

Early-age desexing of dogs and cats

Introduction

What is early age desexing?

Early-age desexing (EAD) is the desexing of cats and dogs at an earlier age than when the procedure is traditionally carried out. The traditional desexing age for dogs and cats is generally between 5½ and 6 months of age, although this can vary between cats and dogs and according to breed. In contrast, EAD is usually carried out between 8-12 weeks of age, although in some studies it is defined as desexing carried between 6-16 weeks^{1,2}, and in others as desexing before 5, 5½ or 6 months of age. Bodyweight, in addition to age, is another major consideration in determining when EAD should be performed. EAD is also referred to by some as prepubertal or paediatric desexing.

EAD was developed in the 1980s in the US to combat the problem of cat and dog overpopulation: that is, where there are more adoptable animals available than there are homes available for them. The relationship between supply and demand for companion animals is a complex one, but the ultimate consequence of overpopulation is the euthanasia of 'unwanted' companion animals in shelters and pounds^{3,4,5}. Early age desexing provided a means of ensuring that puppies and kittens could be desexed before being rehomed, rather than leaving owners to follow through and arrange the procedure themselves.

Traditional desexing age

Desexing at the traditional age of 5½ -6 months age reaches most female dogs prior to first oestrus, but female cats may already have had their first oestrus by this age (Table 1). From a veterinary perspective, desexing has historically been carried out at this age because:

- the most rapid phase of physical maturation is complete by the traditional age (so there is less concern about possible effects on development resulting from desexing)¹
- there was a perception that the risks relating to anaesthetising and performing surgery (in terms of peri-operative or short-term consequences) were reduced when operating on a slightly older animal
- there was a perception that the risk of long-term consequences generally was reduced when operating on a slightly older animal
- vets were trained to desex at this age and therefore would be unfamiliar or uncomfortable with performing desexing at an earlier age.

Who currently practises EAD?

EAD is routinely performed in RSPCA shelters and other large shelters in Australia¹ on dogs and cats that meet the relevant criteria. For example, at RSPCA shelters in Victoria, animals must be 8 weeks of age, in good clinical condition, and weigh >750-1000g prior to being considered for EAD⁷.

The practices of smaller shelters and most council pounds in Australia are currently unknown, however, not all council pounds will routinely desex animals (early-age or traditional age) prior to rehoming. In some cases, councils issue desexing vouchers following rehoming to encourage desexing, but these have achieved only moderate success in terms of follow-through by new owners.

In private practice, EAD is still considered relatively unusual and treated with some caution, with a relatively small number of practices offering EAD for clients¹. Early age desexing may occur in private clinics when the owner is a breeder who specifically requests it in order to protect their

'purebred lines', or if the clinic is located in an area where mandatory desexing by 3 months of age is enforced.

For example, in 2004 the Victorian Government decided to reduce the mandatory age of pet registration from 6 to 3 months. This legislative change, enforced by the local government, was expected to result in more animals being desexed at a younger age in order for owners to access reduced pet registration fees³. However, current EAD trends in Victoria are unknown as each local council is autonomous and data has not been collated across all local council areas. In addition, there has been opposition to EAD from some private veterinary practitioners. Because mandatory microchipping by 3 months of age also results in reduced pet registration fees, this has in some cases replaced the financial incentive of EAD for owners⁸. A small number of councils have also introduced mandatory desexing by 3 months of age, but the effects of this are currently unknown as the policy has only been in place for about a year⁹.

Table 1 Reproduction in the cat and dog⁶

	Dog	Cat
Age at first oestrus (heat)	7-9 months	4-12 months
Oestrous cycle in non-pregnant animals	Every 7 months on average (range 5-8 months)	Every 4-30 days on average [^] (14-19 days where daylength is constant)
Duration of oestrus period	7-42 days (proestrus + oestrus)	2-19 days
Gestation period	Mean = 63 days Range = 58-71 days	Mean = 63 days Range = 58-70 days
Number of young	8-12 for large breeds 6-10 for medium breeds 2-4 for small breeds	4-6
First occurrence of oestrous after parturition	Range ~ 4-12 months See oestrous cycle; pregnancy does not alter interval	7-9 days

[^] Cats need to mate to ovulate: if they do not ovulate, mate and conceive they will stay in oestrous (on heat) for long periods of time with only a few days off-heat in between.

Why does the RSPCA advocate EAD?

The RSPCA advocates that all dogs or cats offered for sale or adoption as companion animals (rather than for breeding), should be desexed prior to transfer of ownership¹⁰. EAD is performed on puppies and kittens (from the age of eight weeks) in RSPCA shelters for the following reasons:

1. EAD is regarded as an effective strategy to prevent unwanted/unplanned pregnancies in cats and dogs to help reduce the number of unwanted companion animals entering shelters and pounds.
2. EAD offers significant animal welfare benefits related to surgery and anaesthesia when compared to traditional age desexing.
3. EAD offers health and behavioural benefits when compared to traditional age desexing.
4. EAD offers all of the commonly accepted medical and behavioural benefits associated with general desexing.
5. The use of EAD reduces the amount of time young animals need to spend in the shelter environment and thus improves the efficiency of shelters in terms of their resources and capacity.

Based on the available scientific evidence and extensive RSPCA experience performing EAD, the RSPCA considers EAD to be a safe and effective strategy to prevent unintended litters.

The following sections outline the evidence that underscores the RSPCA's support for EAD.

EAD as a strategy to reduce overpopulation

Desexing companion animals at an early age, before they are sexually mature (see Table 1), ensures that they cannot produce any unwanted/unplanned litters. Reducing the number of unwanted and unplanned litters may help to reduce the number of unwanted companion animals in the community and thus reduce the number of animals entering shelters and pounds. In turn, this may decrease euthanasia rates (particularly of cats) in shelters and pounds.

In the 2008-2009 financial year the RSPCA received 66,205 cats, of which 39,495 (59.7%) were euthanased, and 69,383 dogs, of which 22,085 (31.8%) were euthanased¹¹.

EAD may be particularly relevant to cats where an 'over-supply' appears to be a significant contributor to high euthanasia rates in shelters and pounds. Thousands more kittens are born each year than are able to be absorbed by available homes, leading to high euthanasia rates^{1,12}. Cats can become pregnant as early as 4 months of age and can produce their first litter at 6 months of age (around the time when they would be desexed traditionally) therefore EAD may help to reduce the number of unplanned first oestrous litters entering shelters annually.

Cats are also highly prolific breeders capable of producing on average 4.2 kittens per litter and 2.1 litters per year. Even with natural attrition (mortality rates of 30%) there are still insufficient homes for the surplus kittens produced¹³.

EAD may also help to reduce the number of unwanted dogs euthanased in shelters and pounds. One survey discovered that 61% of male dog owners and 47% of female dog owners in the Brisbane area would not have had their dog desexed if it had not already been done at the time of acquisition¹. This indicates that EAD may help to reduce unplanned litters for those owners who would generally not have their animal desexed following purchase. However, the problem of 'over-supply' (more adoptable dogs available than homes available) appears to be less of an issue compared to cats. Behavioural factors, rather than 'over-supply', appear to be more primary reasons for the unwanted dog population¹.

The adverse psychological impact on shelter staff of high euthanasia rates of healthy, adoptable unwanted companion animals is a serious issue¹. EAD is an important strategy to help reduce the number of unwanted animals received by shelter staff and thus reduce the number of animals euthanased at shelters. Importantly, EAD prevents unwanted/unplanned pregnancies in any animals leaving shelters. It is critical that animals adopted from RSPCA shelters are desexed prior to leaving the shelter as this guarantees that the animal will not contribute further to the unwanted companion animal population and that desexing is carried out safely.

Furthermore, EAD is often a necessity within the shelter environment. RSPCA shelters are presented with thousands of unwanted companion animals annually¹⁴. It is important to ensure that animals suitable for adoption are safely desexed as soon as possible in order to maximise the ability to find suitable homes for them (younger animals are more easily adopted) and to remove them from the shelter environment which does not provide ideal living conditions for companion animals (risk of infectious disease, stress, socialisation issues and risk of euthanasia if not adopted). Efficient management and adoption of shelter animals also increases shelter intake capacity by enabling RSPCA shelters to accept more unwanted animals presented to them. It is vital to ensure that any animals adopted from the RSPCA do not contribute further to the unwanted companion animal population.

Assessing the impact of EAD on individual animals

What are the potential benefits of EAD?

As well as preventing unplanned pregnancies, there are a number of widely-accepted health and behavioural benefits associated with desexing at a traditional age which also apply to early age desexing. These are outlined in Table 2.

Table 2 Medical and behavioural benefits of general desexing¹⁵

Subject	Desexing provides the following benefits:
Male dogs	<ul style="list-style-type: none"> • prevention of prostatitis (inflammation/infection of the prostate gland) • prevention of benign prostatic hyperplasia (enlargement) • prevention of certain types of hernias and tumours of the testicles and anus • decrease in interest in wandering/roaming to find female mates • reduction of aggressive behaviour towards other male dogs • reduction of urine marking • reduction of inappropriate mounting
Female dogs	<ul style="list-style-type: none"> • prevention of mammary cancer (especially if prior to the first heat) • prevention of reproductive organ disease such as pyometra (life-threatening uterine infection) and ovarian cancer • prevention of unplanned pregnancies • prevention of pseudo-pregnancy behaviours
Male cats	<ul style="list-style-type: none"> • prevention of testicular cancer • decrease in interest in wandering/roaming to find female mates and therefore less likely to be get lost or be in a traumatic accident e.g. hit by car • decrease in fighting with other male cats and therefore reduces risk of cat fight injuries and cat fight related diseases such as Feline Immunodeficiency Virus (FIV) • reduction in urine spraying • reduction in aggression • increase in affection towards people • reduction in interspecies aggression
Female cats	<ul style="list-style-type: none"> • helps to prevent mammary cancer • prevention of reproductive organ disease such as ovarian cancer • prevention of unwanted/unplanned pregnancies • prevention of potentially undesirable 'on heat' behaviours such as restlessness and being highly vocal • increase in affection towards people • reduction in interspecies aggression

A number of studies have compared the veterinary outcomes of EAD and traditional age desexing. These indicate that EAD may also offer certain advantages related to surgery and anaesthesia, and health and behavioural benefits when compared to desexing at the traditional age. Unfortunately however, the majority of these studies do not distinguish between desexing at 8-12 weeks (as practised at RSPCA shelters) and desexing prior to first oestrus. Thus some of the medical and behavioural advantages to individual animals of EAD at 8-12 weeks listed here will also apply to desexing at any age prior to first oestrus.

There are a number of specific benefits relating to surgery and anaesthesia when desexing is carried out on younger patients (ie between 8-12 weeks of age):

1. Desexing surgery is faster and easier when carried out on younger patients as their anatomical structures are less developed^{3,16}. There is less tissue trauma and less tissue handling involved as there is less fat and other tissues to incise. Generally the surgery incision site is smaller and bleeding is reduced and minimal, providing significant animal welfare benefits¹⁷.
2. It takes less time to prepare the animals for surgery which means less time under general anaesthesia. The anaesthetic recovery and wound healing time is shorter providing significant animal welfare benefits^{3,16,18}.
3. The incidence of peri-operative complications is low due to significantly shorter surgical and anaesthetic times¹⁹. One study showed that there were significantly less overall and minor

complications in animals desexed at < 12 weeks of age compared to animals desexed at ≥ 24 weeks of age¹⁸.

4. The enhanced response by younger patients to relatively low doses of anaesthetic agents means that less anaesthesia is required which equates to a reduced cost per patient^{1,16,20}.

There are also some benefits of desexing prior to first oestrus which also apply to animals desexed at an earlier age:

1. Desexing sexually immature animals removes all risks associated with pregnancy in the first oestrus cycle, especially in cats^{16,21}.
2. Patients are not in heat or pregnant at the time of desexing, which simplifies the surgery.
3. Desexing prior to first oestrus significantly reduces the risk of cats and dogs developing malignant mammary cancer:
 - *Cats*: mammary tumours are the third most common tumour type in cats with >85% of all tumors being invasive malignancies. The incidence is greatly reduced when cats are desexed before their first oestrus^{22,23}.
 - *Dogs*: mammary tumours are the most common type of tumour in undesexed female dogs. At least 70% of intact bitches will develop a clinically detected mammary tumor if they live to 15 years, and virtually 100% of them will have microscopic tumor foci. Desexing prior to first oestrus virtually eliminates this risk: bitches desexed before their first oestrus have a 0.5% risk compared to an 8.0% risk when desexed after the first oestrus^{22,23}.
4. There is evidence of behavioural benefits resulting from desexing earlier than 5.5 months:
 - One study found that hyperactivity was reduced in male and female cats that were desexed earlier than 5.5 months of age. For male cats, the occurrence of abscesses, aggression toward vets, sexual behaviours, urine spraying and hyperactivity were also reduced²⁴. This study also found a reduction in asthma and gingivitis in cats desexed early.
 - Another study found that for female dogs desexed earlier than 5.5 months of age, separation anxiety, escaping behaviours, inappropriate elimination when frightened and relinquishment for any reason were decreased²⁵.

What are the potential risks of EAD?

Potential short-term risks

1. Anaesthesia and surgery

Safe EAD requires proper training in paediatric anaesthesia and surgery and relies on access to appropriate resources and equipment to ensure that the recommended preoperative, operative and post-operative protocols are used. A number of studies have demonstrated that, provided these measures are in place, the risk of anaesthetic complications associated with EAD is similar to traditional age desexing^{3,18}.

Procedures must take account of specific considerations relating to surgery on paediatric patients (8-12 weeks of age). Paediatric patients:

- have immature livers and kidneys and are therefore less efficient at metabolism and excretion of some drugs.
- have a lower percentage of body fat, a decreased ability to shiver and a larger surface area to volume ratio - attention to maintenance of body temperature is critical.
- are at greater risk of hypoglycaemia.

One study involving 775 cats and 1,212 dogs found that the incidence of anaesthetic complications in pups and kittens anaesthetised at less than 12 weeks of age was no greater than in those sterilised between 12 and 24 weeks, nor greater than in those sterilised at greater than 24 weeks of age¹⁸.

With regard to short-term surgical complications and post-operative (up to 7 days) complications this study also showed that animals desexed at 24 or greater weeks of age had a

significantly higher overall complication rate (10.8%) than animals desexed at less than 12 weeks of age (6.5%). There were no differences between the groups for major complications, i.e. those which required treatment and resulted in an increase in morbidity or mortality, but for minor complications, i.e. those which required little or no treatment and caused a minimal increase in morbidity, the older animals had significantly more complications than those desexed at less than 12 weeks of age. This study concluded that procedures may be performed safely in prepubertal animals, provided that appropriate attention is given to anaesthetic and surgical techniques¹⁸ (Box 1).

RSPCA shelters currently perform thousands of EAD procedures every year with mortality rates that are either comparable or lower than current estimates of anaesthetic-related deaths in other healthy cats and dogs²⁶. Current estimates in the veterinary anaesthesia literature suggest that approximately 0.1-0.2% of healthy dogs and cats die of an anaesthetic-related complication²⁷.

Box 1 Recommended anaesthetic protocol for EAD^{3,20}

- Minimal withholding of food preoperatively (ie only 2- 4 hours for six to eight week old patients), with resumption of eating within two hours of surgery
- Reduced drug doses and careful titration of doses
- Maintenance of high heart rates and high respiratory rates
- Endotracheal intubation
- Oxygen supplementation with or without additional inhalant anaesthesia
- Peri-operative heating
- Glucose and fluid support if necessary. Place intravenous catheters
- IV fluids at 10ml/kg/hr with the exception of kitten castrations. IV fluids should be given where anaesthesia exceeds one hour
- Analgesia

2. Infectious disease

There has been some concern that EAD can be associated with an increased incidence of infectious disease. It has been hypothesised that a paediatric patient is placed under additional stress, and if desexing occurs prior to the end of the vaccination period, young puppies and kittens will succumb to an infectious disease¹⁸.

Several studies have examined this issue. One study found that the incidence of infectious disease, in particular, parvovirus in puppies, was increased in animals desexed early. However, these animals were in a shelter environment and results were likely influenced by holding times in the shelter and increased exposure to other animals. Susceptibility to infectious disease is also likely to be influenced by shelter management practices. A further study under controlled conditions showed no association with an increase in infectious disease and EAD^{1,28}.

Control of infectious diseases has improved greatly in recent years³. Infectious disease transmission is a risk in shelter environments however effective management practices minimises this risk significantly.

Potential long-term risks

Some veterinarians have expressed concerns regarding long-term medical and behavioural consequences associated with EAD. Numerous controlled prospective studies and retrospective cohort studies and owner surveys have been performed to verify the long-term safety of EAD with the majority concluding that EAD is safe when compared to traditional age desexing⁵. The following section covers the main issues examined in these studies.

1. Behaviour

Consideration of any potential effects of EAD on behaviour is important as behavioural problems are often identified as a significant reason for relinquishment of companion animals, particularly dogs²⁹.

One study compared the behavioural outcomes of kittens desexed at 7 weeks, 7 months and left intact, and found no statistical difference between each group in activity levels, playfulness, excitement, or frequency of vocalisation³⁰.

One retrospective cohort study involving 1842 dogs evaluated the long-term risks and benefits of early age desexing (<5.5 months of age) compared with traditional age desexing. Among male and female dogs desexed at an early age, noise phobias and sexual behaviours were increased whereas separation anxiety, escaping behaviours, inappropriate elimination when frightened and relinquishment for any reason were decreased²⁵.

In a 15 month study, dogs desexed at 7 weeks or 7 months scored higher for general activity compared to intact controls and those desexed at 7 weeks scored higher for excitability compared to intact controls. In follow-up studies there was no difference in numbers surrendered to shelters³¹.

In addition, dogs desexed at an early age have been shown to be more suitable for training as guide dogs at institutions in Australia and the United States³.

EAD is associated with positive behavioural changes in both cats and dogs¹. In one retrospective cohort study among male cats that underwent EAD (<5.5 months of age) the occurrence of abscesses, aggression toward vets, sexual behaviours, urine spraying and hyperactivity was reduced. Hiding and shyness appeared to be increased compared with cats that underwent desexing at an older age. It should be noted however that this study involved animals from shelters and the effects of impoundment on behaviour were not factored into the results^{1,24}.

EAD before the traditional 5.5 months of age was not associated with increased rates of death or relinquishment in cats²⁴.

2. Musculoskeletal development

Desexing in general delays growth plate closure in both cats and dogs. This extended period of growth means that bones are slightly longer resulting in taller stature in some desexed animals (in some this is a slight increase)³.

Studies in cats found that while growth plate closure was delayed no differences were detected between cats desexed at 7 weeks or 7 months of age^{1,32}.

Extended periods of open growth plates may theoretically contribute to an increased susceptibility to long-bone fractures, however, this has not been found in long-term follow-up studies^{24, 25, 33}.

Several long term studies have examined whether there is an association between age at desexing and the incidence of hip dysplasia in dogs. It has been suggested that delayed growth plate closure and the subsequent increased long bone growth seen in dogs neutered at an early age may predispose these dogs to hip dysplasia or angular limb deformities. These studies have produced conflicting results³³.

One study reported no association between age at desexing and the incidence of hip dysplasia²⁸ whereas another study found an association between age at desexing and hip dysplasia²⁵. Dogs desexed before 5.5 months of age had a 6.7% incidence of hip dysplasia, whereas dogs desexed at 6 months or older had an incidence of 4.7%. However, only 54% of the dogs with a diagnosis of hip dysplasia were reported to also have arthritis or joint problems requiring veterinary attention. This study also found that dogs neutered at the traditional age (>5.5 months of age) were 3 times more likely to be euthanased due to hip dysplasia. If desexing prior to 5.5 months of age does increase the incidence of hip dysplasia it is suggested that it may be a less severe form of hip dysplasia²⁵. Further research is warranted in this area specifically examining the effect of EAD desexing (between 8-16 weeks of age) on musculoskeletal development.

3. Obesity

Desexing in general may predispose toward obesity but there is no evidence that EAD increases that risk³. Studies of cats and dogs comparing those desexed at 7 weeks and 7 months found no difference in obesity rates³¹.

4. Neoplasia (cancer)

The reduced risk of neoplasia, particularly testicular and ovarian, is one of the benefits of desexing regardless of whether the procedure occurs prepubertally or at an older age. In addition, desexing dogs prepubertally significantly decreases the risk of developing malignant mammary tumours³⁴. Desexing cats prior to their first oestrous also reduces the risk of malignant mammary cancer (but not to the same extent as in female dogs).

In one study the incidence of osteosarcoma was found to be higher in desexed female Rottweilers, particularly if they had been desexed prior to 5.5 months of age. However, the overall risk of death was lower for those desexed prior to 5.5 months compared to Rottweilers desexed after 5.5 months of age³⁵.

It has been suggested that EAD may impact differently in different breeds of dog¹. Further research is warranted in this area specifically examining the effect of EAD desexing between 8-16 weeks of age on neoplasia risk.

5. Infantile External Genitalia

Under development of external genitalia is often attributed to desexing in general particularly if it is performed at an early age. It is mainly a concern because it may predispose toward other medical conditions³.

One 15 month study examined the effect of prepubertal desexing on secondary sex characteristics. Dogs were divided in to three groups: desexed at 7 weeks, desexed at 7 months and left intact. This study found that females desexed at 7 weeks and 7 months had small infantile vulvas compared to the intact females but that no clinical problems (including perivulvar dermatitis) were evident and that urethral catheterisation was easily achieved in all desexed females³¹.

Male dogs desexed at 7 weeks of age had immaturity of the prepuce, penis and os penis as development of these structures is androgen dependent. However the penis could be fully extruded in all castrated male dogs in this study and there were no gross penile adhesions. The clinical significance of this is unknown and further research may be warranted in this area. This study concluded that there were no significant differences in development between those dogs desexed at 7 weeks of age and those desexed at 7 months of age³¹.

One study examining the effect of age at desexing on male cat external genitalia found that those desexed at 7 weeks were unable to completely extrude the penis and those desexed at 7 months had a variable ability to completely extrude the penis compared to intact males who were capable of complete penile extrusion. However, the clinical significance of this is unknown³⁶.

It has been suggested that infantile genitalia may increase the accumulation of penile secretions, and if this occurred, might predispose toward balanoposthitis (inflammation of the penis and prepuce) but this was not observed in any follow-up studies³.

6. Urinary problems

a *Urethral obstruction in cats*

Concerns that paediatric castration may result in decreased diameter of the penile urethra in male cats and therefore predispose them to urinary obstruction (a life-threatening condition) have been examined.

One study examining the difference between male cats castrated at 7 weeks, 7 months and males left intact found that there was no significant difference in the distal penile urethral diameter in male cats desexed at 7 weeks or 7 months in comparison to intact males³⁶.

Another study examined the effect of early castration on the urethra of 30 male cats histologically which were divided into three groups: sexually intact (controls), castrated prepubertally (at 5 months of age) and castrated prepubertally (at 5 months of age) and then subsequently treated with testosterone. This study did not find any significant difference in urethral circumference between these three groups³⁷.

A further study compared the diameter of the lumen of the urethra of littermates which were castrated at 3 months, castrated at 3 months by ligation of the spermatic cord and left intact. The critical diameter of the pre-prostatic and musculo-membranous urethra was similar in all three groups at 6 and 7 months of age³⁸.

These studies suggest that the development and maturation of the urethra of male cats over the time of puberty is not dependent on testosterone³⁴.

One study examined the urethral diameters of female cats desexed at 7 weeks, 7 months and left intact. This study found that female cats desexed at 7 weeks of age had smaller pre-pelvic urethral diameters compared to intact cats. However, the clinical significance of this is unknown. This study also suggested that there appeared to be no difference in urethral function despite any anatomical differences that may be present³⁶. Further research is warranted in this area.

In a recent retrospective cohort study evaluating the long-term risks and benefits of early-age desexing (<5.5 months) involving 1660 cats no association was found between the age of desexing and the occurrence of urethral obstruction in male cats²⁴.

Another cohort study examining long-term results and complications of gonadectomy performed at an early age (< 24 weeks of age) or at the traditional age, involving 263 cats from animal shelters, over a three year follow-up period, did not find an association with urinary obstruction and desexing male cats prepubertally (< 24 weeks of age)³⁹.

b *Urinary disease in cats*

The incidence of urinary tract disease in cats desexed at an early age was examined in a long-term study that found that cats desexed at the traditional age (≥ 24 weeks of age) had significantly more urinary tract problems in comparison to cats desexed at < 24 weeks of age. Cystitis was the most common problem seen, with a greater incidence occurring in cats desexed at the traditional age^{1,39}.

In a recent retrospective cohort study evaluating the long-term risks and benefits of early-age desexing (<5.5 months) involving 1660 cats no association was found between the age of desexing and the occurrence of feline lower urinary tract disease²⁴.

c *Cystitis in dogs*

One study found an association between age at desexing and cystitis. Cystitis was more common in those dogs desexed at <5.5 months of age. However, none of these dogs had more than two episodes of cystitis so this does not appear to reflect a chronic susceptibility²⁵. Furthermore, cystitis is usually easily treated with a course of antibiotics and generally does not have any long-term consequences. It is important to note that this study defined EAD as <5.5 months of age but did not specifically examine the effect of EAD desexing (between 8-16 weeks of age) on the occurrence of cystitis.

d *Urinary incontinence in female dogs*

Desexing in general is a risk factor for the development of urinary incontinence at some stage in life and this is supported by a number of studies. It has been suggested that prepubertal desexing may result in increase incidence of urinary incontinence in female dogs because of the lack of oestrogenic influence on the urinary tract. It is a reasonable concern that early age desexing might increase the risk of developing this condition³. One retrospective cohort study found that among female dogs, decreasing age at desexing on a continuous scale was associated with increasing incidence of urinary incontinence that required medical treatment. Those desexed before 3 months of age appeared to be at highest risk, compared with those desexed at ≥ 3 months. This study suggested that the projected cumulative incidence during the first 6 years of life (when most cases of urinary incontinence were diagnosed) was 12.9% for female dogs desexed at < 3 months and 5% for those desexed ≥ 3 months of age²⁵. This is an important issue because acquired urinary incontinence can be a life-long condition that can require daily medication. Urination inside

the house can be a reason for relinquishment of dogs to shelters^{1,25}. However, none of the female dogs with urinary incontinence in this study were relinquished to a shelter or given to another owner for any reason and their rate of euthanasia was not higher than the overall rate²⁵

It should be noted that while this study shows an association between age at desexing and urinary incontinence, other studies on female dogs give conflicting information ranging from a significant increase, to a reduced risk to no difference³ and for this reason further research is warranted in this area.

When should EAD be recommended?

Desexing cats and dogs at an early age is an appropriate strategy where the benefits of EAD outweigh any potential risks. However, the relative risks and benefits of EAD can vary depending on the context and whether individual animals or whole populations are being considered. For this reason, the following discussion examines the use of EAD in shelters and pounds separately from other contexts.

Shelters and pounds

The most effective way to ensure that animals adopted from shelters do not reproduce is to desex them prior to adoption. Programs where new owners are given vouchers to desex animals after adoption have historically shown poor compliance rates (estimated to be less than 60%)¹. Desexing all shelter animals also provides a positive psychological impact on shelter staff as they know that these animals will not contribute to the problem of unwanted animals.

It is not practical, nor in the best interests of these animals, to postpone desexing until puppies and kittens reach >5½ months of age. Animals desexed at a traditional age would spend a greater period of time in the shelter, increasing their risk of contracting disease, stress, and death and reducing their opportunities for socialisation with humans and conspecifics. In addition, due to the very high number of animals received annually, postponing desexing until the traditional age would significantly affect shelter capacity.

The available scientific evidence indicates that the potential medical risks posed by EAD are very low and are significantly outweighed by the benefits of EAD to puppies and kittens held in shelters. EAD thus appears to be the best available desexing strategy for male and female cats and dogs in shelters and pounds.

Other contexts

Extending EAD into private practice for privately owned animals and prior to any point of sale/adoption including pet shops and breeders has been suggested as a strategy to decrease the number of unwanted companion animals. This is examined separately for dogs and cats.

Cats

Based on the available evidence, EAD does not appear to be associated with an increased occurrence of any serious medical or behavioural conditions in either male or female cats compared to traditional age desexing. Indeed, EAD may offer additional behavioural benefits in male cats.

In cats, there is significant evidence of overpopulation of kittens contributing to the number of unwanted adoptable cats. There are insufficient homes available for the number of kittens born annually, leading to high euthanasia rates. Approximately 50% of cats entering shelters are kittens¹, suggesting that the indiscriminate breeding of cats is an issue that needs to be addressed to control the population entering shelters.

It has been suggested that performing EAD in private practice could help to reduce the number of unwanted kittens and cats entering shelters and pounds. However, this would depend to some degree on what proportion of unwanted cats come from the 'owned' cat population. It is clear that desexing prior to first oestrus means no unwanted pregnancies and that the current traditional age of desexing cats does not remove this risk. An EAD strategy that reaches cats that would otherwise become pregnant would reduce the number of kittens and cats entering shelters and pounds and thus reduce shelter euthanasia rates.

There are a number of reasons put forward to explain why shelters are still inundated with kittens despite a declining owned cat population¹³:

- 82-94% of the registered 'owned' cat population is desexed (exact number varies with the study referred to), however only 41% of the owned population is registered
- Only 7.6% of unregistered 'owned' cats are desexed
- Only 1.5% of 'semi-owned' cats are desexed
- Only 33% of cats under 6 months of age are desexed, and only 70% at 6 months of age
- 13% of female cats have had at least one litter before being desexed.

It appears that 'semi-owned' cats may contribute significantly to shelter admissions (40% of intake) with 22% of the Victorian population advising that they feed stray/semi-owned cats¹³. Therefore strategies may need to include programs to target this source of unwanted cats. Further research is required on semi-owned cats and to understand the psychology of those that feed them. Potential strategies to increase desexing of unowned cats, such as the Victorian-based 'Who's for cats' campaign, need further analysis¹³. The source of semi-owned cats is also relevant - if these cats originate from undesexed 'owned' cats, then desexing prior to acquisition of pet cats may also help to reduce the number of stray/semi-owned cats.

It is also important to consider that cats are wanderers and owners are unlikely to know when their cat has become sexually mature and is capable of conceiving (as early as 4 months of age). The high percentage of female cats having at least one litter before being desexed indicates the high risk of waiting to desex until the cat is >5½ months of age.

Strategies could also target the non-registered 'owned' cat population of which, according to one study, only 7.6% are desexed¹³. EAD may be an appropriate strategy for population control in areas where owned cats have been found, by independent research, to contribute significantly to shelter euthanasia rates¹². EAD prior to acquisition from pet shops and breeders may be one way of targeting this source of unwanted cats. However, if 41% of cats are acquired passively as strays or from friends, further strategies need to be implemented to ensure that these cats are desexed⁴⁰.

In terms of infectious disease transmission it is best to minimise stress, holding times and exposure to other animals in animal facilities if the kitten has not yet completed its vaccination course. Clearly in a shelter environment this is not an option. Very young kittens undergoing surgery in private practice may be at a slightly higher risk of contracting infectious disease if they have not achieved full immunity, but this potential risk must be balanced against the risk of unwanted pregnancy. Any infectious disease risk can be significantly minimised by management practices and tailoring the clinic vaccination protocol such that the kitten achieves full immunity at the earliest possible age. Any risk must also be balanced against the various benefits of EAD.

Dogs

Based on the available evidence, EAD does not appear to pose a higher risk of veterinary or behavioural problems in male or female dogs when compared to traditional age desexing, with the possible exception of the potential for a slightly increased risk of urinary incontinence in female dogs.

In the shelter environment, this potential risk is significantly outweighed by the benefits and necessity of EAD. However, for owned female dogs presenting to veterinarians in private practice, any concerns about urinary incontinence arising from EAD must be balanced against the risk of unplanned pregnancy in that individual animal.

As described for cats, very young puppies undergoing surgery in private practice may be at a slightly higher risk of contracting infectious disease if they have not achieved full immunity. However, this can be reduced by tailoring the clinic vaccination protocol such that the puppy achieves full immunity at the earliest possible age and ensuring high standards of clinical management.

Desexing male and female dogs at the traditional age (5½-6 months of age) is, in most cases, sufficient to remove any risk of unwanted pregnancies in dogs. Thus the key benefit of practising EAD in owned dogs is not to prevent first oestrus litters, but that it can be carried out at the breeder, before dogs are sold. Desexing rates for owned adult dogs are generally lower than those

for cats: one study of adult dogs and cats presented to Australian veterinary practices found that only 75% of dogs were desexed, compared to 96% of cats^{41,42}. This difference was mostly accounted for in a relatively low rate of desexing for male dogs (64%) compared to females (84%)⁴¹. A survey of dog owners in the Brisbane area found that 61% of male dog owners and 47% of female dog owners would not have had their dog desexed if it had not already been done at the time of acquisition¹.

These studies indicate that a strategy of EAD that targets male dogs prior to sale could significantly assist in raising the overall desexing rate. However, further research is required to determine the optimal age for desexing of female dogs which would minimise the risk of urinary incontinence while increasing overall desexing rates and further reducing unplanned pregnancies in female dogs¹⁶.

There is some debate over whether the issue of unwanted dogs is as strongly associated with desexing and unplanned breeding as it is in the case of cats. Behavioural problems, rather than over-supply, appear to be the main reason for relinquishment of dogs to shelters, but this may actually mask a true over-supply problem. While dogs are easily obtainable and therefore generally undervalued, because they have a higher profile in the community compared to cats it is easier to find homes for them. However, those owners may not be fully prepared for the responsibility of owning a dog or may obtain a dog for the wrong reasons, thus leading to relinquishment after the attractive 'puppy phase' has passed.

Conclusions

Based on the available scientific evidence and extensive RSPCA experience performing EAD, the RSPCA considers EAD to be a safe and effective strategy to prevent unintended litters.

RSPCA shelters routinely perform EAD for a number of important reasons. Desexing all puppies prior to rehoming ensures that animals adopted from RSPCA shelters do not contribute to the unwanted companion animal population. Reducing the number of unwanted animals may help to reduce the number of animals received by shelters and pounds and thus reduce euthanasia rates in shelters and pounds. EAD also ensures the efficient management of shelter animal populations. Safely desexing animals as soon as possible after entry to a shelter helps to maximise the potential to find them suitable homes and to minimise the time spent in the shelter environment. Efficient management and adoption of shelter animals also increases shelter intake capacity by enabling RSPCA shelters to accept more unwanted animals presented to them.

Importantly, EAD also provides significant animal welfare benefits relating to anaesthesia and surgery as well as long-term health and behavioural benefits (Table 4).

In shelter environments EAD of both cats and dogs (male and female) is justified, practical and often necessary. Any potential risk posed by EAD is significantly outweighed by the various benefits and necessity of EAD within the shelter environment.

For those animals that are not housed in shelters or pounds, the decision on whether to desex at an early age should follow the same process of weighing up the potential risks and benefits. By adopting vaccination protocols that aim for full immunity as early as possible, vets in private practice will be able to desex kittens and puppies safely earlier than the traditional age. Determining at exactly what point between 6-16 weeks of age an individual animal should be desexed will depend on the criteria set by the clinic and the circumstances in which the animal is presented.

In the case of cats, desexing prior to sexual maturity (<4 months of age) is recommended for all kittens in order to prevent accidental pregnancy. Desexing kittens at an even earlier age (but >6 weeks) is advisable where a litter of kittens is presented by the owner prior to sale, to remove any risk of accidental pregnancy post-sale. Desexing individual kittens at an earlier age is also advisable when they are presented by their new owner and there is a likelihood that they will not be presented again prior to sexual maturity.

In the case of dogs, both traditional and early-age desexing will prevent accidental pregnancy as they both occur prior to sexual maturity. The issue for vets in private practice is whether there is a risk that puppies presenting to private practice at an early age will not be presented again prior to sexual maturity. Where there is an opportunity to remove this risk, such as when a litter of puppies is presented by the owner prior to sale, EAD provides a safe and effective means to do this.

Table 4 Summary of the animal welfare benefits of EAD

Subject	Benefits:
Cats	<ul style="list-style-type: none"> • prevents unwanted/unplanned pregnancies thereby reducing the number of unwanted cats and kittens in the community and the number entering shelters and pounds thereby reducing euthanasia rates • the surgery is faster with less tissue trauma and the anaesthetic recovery and wound healing times are shorter providing significant animal welfare benefits • positive behavioural benefits particularly in male cats • positive health benefits including a reduced risk of mammary cancer in female cats • does not appear to be associated with an increased occurrence of any serious medical or behavioural conditions • allows shelters to re-home animals efficiently thereby maximising adoption rates and shelter intake capacity
Dogs	<ul style="list-style-type: none"> • prevents unwanted/unplanned pregnancies thereby reducing the number of unwanted cats and kittens in the community and the number entering shelters and pounds thereby reducing euthanasia rates • the surgery is faster with less tissue trauma and the anaesthetic recovery and wound healing times are shorter providing significant animal welfare benefits • positive health benefits including a reduced risk of mammary cancer in female dogs • allows shelters to re-home animals efficiently thereby maximising adoption rates and shelter intake capacity

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