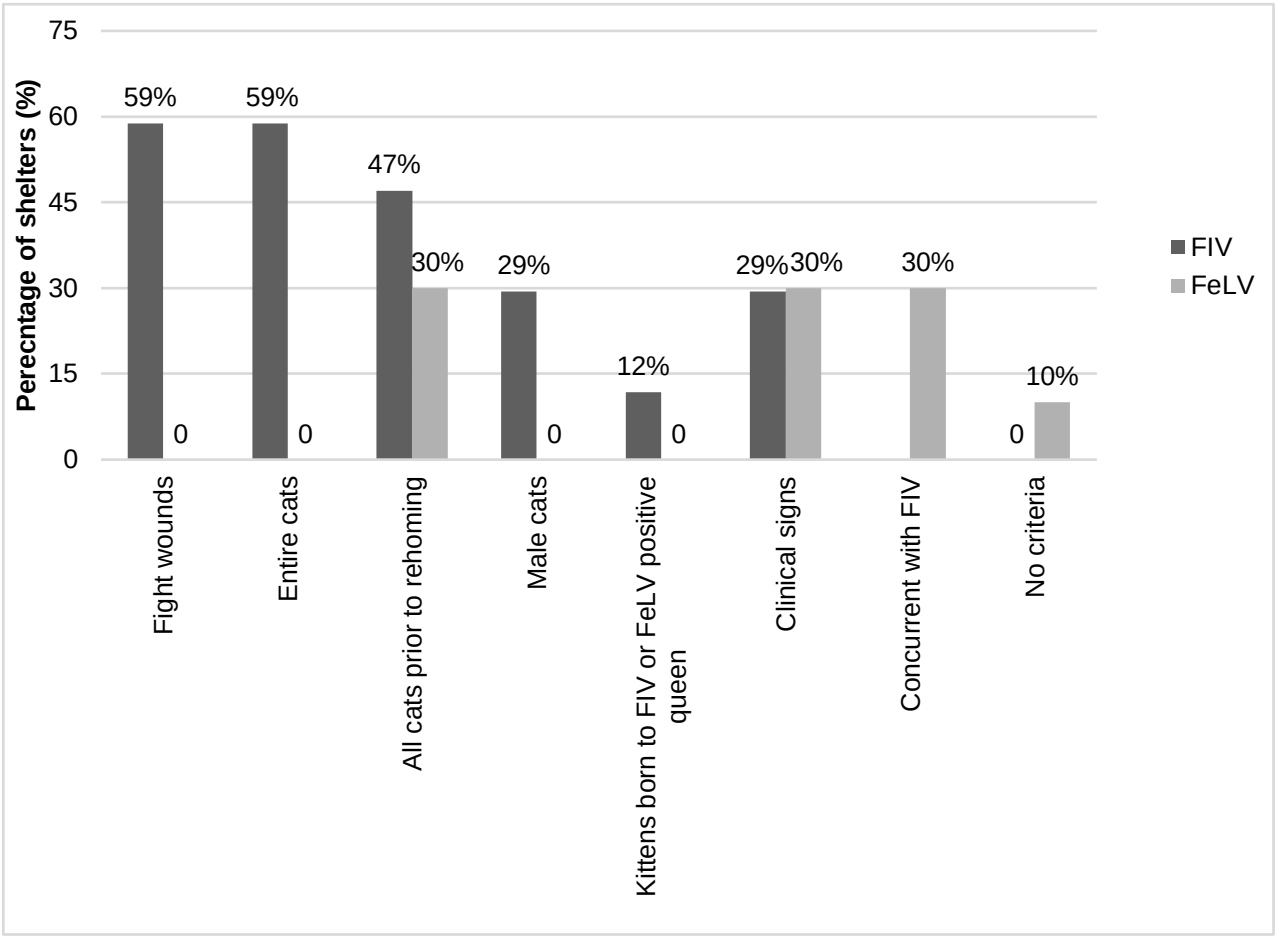

Figure 1. Reasons for FIV and FeLV screening with a PoC test kit (respondents could give more than one answer). All 17 shelters performed FIV testing while only 10/17 shelters performed FeLV testing.

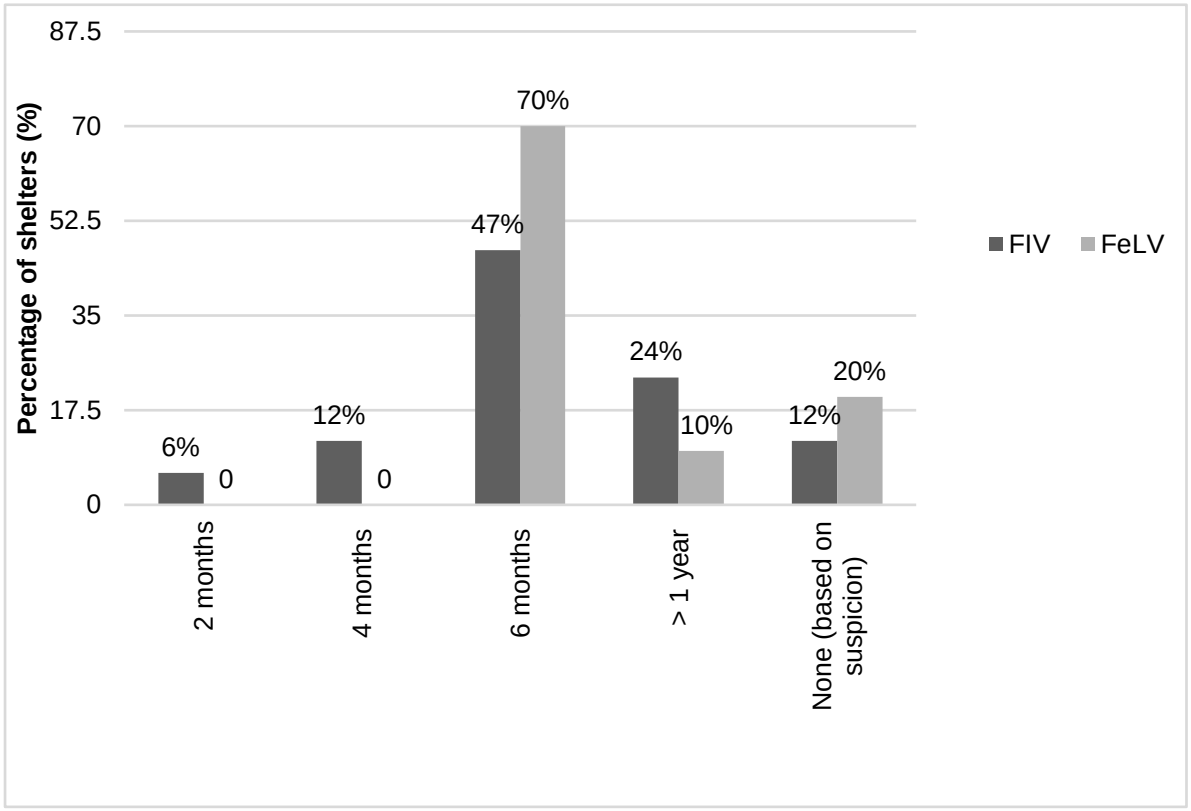

Figure 2. Minimum age for FIV and FeLV testing. All 17 shelters performed FIV testing, while only 10/17 shelters performed FeLV testing.

Figure 3. Perceived frequency with which shelters diagnosed FIV and FeLV infection. All 17 shelters performed FIV testing, while only 10/17 shelters performed FeLV testing.

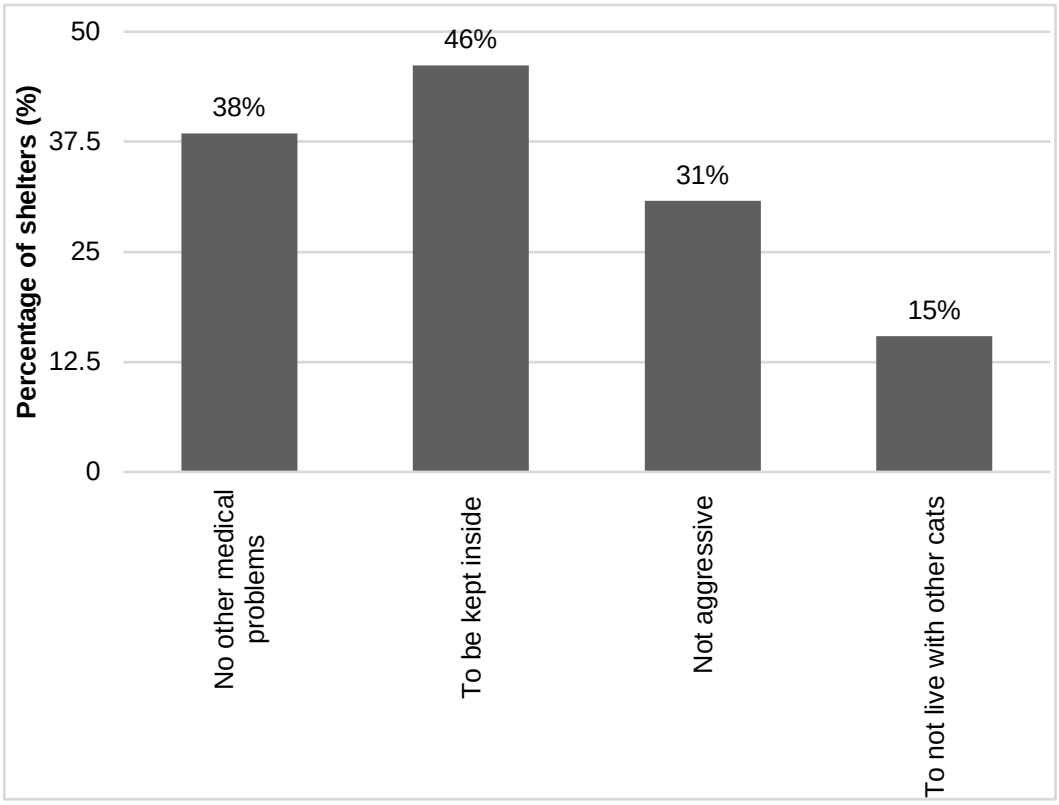

Figure 4. Reasons given by the 13 shelters surveyed that considered rehoming FIV-positive cats under certain circumstances (respondents could give more than one answer).