

Early-age desexing of cats and dogs

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 around 5½ to 6 months of age (sometimes from 5 months of age), although this can vary between individual cats and dogs and according to breed. In contrast, EAD is defined as desexing between 6-16 weeks of age, although it is most commonly performed between 8-12 weeks of age. Some studies define EAD as desexing carried out before 5, 5½ or 6 months of age. In addition to age, bodyweight and general health are other major considerations 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 over-population: 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 over-population 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

For female cats desexing at the traditional age of 5½-6 months does not remove the risk of an unplanned litter, particularly first oestrus litters. Female cats can attain sexual maturity from as early as 4 months of age, well before the traditional desexing age. The cat gestation period is about 58-63 days which means that a cat can produce their first litter of kittens at 6 months of age (see Table 1). Male cats can attain sexual maturity from about 5 months of age so there is a risk that a male cat may be able to mate and sire an unplanned litter if desexed at the traditional age, particularly an early-maturing male cat (Table 1).

Male dogs can attain sexual maturity from about 4-5 months of age so there is a risk that a male dog may be able to mate and sire an unplanned litter if desexed at the traditional age. Female dogs can attain sexual maturity from about 4 months of age, with the average age of onset reported to be 6-10 months (Table 1), so there is a risk that a female dog may be able to mate and produce unwanted puppies particularly an early-maturing female dog. EAD removes any risk of unplanned litters that may not be prevented by traditional-age desexing.

From a veterinary perspective, desexing has historically been carried out at 5½-6 months 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 anaesthesia and 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 was generally 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 (e.g. Animal Welfare League) in Australia on dogs and cats that meet the relevant criteria¹. For example, at RSPCA shelters in NSW, animals must be 8 weeks of age, healthy, in good body condition, and close to 1 kg before being considered for EAD. For males it is also important to verify prior to the desexing procedure that both testes are in the scrotum as they can retract to the inguinal area or back into the inguinal canal or abdomen under general anaesthesia: if both testes cannot be palpated then desexing is delayed⁷.

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 generally achieve 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. Where early age desexing occurs in private clinics this is often when the owner is a breeder who specifically requests EAD, usually in order to protect their 'genetic lines', or if the clinic is located in a council area where desexing by 3 months of age is mandatory such as in some council areas in Victoria and in the Australian Capital Territory (for cats).

Table 1 Reproduction in the cat and dog^{6,8,9}

	Dog	Cat
Female - age at sexual maturity/first oestrus (heat)	Range 4 months to 2 years Average 6-10 months	Range 4-12 months
Male - age at sexual maturity	Range 4-5 months to 2 years	Range 5-12 months
Oestrous cycle in non- pregnant animals	Every 7 months on average (range every 5-8 months)	Every 4-30 days on average (14-19 days where day length 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	See oestrous cycle; pregnancy does not alter interval	7-9 days

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 in RSPCA shelters for the following reasons:

1. EAD is an effective strategy to prevent unwanted/unplanned litters 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. EAD reduces the amount of time young animals need to spend in the shelter environment (reduces the length of stay) which improves shelter efficiency in terms of resources and maximises the capacity to save lives. Reducing the length of stay also reduces the risk of animal illness (infectious disease).

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 will help to reduce the number of unwanted companion animals in the community and thus help to reduce the number of unwanted animals entering shelters and pounds. In turn, this will help to decrease euthanasia rates (particularly of cats) in shelters and pounds.

In the 2010-2011 financial year the RSPCA nationally received 64,617 cats, of which 37,177 (57.5%) were euthanased, and 67,573 dogs, of which 19,583 (29.0%) were euthanased¹¹. The number of homeless and unwanted pets in Australia is significant, with an estimated 250,000 cats and dogs euthanased annually in Australian shelters and pounds. The total figure is more likely to be between 300,000 to 400,000 per year, if pets with a good prognosis that are euthanased at the owner's request at veterinary practices are included. It is estimated that only approximately 10% of animals arriving at shelters are truly not rehomingable because they have a medical and/or behavioural condition which is not treatable and for animal welfare reasons they require euthanasia. Therefore, with sufficient and appropriate resources, it is estimated that approximately 90% of dogs and cats entering shelters could be treatable and rehomingable. Euthanasia of treatable and adoptable pets is a global problem, with similar statistics in the USA to those of Australia; euthanasia rates of 8-10 per 1000 human population occur in both countries^{12,46}.

EAD is particularly relevant to cats where an 'over-supply' appears to be a significant contributor to high euthanasia rates in shelters and pounds. For cats, there are insufficient homes available for the number of kittens born annually, leading to high euthanasia rates. Of the cats entering RSPCA shelters, slightly more than half are kittens, suggesting that the indiscriminate breeding of cats is an issue that needs to be addressed to control the population entering shelters. Despite the best efforts of shelters the euthanasia rate for cats is >50%, mainly due to a lack of resources and lack of available homes. Urgent action is required to reduce unacceptably high euthanasia rates of cats and kittens in Australia. While a similar number of cats and dogs are admitted to RSPCA shelters annually, cats are twice as likely as dogs to be euthanased. Approximately the same percentage of cats and dogs are rehomed; the difference in euthanasia rates lies in the reclaim rates, with very few cats reclaimed by original owners^{1,11,12,13,46,57}.

More than 50% of cats entering shelters are kittens; most are brought in by members of the general public either as strays or owner-surrendered cats. Of adult cats, approximately half are owner-surrendered and half are stray. **For kittens, 40% are surrendered by owners of the queen and 60% are stray.** In contrast to common perception of cats entering shelters, only a minority (10%) of cats are feral, and the vast majority are socialised to humans. Of adult cats surrendered by owners, the most common reasons are related to factors associated with the owner, predominantly accommodation issues, rather than cat-specific factors; behaviour and health together accounted for less than 10%. In contrast, **over 60% of kittens surrendered by owners were because there were 'too many' and they were 'unwanted'**. For both adult cats and kittens, behaviour was not a major reason given for relinquishment, but the behaviours causing problems were predominately unsocial and aggressive behaviour (40%) and inappropriate elimination (approximately 20%)¹².

Cats can become pregnant as early as 4 months of age⁶ and can produce their first litter at 6 months of age (around the time when they would be desexed traditionally). EAD enables cats to be desexed prior to sexual maturity thereby removing the risk of an unplanned litter (particularly first oestrous litters in female cats) and therefore reducing the number of unwanted kittens entering shelters and pounds annually. Data shows that 12-20% of owned queens that are ultimately desexed have a litter of kittens prior to being desexed. Another study found that only 33% of cats under 6 months of age are desexed and only 70% of cats are desexed at 6 months of age¹⁵. 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 produced¹⁵.

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, there are questions about whether the problem of 'over-supply' (more adoptable dogs available than homes available) is as much of an issue compared to cats. Approximately 10% of dogs entering shelters are puppies (versus ~50% of cats entering shelters being kittens). Most dogs entering shelters are aged from 6 months to 2 years of age indicating that they initially have a home. Therefore 'over-population' of dogs does not appear to be the major cause of the unwanted dog population. Behavioural issues, appear to be one of the primary reasons for the

unwanted dog population¹. However, this may mask a true ‘over-supply’ problem. While dogs are easily obtainable and therefore generally under-valued, and because dogs have a higher profile in the community compared to cats, it may be easier to find homes for puppies initially. 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.

The adverse psychological impact on shelter staff of high euthanasia rates of healthy unwanted companion animals is a serious issue¹. Compassion fatigue is a term used to describe secondary traumatic stress disorder amongst caregivers. In shelters, it is the cost of caring for animals that are suffering⁶³. Studies have revealed that 50% of shelter workers directly involved with euthanasia develop post-traumatic stress, predisposing them to depression, substance abuse, high blood pressure, sleeplessness and suicide. The health costs associated with these shelter workers has never been measured and data shows that the staff turnover rate in shelters is proportional to the euthanasia rate¹². EAD provides a proactive means of addressing the issue of unwanted companion animals and may help to alleviate compassion fatigue.

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 annually¹⁶. 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, exposure to other animals, stress, reduced immunity, 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 and therefore save more lives overall. 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.

A number of studies have compared the veterinary outcomes of EAD and traditional age desexing. These indicate that EAD may offer certain advantages related to surgery and anaesthesia, and health and behavioural benefits when compared to desexing at the traditional age.

There are a number of specific benefits relating to surgery and anaesthesia when desexing is carried out on younger patients (e.g. 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 although gentle handling of delicate paediatric tissues is required^{3,18}. Tissues are elastic with minimal fat with good exposure/visualisation resulting in less tissue trauma. Generally the surgical incision site is smaller and bleeding is reduced and minimal (good haemostasis), providing significant animal welfare benefits¹⁹.
2. It takes less time to prepare the animals for surgery and surgery is faster which means less time under general anaesthesia. The anaesthetic recovery and wound healing time is faster providing significant animal welfare benefits including less patient discomfort^{3,18,20,57}.
3. Lower morbidity. The incidence of peri-operative complications is low due to significantly shorter surgical and anaesthetic times²¹. One study showed that there were significantly less overall and minor complications in animals desexed at <12 weeks and 12-23 weeks of age compared to animals desexed at ≥24 weeks of age²⁰.
4. The enhanced response by younger patients to relatively low doses of anaesthetic agents means that less anaesthetic agent is required, which equates to a reduced cost per patient^{1,18,22}.

Table 2 Medical and behavioural benefits of general desexing¹⁷

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 (and therefore decreased risk-associated behaviour, e.g. less likely to become lost or be in a traumatic accident such as being hit by a car) • reduction of aggressive behaviour towards other male dogs
Female dogs	<ul style="list-style-type: none"> • prevention of mammary cancer (particularly if desexed prior to the first heat) • prevention of reproductive organ disease such as pyometra (life-threatening uterine infection) and ovarian and uterine 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 decreased risk-associated behaviour, e.g. less likely to become lost or be in a traumatic accident such as being hit by a car • reduction of risk of cat fight injuries and cat fight related diseases such as feline immunodeficiency virus (FIV) • reduction in urine spraying • reduction in aggression towards other cats • tends to increase affection towards people
Female cats	<ul style="list-style-type: none"> • prevention of reproductive organ disease such as ovarian cancer and uterine diseases • prevention of unwanted/unplanned pregnancies • prevention of potentially undesirable 'on heat' behaviours such as restlessness and being highly vocal • tends to increase affection towards people • prevention of mammary cancer

There are also major benefits associated with desexing prior to sexual maturity which also apply to animals desexed at an earlier age:

1. Desexing animals before they attain sexual maturity removes the risk of an unplanned litter (e.g. no risk of an unplanned first oestrus cycle litter in cats)^{18,23}.
2. Patients are not in heat or pregnant at the time of desexing, which simplifies the surgery. Desexing prior to first oestrus minimises the side effects (short-term) of desexing⁵⁹.
3. Desexing prior to first oestrus significantly reduces the risk of female dogs developing malignant mammary cancer:
 - Mammary tumours are the most common type of tumours in female dogs. Early desexing dramatically reduces the risk of dogs developing mammary neoplasia. The risk of developing malignant mammary tumours in dogs desexed prior to the first oestrus is reduced by 99.5% as compared to intact dogs. Approximately half of all canine mammary tumours are malignant, and desexing prior to first oestrus virtually eliminates any risk^{24,25,37,56}.
 - Desexing cats at an early age, especially before the first oestrus is also thought to have a sparing effect and reduces the risk of mammary tumour development, but the degree of protection is less precisely documented than that for dogs⁵⁸.

There is evidence of behavioural benefits resulting from desexing earlier than 5½ months of age:

1. One study found that hyperactivity was reduced in male and female cats that were desexed earlier than 5½ months of age. For male cats, the occurrence of abscesses, aggression toward vets, sexual behaviours, urine spraying and hyperactivity were also reduced²⁶. This study also found a reduction in asthma and gingivitis in cats desexed early.

2. Another study found that for dogs desexed earlier than 5½ months of age, separation anxiety, escaping behaviours, inappropriate elimination when frightened and relinquishment for any reason were decreased²⁷.

What are the common concerns about EAD and how valid are they?

Concerns regarding potential short-term risks

Some concerns have been raised regarding potential short-term risks associated with EAD. The following section examines the main areas of concern.

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^{3,20}. Advances in veterinary anaesthesia have also reduced anaesthetic risk.

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.

A prospective randomised study involving 775 cats and 1,212 dogs found that prepubertal desexing did not increase morbidity or mortality on a short-term basis compared with desexing at the traditional age²⁰. In fact with regard to short-term anaesthetic and surgical complications and post-operative (up to 7 days) complications this study 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. 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 techniques²⁰ (Box 1).

In another study 96 kittens were desexed between 6-14 weeks of age. There were no important anaesthetic complications, or complications during or after surgery. There were no deaths and the morbidity was negligible. The surgical wound infection rate was 0% and the study concluded that EAD of kittens is a low-risk procedure provided proper precautions and techniques are used⁵².

In 2009, the 3-day spay morbidity at the RSPCA Greater Manchester Hospital in the UK, defined as presentation at the hospital for a complication related to the desexing procedure within 72 hours of discharge, was less than 0.1% for EAD cats, which is directly comparable to figures for complications resulting from traditional age desexing at that hospital⁵⁰. Evidence-based studies on kittens following early desexing document shorter recovery times, lower morbidity and equivalent mortality rates compared with traditional-age desexing⁵⁰.

RSPCA shelters in Australia currently perform many thousands of EAD procedures every year. The Australian RSPCA experience with EAD is that the risk of anaesthetic and surgical complications is no different and possibly less than traditional age desexing. Current estimates in the veterinary anaesthesia literature suggest that approximately 0.1-0.2% of healthy dogs and cats die of an anaesthetic-related complication^{28,29}.

Box 1 Recommended Anaesthetic Protocol for EAD^{3,7, 22}

- House littermates together prior to surgery and as soon as can stand in recovery
- Minimal withholding of food preoperatively (varies 2-8 hours) with resumption of feeding as soon as standing or within 1-2 hours of surgery
- Reduced drug doses and careful titration of doses
- Reduce stress by using premedication and gentle handling
- Analgesia
- Maintenance of high heart rates and high respiratory rates
- Endotracheal intubation
- Oxygen supplementation with or without additional inhalant anaesthesia
- Peri-operative heating (prevent hypothermia)
 - Use heating pads or hot water bottles throughout general anaesthesia and recovery
 - Warm all prep solutions
 - Don't allow the coat to become wet
 - Avoid excessive clipping and excessive use of alcohol
 - Use small surgical incisions
 - Reduce prep, surgical and anaesthesia time
- 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

2. Infectious disease

Some concerns have been raised that EAD may be associated with an increased incidence of infectious disease.

In the shelter context, the length of stay (period of time the animal is under the shelter's care, from intake to exit) has been clearly identified as a major risk factor for animal illness such as infectious disease in shelters^{7,31}. EAD enables shelters to rehome animals from the shelter efficiently which in turn reduces the length of stay for animals. Therefore EAD actually helps to reduce the risk of infectious disease in the shelter context.

Control of infectious diseases has improved greatly in recent years³. Infectious disease transmission is a risk in shelter environments, however, effective animal health and infectious disease prevention management practices significantly minimises any risk in the shelter context. Practices that help to minimise infectious disease risk include veterinary health assessment and vaccination on entry; isolation/quarantine areas; efficient rehoming to reduce length of stay and facility and sanitation protocols. Protocols should be arranged so that movement through the shelter and cleaning proceed from the areas housing those animals that are most susceptible to disease and/or the healthiest animals to those who are most likely to be the source of contagious disease^{7,31}. Ensuring animals are in the best physical health possible and minimising stress while in the shelter can also reduce risk of infectious disease²⁰.

While one study found that the incidence of infectious disease, in particular, parvovirus in puppies, was increased in animals desexed early, these animals were in a shelter environment and results were likely influenced by holding times in the shelter and increased exposure to other animals^{1,30}. A further study under controlled conditions showed no association with an increase in infectious disease and EAD¹. A study

of 1660 cats (47 month median follow-up) demonstrated that those cats desexed <5½ months of age were no more likely than those desexed at >5½ months of age to have any conditions that were apparently associated with long-term immune suppression (age range at desexing: 6 weeks - 12 months). EAD cats had a lower incidence of gingivitis, a condition that may be associated with immune suppression^{26,36}.

In non-shelter contexts such as private practice where early age desexing would be an elective procedure, veterinarians can tailor the vaccination protocol to ensure animals are up-to-date with their vaccination status prior to their admission for desexing. For example, for a kitten the process could be to vaccinate, re-vaccinate and then desex⁵⁷.

Concerns regarding potential long-term risks

Some concerns have been raised regarding potential long-term medical and behavioural risks 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 examines the main areas of concern.

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 dogs³². It is important to note that behaviour can be influenced by a combination of factors such as genetics (inheritance), life experiences and the environment.

One study compared the behavioural outcomes of kittens desexed at 7 weeks, desexed at 7 months and left intact, and found no statistical difference between each group in activity levels, playfulness, excitement, or frequency of vocalisation³³. Another long-term cohort study involving 263 cats compared the behaviour of cats that were desexed at the traditional age (≥ 24 weeks old; median 51 weeks; range 24-390 weeks) and prepubertal (<24 weeks old; median 9 weeks; range 6-22 weeks) during a median follow-up period of 37 months. Compared with traditional-age desexing, prepubertal desexing did not result in an increased incidence of behavioural problems and the study concluded that prepubertal desexing may be performed safely in cats without concern for increased incidence of behavioural problems for at least a 3-year period after desexing (the follow-up period for this study)⁴².

One retrospective cohort study involving 1660 cats evaluated the long-term risks and benefits of EAD compared with traditional age desexing. The study found that desexing at <5½ months was associated with decreased occurrence of hyperactivity and increased occurrence of shyness around strangers. Among male cats, EAD was associated with reduced occurrence of abscesses, aggression toward vets, sexual behaviours and urine spraying was reduced among male cats that underwent EAD. Hiding appeared to be increased compared with male 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^{1,26}. The study concluded that EAD before 5½ months of age was not associated with increased rates of death or relinquishment or occurrence of any serious behavioural condition in cats²⁶.

A retrospective cohort study involving 1842 dogs evaluated the long-term risks and benefits of early age desexing compared with traditional age desexing. All study dogs had been desexed between 6 weeks and 12 months of age. 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 decreased²⁷.

Another long-term cohort study involving 269 dogs which were divided into two groups based on the estimated age at desexing: traditional age (≥ 24 weeks old; median 52 weeks; range 24-280 weeks) and prepubertal (<24 weeks old; median 10 weeks; range 6-22 weeks). Prepubertal desexing did not result in an increased incidence of behavioural problems, compared with traditional-age desexing, during a median follow-up period of 48 months after desexing. The study concluded that prepubertal desexing may be safely performed in dogs without concern for increased incidence of behavioural problems during at least a 4-year period after desexing³⁰.

In a 15-month study, dogs were desexed at 7 weeks, 7 months and left intact and the effects of EAD on behavioural development were investigated. Seven behavioural characteristics were assessed including excitability, general activity, barking, playfulness, aggression toward other dogs, affection toward people, and outgoing nature. Excitability and general activity were the only behavioural characteristics that were significantly different among treatment groups. Dogs desexed at 7 weeks or 7 months scored higher for general activity compared to intact controls and male dogs desexed at 7 weeks scored higher for excitability compared to intact male controls. This study concluded that with respect to behavioural development, the effect of desexing pups at 7 weeks of age was similar

to desexing pups at 7 months of age³⁴.

Some concerns have also been raised about prepubertal desexing and possible retention of juvenile behaviours (e.g. playfulness, curiosity). While some anecdotal reports suggest that dogs and cats desexed prepubertally may be more likely to maintain juvenile behaviours and be more difficult to train, scientific evidence suggests the contrary²². A comparison of cats desexed before or after 24 weeks of age and adopted from a shelter showed no difference in urinary or aggressive behaviours according to their owners, who were unaware of the age at which the cat had been desexed. Rate of retention of cats in adoptive households did not differ between the groups. Groups of dogs desexed at 7 weeks of age or 7 months of age and trained as disability service dogs were reported to be equally likely to succeed in training; prepubertally desexed dogs had a higher success rate in becoming guide dogs compared to littermates desexed at the traditional age²².

If evidence is found that early-age desexing does increase the likelihood of retained juvenile behaviours then it may be argued that retention of puppy and kitten behavioural traits such as playfulness may actually be desirable for some pet owners.

The clinical significance of performing EAD during the critical socialisation period (3-17 weeks of age) and the fear imprinting period (7-9 weeks of age) is currently unknown and further research may be warranted in this area.

2. Musculoskeletal development

Desexing in general (both traditional age and EAD) appears to delay physeal (growth-plate) closure in both cats and dogs. The mechanism appears to be that physeal closure is dependent on gonadal steroids and the reduction of hormones after desexing results in a delay in physeal cartilage maturation and later physeal closure. It has been demonstrated that increased limb length in desexed dogs compared to intact dogs was not due to increased growth rate but rather to delay in physeal closure³⁴. Concerns have been raised about whether delayed physeal closure might increase the risk of musculoskeletal problems (e.g. fractures, angular limb deformities, hip dysplasia etc.) and whether EAD might further increase any risk.

A prospective controlled study examined the effect of EAD on physical and behavioural development in cats by comparing cats that were desexed at 7 weeks, desexed at 7 months and intact cats. No differences were found between the two groups of desexed cats for any of the study variables (including skeletal development). Closure of the distal radial physis was similar in those cats desexed at 7 weeks and 7 months of age. Distal radial physeal closure was delayed significantly in both groups of desexed cats compared to the intact cats, however, the mature radius length did not differ significantly statistically between the groups. The study concluded that desexing cats at 7 weeks of age had similar effects on physical development compared with desexing at the more traditional age of 7 months³⁵.

Another study examined the time of closure of the proximal and distal radial physes, radial length and the age and radial length at the time of the growth plateau (when bone length no longer increases significantly) in cats. Male and female cats were desexed at 7 weeks, 7 months, or left intact. For male cats the time of proximal radial physeal closure did not differ between groups. Female cats desexed at 7 weeks had delayed proximal radial physeal closure compared to those desexed at 7 months or left intact (no clinical significance of this has been demonstrated - see below). In both males and females desexed animals had delayed closure of the distal radial physis compared to intact animals. Age at desexing had no effect on distal radial physeal closure⁵³. This study also found that radial length at 24 months of age differed by groups for both males and females, with mean final radial length in desexed males 13% greater than in intact males, and mean final radial length in desexed females 9% greater than in intact females. Age and radial length at the growth plateau were also significantly greater in desexed animals compared to intact animals. Age at desexing had no effect on age and radial length at time of growth plateau. The study concluded that delay in physeal closure and possible subsequent predisposition to Salter-Harris fractures, were not different in cats desexed at 7 weeks or 7 months of age⁵³.

The available evidence provides conflicting information regarding the clinical relevance of delayed physeal closure. Studies report that no clinical relevance of delayed physeal closure has been demonstrated^{26,50}, but that it does not appear to render the growth plates more susceptible to injury³⁶. Other studies in cats suggested four risk factors for spontaneous femoral capital physeal fractures in cats older than 1 year: gender and reproductive status, delayed physeal closure and abnormally high body weight. These studies suggest that obese desexed male cats appear to be predisposed to femoral capital physeal fractures, however, the studies did not report any distinction between EAD (6-16 weeks) and general desexing and the risk of fractures. One of the studies reported that one of the affected cats was a 24-month-old intact male, therefore a prolonged growth phase caused by desexing cannot explain this lesion in all cases^{60,61,62}. Furthermore, it is important to recognise that desexing at 7 weeks and 7 months have both been shown to delay physeal closure and the delay appears to be similar between early and traditional age desexing (with the possible exception of the proximal radial physis in female cats).

Therefore, if delayed physeal closure does increase the risk of spontaneous femoral capital physeal fractures, any potential risk may be similar for cats desexed at 7 weeks and those desexed at the traditional age. Importantly, population studies provide no association between age at desexing and incidence of fractures in either cats or dogs⁵⁶. A long-term study of 263 cats found no differences in the incidence of musculoskeletal problems between animals desexed at a traditional age or at an early age⁴². In another long-term study of 1660 cats, the age at desexing was not associated with the frequency of long bone fractures²⁶.

A 15-month study examined the effects of prepubertal desexing on skeletal development in 32 dogs assigned to three groups, those desexed at 7 weeks, 7 months and left intact. Physeal closure was delayed in all desexed dogs compared to those left intact: the delay was longer in dogs desexed at 7 weeks compared with dogs desexed at 7 months. Rate of growth was unaffected by desexing but the extended growth period resulted in greater final radial/ulnar length in dogs desexed at 7 weeks. The study concluded that with respect to skeletal development the effect of desexing pups at 7 weeks was similar to that of desexing pups at 7 months³⁴. Further, in a long-term study of 1842 dogs (desexed between 6 weeks and 12 months of age), age at desexing was not associated with the frequency of long bone fractures²⁷.

A cohort study was undertaken to determine long-term results and complications of desexing performed at an early age or at the traditional age in dogs. The study involved 269 dogs which were divided into two groups based on the estimated age at desexing, traditional age (≥ 24 weeks old; median 52 weeks; range 24-280 weeks) and prepubertal (< 24 weeks old; median 10 weeks; range 6-22 weeks)³⁰. Prepubertal desexing did not result in an increased incidence of problems associated with any body system, compared with traditional-age desexing during a median follow-up period of 48 months after desexing. A difference between age groups was not reported for overall incidence of musculoskeletal system problems or incidence of hip dysplasia. Concerns that prepubertal desexing would result in increased incidence of musculoskeletal disorders or hip dysplasia were not supported by the results of this study. It has been speculated that delayed physeal closure and the subsequent increased long bone growth (and decreased muscle mass, in the absence of testosterone) seen in dogs desexed at an early age might predispose these dogs to hip dysplasia or angular limb deformities. Hip dysplasia was diagnosed infrequently in dogs in this study, and of those that were affected, most dogs did not require medical or surgical treatment. No difference was seen between age groups in the incidence of hip dysplasia. Angular limb deformities were not observed in dogs in this study. It is also important to note that the rate of retention in the original adoptive household was the same for dogs that underwent prepubertal desexing as those that underwent traditional-age desexing³⁰.

While this study found no association between age at desexing and the incidence of hip dysplasia³⁰, another study found an association between age at desexing and hip dysplasia²⁷. Dogs desexed before 5½ months of age had a 6.7% incidence of hip dysplasia, whereas dogs desexed at $\geq 5\frac{1}{2}$ months 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 desexed at the traditional age were three times more likely to be euthanased due to hip dysplasia. If desexing prior to 5½ months does increase the incidence of hip dysplasia, the authors suggested that it may be a less severe form²⁷. When assessing hip dysplasia risk it is important to recognise that hip dysplasia is considered to be a multifactorial condition involving multiple genes interacting with the environment. Known and presumptive environmental factors appear to affect its expression with both diet and exercise having been implicated as significant environmental effects⁵⁴.

3. Obesity

As with hip dysplasia, obesity is a multifactorial condition influenced by a number of factors such as diet, activity level and genetics. Desexing in general may predispose toward obesity (evidence for cats but conflicting information on whether dogs are more likely to experience weight gain after desexing⁵⁶). However, there is no evidence that EAD increases any risk³.

Metabolic rate has been shown to decrease in cats after desexing⁵⁰. A study comparing cats desexed at 7 weeks, 7 months and left intact found that bodyweight did not significantly differ between the two desexed groups, but those cats desexed at 7 months were significantly heavier than intact animals. Desexed cats had significantly greater falciform fat thickness than intact animals, however there was no significant difference between the two desexed groups³³. Longer term studies found no association between age at desexing and obesity^{26,42}.

A study of dogs comparing those desexed at 7 weeks, 7 months and left intact found no difference in obesity rates³⁴. A long-term study also found that for male and female dogs desexed early ($< 5\frac{1}{2}$ months), obesity was decreased²⁷.

Diabetes

Desexed cats have a two to nine fold increased risk of developing diabetes mellitus than sexually intact cats⁵⁶ although no correlation between timing of desexing and risk of developing diabetes mellitus has been identified. Other risk factors are important such as breed, gender and increasing age⁵⁰.

4. Neoplasia (cancer)

It is important to note that one of the major benefits of desexing is the reduced risk of neoplasia associated with the reproductive organs such as testicular, uterine and ovarian cancer, regardless of whether the procedure occurs prepubertally or at an older age. In addition, desexing dogs prior to the first oestrus significantly decreases the risk of developing malignant mammary tumours (risk reduced by 99.5% compared to intact females)³⁷. Desexing cats at an early age, especially before the first oestrus also has a sparing effect and reduces the risk, but the degree of protection is less precisely documented than that for dogs. Benign tumours of the feline mammary gland are relatively infrequent and account for only ~10% of these tumours⁵⁸ (i.e. the majority of feline mammary tumours are malignant). One study found that female cats desexed prior to 6 months of age had a 91% reduction in the risk of mammary carcinoma development compared with intact cats. Those desexed prior to 1 year had an 86% reduction in risk. Those desexed between 13 and 24 months of age had an 11% risk reduction and after 24 months there was no benefit⁵¹.

A study examining the relationship between endogenous sex hormones and bone sarcoma genesis found that male and female Rottweilers desexed at <1 year of age were significantly more likely to develop bone sarcoma than intact dogs. There was a highly significant inverse dose response relationship between duration of lifetime gonadal exposure and incidence rate of bone sarcoma. This suggests that desexing in general, rather than EAD specifically, increases the risk of osteosarcoma in Rottweilers. However, desexed female and male dogs lived longer than sexually intact dogs in this cohort study which, the authors suggest, might be expected to contribute to a higher overall cancer incidence associated with desexing. The study did not find a statistically significant difference in the overall cancer incidence rate in desexed male or female dogs compared with intact dogs³⁸.

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. When assessing the benefits of EAD against any risk it is important to consider risk of neoplastic disease across all body systems.

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 females³⁴. 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 and those desexed at 7 months of age³⁴.

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 unknown³⁹. Another study comparing cats desexed at 7 weeks, 7 months and left intact found that the penis of each male cat in all three groups could be completely exteriorized at 1 year of age. Subjectively, penile spines were absent in those desexed at 7 weeks, atrophied in those desexed at 7 months and fully developed in intact cats³³. The authors suggest that even if early-age desexing results in anatomic differences in the penis, these changes do not appear to lead to an increase in the incidence of feline lower urinary tract disease (FLUTD) or urinary obstruction. They conclude that concerns about these conditions should not be used as a reason to delay castration of male cats²⁷.

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 using cystourethrography found that there was no significant difference between the pre-prostatic and penile urethral diameter in desexed male cats compared to intact males³⁹. The author added that the site of urethral obstruction in male cats has been reported as the urethra at the ischial arch or the distal penile urethra. Diameter of the urethra at the level of the ischial arch was not evaluated in this study due to poor urethral filling caused by the normal narrowing present at the mid-pelvic urethra. This study also indicated that the findings suggested that the development and maturation of the urethra of male cats over the time of puberty does not appear to be dependent on testosterone³⁹.

Another study examined the effect of early castration on the urethra of 30 male cats histologically which were divided into three groups: intact, castrated prepubertally at 5 months of age, and castrated at 5 months and subsequently treated with testosterone. This study did not find any significant difference in urethral circumference between these three groups at three points along the urethra (distal and proximal to the os penis)⁴⁰.

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 age⁴¹. The number of animals in these studies are small compared to other studies.

Another study was performed to determine the effect of EAD on skeletal, physical, and behavioural development of the domestic cat. Thirty-one domestic shorthaired cats were randomly divided into three groups: desexed at 7 weeks of age, 7 months of age, and left intact. Urethral pressure profiles were performed and the maximal urethral pressure (MUP), maximal urethral closure pressure (MUCP) and functional urethral pressure length (FUL) determined. Positive contrast retrograde urethrograms were used to measure urethral diameter (UD) in the male cats. There were no statistically significant differences amongst the three treatment groups in MUP, MUCP, FUL and UD. There were no statistically significant differences between desexed cats for any parameter measured. It was concluded that desexing at 7 weeks of age and 7 months of age had similar effects on skeletal, physical, and behavioural development in the domestic cat⁵⁵.

Another study examined the urethral diameters of female cats desexed at 7 weeks, 7 months and left intact and 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 present³⁹.

In a recent retrospective cohort study evaluating the long-term risks and benefits of EAD involving 1660 cats no association was found between the age of desexing (age range at desexing: 6 weeks to 12 months) and the occurrence of urethral obstruction in male cats²⁶.

Another cohort study examining long-term results and complications of desexing performed at an early age (<24 weeks of age; median 9 weeks; range 6-22 weeks) or at the traditional age (≥24 weeks; median 51 weeks; range 24-390 weeks), involving 263 cats from animal shelters over a three year follow-up period, did not find an association with urinary obstruction and EAD. Within 3 years of surgery, two male cats developed urethral obstruction: both were in the traditional-age desexed group. None of the 70 males that underwent prepubertal desexing had obstructive episodes⁴².

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; median 51 weeks; range 24-390 weeks) had more urinary system problems in comparison to cats desexed at <24 weeks of age (median 9 weeks; range 6-22 weeks). Cystitis was the most common problem seen. Concerns that prepubertal desexing would result in increased incidence of feline idiopathic lower urinary tract disease and potential urethral obstruction in male cats were not supported by the results of this study. Cats that were desexed at the traditional age appeared to be at increased risk for urinary tract problems (including cystitis). This study suggested that desexing at an early age may result in some other unidentified protective effect on the urinary tract^{1,42}.

In a recent retrospective cohort study evaluating the long-term risks and benefits of EAD involving 1660 cats, no association was found between the age of desexing and the occurrence of feline lower urinary tract disease²⁶.

c Cystitis in dogs

One study found an association between age at desexing and cystitis. Cystitis was more common in those dogs desexed at <5½ months of age. However, none of these dogs had more than two episodes of cystitis so this does not appear to reflect a chronic susceptibility²⁷. Furthermore, cystitis is usually easily treated with a course of antibiotics and generally does not have any long-term consequences.

d Urinary incontinence in female dogs

Desexing in general has often been associated with an increased risk of developing urinary incontinence at some stage in life and this is supported by a number of studies. The incidence of urinary incontinence due to desexing varies between 3% and 21% in different studies⁵⁶. Urinary incontinence after desexing can occur immediately or up to 10 years after surgery with approximately 75% of dogs with urinary incontinence becoming incontinent within 3 years after desexing⁴⁷. In the majority of cases the cause for urinary incontinence after desexing is a reduction in the urethral closure pressure⁴⁸. It has been suggested that prepubertal desexing may result in an increased 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. In considering urinary incontinence risk it is important to note that the risk of urinary incontinence is also influenced by factors such as body weight and breed. It has been reported that desexing after first oestrus only slightly reduces the risk of urinary incontinence, however, there is a greater surgical risk due to bleeding and the risk for mammary neoplasia is increased⁵⁹.

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 age²⁷. 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^{1,27}. Once an animal is formally owned by a responsible and caring person, it is important to maintain and enhance the pet-owner bond and prevent relinquishment of the animal. It is important to note that 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 rate²⁷.

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 difference and for this reason further research is warranted in this area³.

A recent systematic review evaluating the strength of evidence for an association between desexing, age at desexing and urinary incontinence in female dogs identified seven relevant studies: four were judged to be at high risk of bias. Of the remaining three studies (which were judged to be at moderate risk of bias), there was some weak evidence that desexing, particularly before the age of three months, increases the risk of urinary incontinence. There was no direct evidence found in the review that the occurrence or absence of oestrous before desexing plays a role in the aetiology of urinary incontinence. The authors recommend that the information obtained should be balanced with other available information on the risks and benefits of desexing and that further research on the association between urinary incontinence and desexing should focus on recording age, breed and tail docking as potential confounders. They also suggest that occurrence of oestrous before desexing should be recorded and studies should ideally include dogs desexed at a wide range of ages⁶⁴.

One study suggested that to reduce the potential risk of urinary incontinence in female dogs, delaying desexing until at least 3 months of age may be beneficial²⁷. Delayed desexing is also indicated if juvenile vaginitis, infantile vulva, or urinary incontinence are present³.

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. 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 and do not contribute to the unwanted companion animal population 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 thereby helping to alleviate compassion fatigue.

It is not practical, nor in the best interests of shelter animals to postpone desexing until puppies and kittens reach 6 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 efficiency and capacity.

The available evidence indicates that the benefits of EAD in shelter contexts far outweigh any potential risks. EAD is 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. EAD of animals in non-shelter contexts should undergo the same process of weighing up the benefits against any risks. This is examined separately for dogs and cats.

Cats

EAD does not appear to be associated with an increased occurrence of any serious short-term or long-term (medical or behavioural) problems in either male or female cats compared to traditional age desexing. In fact, EAD of cats is associated with health and behavioural benefits. In addition, urgent action is required to reduce unacceptably high euthanasia rates of cats and kittens in Australia. EAD offers an effective strategy to combat the unwanted cat population as it enables cats to be safely desexed prior to sexual maturity thereby removing the risk of an unplanned litter. The current traditional age of desexing cats does not remove this risk as cats can achieve sexual maturity prior to desexing.

Any concerns about infectious disease transmission in non-shelter contexts can be addressed by tailoring the clinic vaccination protocol to ensure kittens are up to date with their vaccination status prior to desexing and by ensuring high standards of clinical management.

Strategies to prevent unwanted kittens from owned queens

EAD of owned cats by veterinarians is critically important to reduce the number of unwanted kittens from the owned cat population entering shelters and pounds each year. In cats, there is significant evidence of overpopulation of kittens contributing to the number of unwanted cats. There are insufficient homes available for the number of kittens born annually, leading to high euthanasia rates (>50% cat euthanasia rate)^{1,46,57}.

Of the cats entering RSPCA shelters, slightly more than half are kittens, suggesting that the indiscriminate breeding of cats is an issue that needs to be addressed to control the population entering shelters. **40% of these kittens are surrendered by owners of the queen** (which may be an underestimate⁴⁶) and 60% of kittens are stray. Over 60% of kittens surrendered by owners were because there 'were too many' and they were 'unwanted'. The Queensland Household Survey found 94% of owned cats were desexed; in Sydney desexing rates were reported to be approximately 97%. If that is the case then the question arises: how could 40% of kittens be coming from the owned cat population? One explanation, shown by data from Australia and the US, is that 12-20% of owned queens that are ultimately desexed have a litter of kittens prior to being desexed. Significantly, research shows that the number of kittens born from cats that were ultimately desexed was calculated at only slightly less and

not statistically different from those that were never desexed (2.5 versus 3.4)¹². Vets play a critical role in preventing these 'pre-desexing' litters. Furthermore, a study in the UK found that up to 70.5% of litters may be unplanned for owned cats⁴⁹. Another study found that only 33% of cats under 6 months of age are desexed and only 70% of cats are desexed at 6 months of age¹⁵.

Another additional reason to explain this discrepancy could be that desexing rates may vary and the high desexing rates mentioned above may not accurately reflect all situations. A national study found that of the cats that were owner-surrendered to RSPCA shelters, just under 50% were categorised as desexed prior to admission. This indicates that there may be something different about the population of cats admitted to shelters and the people who own them, compared to cat owners in the community that do not surrender their pets⁴⁶. The 'Who's for Cats' report also states that while 82-94% of the 'registered' owned cat population is desexed (depending on the study referred to), only 41% of the owned population is registered and only 7.6% of 'unregistered' owned cats are desexed (59% of owned cats are not registered in Victoria)¹⁵.

An EAD strategy that reaches owned cats that would otherwise become pregnant or sire a litter would reduce the number of kittens and cats entering shelters and pounds and reduce shelter euthanasia rates. There is an urgent need to reduce the 'spay delay' in the owned cat population which is a likely contributor to unwanted kittens. It is clear that desexing prior to sexual maturity means no unwanted pregnancies (particularly no unplanned first oestrus litters) and that the current traditional age of desexing cats does not remove this risk, female cats can achieve sexual maturity well before the traditional desexing age for cats. There are a number of significant ways vets can help to reduce the number of unwanted owned kittens:

- 1. Desexing owned male and female kittens early (≤ 4 months of age) by incorporating desexing into the initial preventative health program, e.g. vaccinate, re-vaccinate and then desex⁵⁷ thereby removing any risk of unplanned pregnancy. A report from the UK RSPCA supports this and suggests that for owned cats, given that early desexing is an elective surgical procedure, kittens should be vaccinated prior to admission for surgery and hence desexed from 12-16 weeks⁵⁰.**
- 2. Desexing owned male and female kittens at an even earlier age (but >6 weeks of age) where a litter of kittens is presented by the owner prior to their sale, thereby removing any risk of an unplanned litter post-sale. One study found that 41% of cats are acquired passively as strays or from friends, so while desexing kittens prior to their sale will significantly assist in reducing the unwanted cat population, EAD of owned cats (that were not desexed prior to sale) is equally important⁴³.**
- 3. Educating cat owners not to allow their cat to produce a litter before being desexed.**
- 4. Educating cat owners that cats can become pregnant as early as 4 months of age.**

For this to occur effectively, professional veterinary bodies in Australia will need to embrace EAD of kittens and universities will need to train veterinary students in EAD. Animal welfare organisations will need to partner with universities in the training of veterinary students in EAD (this already occurs in some states). Universities will also need to partner with shelters to increase awareness among veterinary students of the magnitude of the challenges facing shelters and the scale of the unwanted companion animal population (estimated to be 300,000-400,000 animals per year), for example by providing the opportunity for a shelter rotation for *all* veterinary students, especially in later years of the veterinary course¹². These opportunities will teach veterinary students about the critical and specific role private practice vets in play in reducing the number of unwanted cats.

The source of stray and semi-owned cats is also relevant, if a proportion of these cats originate from non-desexed 'owned' cats, then EAD of owned pet cats may also help to reduce the number of stray/semi-owned cats overall, in combination with other targeted strategies.

Dogs

Based on the available evidence, EAD does not appear to pose a higher risk of medical or behavioural problems in male or female dogs when compared to traditional age desexing, with the possible exception of a slightly increased risk of urinary incontinence in female dogs and (according to one study only) possibly a slightly increased risk of mild hip dysplasia. In the shelter context, any potential risk is significantly outweighed by the benefits and necessity of EAD. However, for owned female dogs presenting to veterinarians in private practice, vets should weigh up the benefits against any risks for each individual dog on a case-by-case basis.

Benefits of EAD include animal welfare advantages related to anaesthesia and surgery and removing the risk of an unplanned litter that may not be prevented by traditional-age desexing. In addition, EAD provides an opportunity to prevent unplanned litters that may otherwise occur post-sale. For example, where there is a risk that puppies presenting in private practice at an early age will not be presented again prior to sexual maturity, EAD may be carried out while puppies are owned by the breeder, before the dogs are sold thereby preventing unplanned litters post-sale. Vets may also consider EAD of individual dogs when they are presented by their new owner as part of the initial preventative health program, provided the benefits outweigh any risks.

As described for cats, any concerns about infectious disease transmission in non-shelter contexts can be addressed by tailoring the clinic vaccination protocol to ensure puppies are up to date with their vaccination status prior to desexing and by ensuring high standards of clinical management. Once an animal is formally owned by a responsible and caring person, it is important to maintain and enhance the pet-owner bond and prevent relinquishment of the animal. Applying the precautionary principle for urinary incontinence, studies suggest that for owned female dogs, delaying desexing until at least 3 months of age may be beneficial and delaying if juvenile vaginitis, infantile vulva or urinary incontinence is present.

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 of cats and dogs.

RSPCA shelters routinely perform EAD for a number of important reasons. Desexing all animals 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 will help to reduce the number of animals received by shelters and pounds and thus reduce euthanasia rates in shelters and pounds¹⁴. 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 animals suitable homes and to minimise the time spent in the shelter environment which is not ideal. Efficient management and adoption of shelter animals also increases shelter intake capacity by enabling RSPCA shelters to accept more unwanted animals presented to them and therefore save more lives overall.

Importantly, EAD also provides significant animal welfare benefits relating to anaesthesia and surgery as well as some 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 a necessity. The benefits of EAD in the shelter context far outweigh any potential risk. RSPCA shelter staff are fully trained and competent in EAD which further reduces any potential risks significantly.

For those animals that are not housed in shelters or pounds, the decision about whether to desex at an early age should follow the same process of weighing up the benefits against any potential risks. By adopting vaccination protocols that ensure the animal is up-to-date with their vaccination status prior to desexing, vets in private practice will be able to reduce risk of infectious disease. Where EAD is considered appropriate for an owned animal, determining at exactly what point between 6-16 weeks of age an individual animal should be desexed will depend on the opinion of the attending veterinarian, the criteria set by the clinic and the circumstances in which the animal is presented.

In the case of **cats** in non-shelter contexts, desexing prior to sexual maturity (≤ 4 months of age) is recommended for all kittens (male and female) in order to prevent unplanned litters. Desexing kittens at an even earlier age (but >6 weeks) is advisable where a litter of kittens is presented by the owner/breeder prior to sale, to remove any risk of unplanned litters post-sale. EAD of individual kittens is also advisable when they are presented by their new owner as part of the initial preventative health program.

In the case of **dogs** in non-shelter contexts, early-age desexing will remove any risk of unplanned litters that may not be prevented by traditional-age desexing. EAD provides an opportunity to prevent unplanned litters that may otherwise occur post-sale for example when a litter of puppies is presented by the owner prior to sale. Vets may also consider EAD of individual owned dogs when they are presented by their new owner as part of the initial preventative health program provided the benefits outweigh any risks.

Table 4 Summary of the animal welfare benefits of EAD

Subject	Benefits:
Cats	<ul style="list-style-type: none"> • prevents unplanned litters 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 rehome animals efficiently thereby reducing risk of infectious disease and maximising shelter capacity to save lives
Dogs	<ul style="list-style-type: none"> • prevents unplanned litters reducing the number of unwanted dogs and puppies 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 rehome animals efficiently thereby reducing risk of infectious disease and maximising shelter capacity to save lives

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