



An Up to Date Guideline for Management and Prevention of Dog and Cat Bite – A Literature Review

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Authors' contributions

This work was carried out in collaboration among all authors. Author MMH literature search, review articles, writing manuscript, edit and revise manuscript. Author MTM edit manuscript. Author AS idea about the topic, edit manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: The prevalence of animal bites is high, of which the vast majority are from cats' and dogs'. There is a wide variation in severity of such bites from mild to lethal. The evidence in the literature with respect to management does not provide a solid ground on which such cases could be managed. Dog and Cat bites are more common and can have dramatic consequences especially for children.

Objective: This project is to identify current evidence in the literature on epidemiology, management and prevention of dog and cat bites. This review is aimed at clinicians who deal with dog and cat bites. The basic principles of wound management and indications for use of antimicrobials, tetanus and rabies prophylaxis as well as preventive education are the primary focus of this article to help the clinicians. This aims at updating the management of patients who sustain a dog or a cat bite.

Materials and Methods: A literature review on the management of animal bites was performed. UK NICE guidelines, University of Texas bites management guidelines, WHO rabies prophylaxis protocol, UK Green Book and infectious diseases text books also reviewed.

Results: The available data in the literature suggest that appropriate wound management is the most important factor for prevention of infection in dog and cat bites. Antibiotic prophylaxis should only be given in high-risk wounds and primary closure should be performed in low-risk wounds.

Conclusions: Proper assessment and wound care are the prime consideration for dog and cat bites management.

Keywords: Dog bites; cat bites; dog and cat bites; animal bites; management; education.

1. INTRODUCTION [1-10]

People are increasingly keen on pet keeping, especially cats and dogs.

According to American Pet Products Association (APPA) National Pet Owners Survey 2017-2018, 68% of house has some pet and among them 86% are dog and cats (48% dogs 38% cats) in USA. It is increased 25% compared with 10 years prior. Animal bites represent a significant global health issue and grew to be common public health problem. They account for 5 % of the total traumatic wounds evaluated in the emergency department (ED) and approximately 1 % of all the ED visits. A big study in South Korea found about 0.7% trauma patients had dog bite injury. The numbers of new A&E attendances in UK is 1-2%.

In USA about 4.7 million emergency department visits for animal bites every year, about 2% of patients need hospitalization. There are 10 to 20 animal bite related deaths, mostly from dogs, annually. The running costs of management of these bite wounds costing \$53.9 million to one billion annually. The evidence in the literature regarding their management in many areas is still conflicting and unclear.

The aim of the review is to identify and assess the current evidence for the epidemiology, management and education on dog and cat bites.

2. MATERIALS AND METHODS

A literature review on the management of animal bites was performed. The key search on Pub Med, Cochrane library, TRIP Medical Database for dog bites, cat bites, dog and cat bites, animal bites, management, investigation, and education has been done in February 2021. All relevant papers related to epidemiological aspect and management of dog bite and cat bite were reviewed. We also reviewed UK NICE guidelines and University of Texas guidelines, UK green

book, WHO Rabies prophylaxis protocol and infectious diseases text books.

3. DISCUSSION

3.1 Epidemiology [3,6,8,11-16]

The dog bites account for 80% to 90% of domestic animal bites in the United States.



Fig 1. Dog bite sometimes can be fatal



Fig 2. Extremities are common site of Cat bite

The Cat bites account for 5% to 15% of animal bite wounds. Cat bites occur most often in adult women, usually on the extremities. (Fig. 2) 20% of the bites require medical attention.

In Canada between 1990 and 2007, 24 of 28 fatal dog bites occurred in children younger than 12 years of age. (Fig. 1) Attention-deficit

hyperactivity disorder has been associated with an increased risk of injury.

The incidence of dog bites peaks during the spring and summer seasons; they are often unprovoked, and more than half occur at home with a dog that is familiar to victim. Two scenarios were identified that increased the likelihood of a bite: (a) attempting to separate fighting animals and (b) attempting to aid an injured animal. These bits sometimes may be provoked attack, especially in children. The location of bite injuries is largely dependent on age. In younger children, the most frequently affected areas are the head, face and neck whereas in adults extremities are involved. Approximately 4% patients required hospital admission at least for intravenous antibiotics; about 2.3% animal bite victims required at least one surgical procedure. Each year in the United States, dog attacks kill approximately 20 to 35 people, many of them young children. The reported mortality rate in the literature ranges from 0.5% to 1.2%.

3.2 History Taking and Assessment [6,16,17,18,19,20]

3.2.1 History taking

- When and where the incident took place.
- Type of animal and ownership (i.e., breed health, rabies vaccination history, behavior, and whereabouts).
- Circumstances around the incident and mechanism of injury (i.e., provoked or defensive bite versus unprovoked bite).
- Location and severity of the bites, in the form of depth and exposure to underlying structures.
- Any pre-hospital treatments including wound irrigation.
- Review the patient's medical history.
- Assess if the patient is in an immunocompromised state.
- Current medications including recent steroid or anticoagulant use.
- Allergies.
- Tetanus vaccination history,
- Assess risk of rabies and consider rabies prophylaxis (traveler from high risk countries of Rabies)
- Further enquiries for child neglect is suspected.
- Monitor vital signs in case of traumatic bite and suspected sepsis.

3.2.2 Examination

- Full physical examination with the patient change into gowns and assess the site of any unseen injuries. If necessary, local anaesthetic or tourniquet can be used.
- Stratify the wound as per the type of skin injury and the concomitant soft tissue, tendon and bony injury; as puncture, laceration, crushing, avulsion, dislocation of joints or fracture.
- Inspect for foreign body presence.
- Assess neurovascular status of the affected part.
- Assess associated symptoms such as fever, rigor, nausea or vomiting.
- Assess draining lymph nodes for enlargement and tenderness.
- Make careful documentation with diagrams/photographs of the wound.
- Children with facial or cranial bites need cervical immobilization till assessed.

3.2.3 Investigations

- Plain radiography to elicit any bone or joint involvement and the presence of any foreign bodies.
- Doppler ultrasound for suspected vascular injury.
- Wounds Swab.
- If systemic infection is suspected,
- Complete Blood Count.
- C-reactive protein, erythrocyte sedimentation rate, and blood cultures.
- Computed Tomography scan (in case of Paediatric injuries to the head or face).

3.3 Risks Stratification

It is important to identify the high-risk patients and wounds to direct the management plan (Table 1).

3.4 Microbiology [3,6,27-30]

The majority of infections due to bites are polymicrobial; mix of skin commensals of the victim and those of mouth of the animal. Most common organism isolated from dog and cat bite wounds are *Pasteurella* species. Among members of the genus *Pasteurella*, *Pasteurella canis* is the most common species isolated from infected dog bite wounds. The most frequent microorganism isolated in cat bites is *Pasteurella multocida*, which is part of the natural oral flora of domestic cats. Some other aerobic or anaerobic bacteria also commonly isolated from dog or cat bite wounds (Table 2).

Table 1. High risk factors [6,10,19,21-27]

High risk patients	High risk wounds
<ul style="list-style-type: none"> • Age- <2 and >50 years • Co-morbidity- Diabetes, Asplenia, Liver Presence of devitalised tissue • disease, Malignancy, Vascular disease, • HIV • Post mastectomy • Alcoholism • Immunosuppression • Artificial heart valve 	<ul style="list-style-type: none"> • Moderate to severe wounds • Moderate to severe wounds • Deep Puncture wound, large avulsion, crush injury • Cat bite • Contaminated wound • Foreign body • Hand, wrist, foot, genitalia involvement • Associated injury- bone, joints, tendon, nerve, vessel • Adjacent to prosthesis • Delayed presentation > 8 hours • Scalp, face wound in infant and young children • Primary closure of wounds

Table 2. Common Organisms

Organism	Dog bites (%)	Cat bites (%)
Pasteurella	5-50% (mostly P. canis)	75% (mostly P. multocida)
Streptococcus	46%	46%
Staphylococcus	46%	35%
Neisseria	32%	35%
Moraxella	10%	35%
Corynebacterium	12%	28%
Fusobacterium	32%	32%

Pasteurella multocida is a small, 0.2-2 micrometer, non-motile, facultative anaerobic, gram-negative, pleomorphic coccobacillus. Culture and sensitivities are usually available after 48 hours of incubation and if not treated it can lead to sepsis and multiple organ failure. Sometimes Culture may take up to a week to grow.

Pasteurella wound infection is characterized by an early onset of local intense cellulitis, purulent discharge, and lymphangitis, usually within the first 24 hours after the injury.

The early onset helps to differentiate it from staphylococcal or streptococcal causes, which usually develop after 24 hours. *Capnocytophaga canimorsus*, which, although rare, can cause a serious and potentially fatal infection specially in immunocompromised or asplenia patients.

3.5 Management

3.5.1 Antibiotics [3,6,7-11,15,17,19-22,27,29,30-38]

The primary morbidity from animal bites is infection, but most of them don't need

prophylactic antibiotics. Although there is discrepancy in the literature, the reported overall infection rate in recent studies is 1-30%, with the incidence of infection in cat bites is double than dog bites (30-50% vs 2-20%). Fortunately, with appropriate wound care the rate of the infection drops as low as 1-2%. Another study found post-operative infection rate was 6.3%.

Although most of the low risk dog bite wounds do not need routine antibiotics but cat bite wounds should be treated with prophylactic antibiotics as they have a high rate of infection. Only wounds with greater than 5% risk of infection should be treated with antibiotics. Prophylactic antibiotics were associated with a statistically significant reduction in the rate of infection in hand bites. Prophylactic antibiotics should also be considered for the high risk deep puncture wound and wound closed primarily. Antibiotics are not generally needed if the wound is more than 2 days old and there is no sign of local or systemic infection (Fig. 3).

3.5.2 Antibiotics of choice

The first-line antibiotic treatment of choice for either bite wounds is the betalactam antibiotic

amoxicillin-clavulanic acid. Alternative antibiotics used for penicillin allergic patients (Table 5). For children under 12 years old who are allergic to penicillin, better to seek advice from a microbiologist. Pregnant woman who is allergic to penicillin, azithromycin could be an option.

Erythromycin alone is not advisable for prophylaxis or treatment of bite wounds as more than 80% *P. multocida* are resistant to this antibiotics and can cause serious treatment failure. If MRSA is suspected, the first line antibiotics include, SMX-TMP (Co-trimoxazole), doxycycline, minocycline, and clindamycin.

The route of administration depends on patients and severity of the wounds. A study showed that 86% of cat bite wounds were successfully treated with oral antibiotics and only 14% needed hospital admission as well as parenteral antibiotics.

Duration of treatment: The length of treatment depends whether the wound is superficial or involves bone or joint. Prophylactic treatment should be carried out over 3-5 days. The superficial wounds infection requires 1 to 2

weeks of treatment. A bone or joint involvement requires up to 6 weeks of intravenous antibiotics.

3.5.3 Treatment of established infection

The pus or wound swab should send for culture and sensitivities before starting empirical antibiotics. The choice of empirical antibiotic is same as table shown in Prophylactic antibiotics (Table 3). Wound should review in 24-48 hours.

Localized, superficial infection can be treated with oral antibiotics. Severe infection or systemically unwell patients needed hospital admission and intravenous antibiotics. One study showed only 1.4%-3.7% patients needed hospitalization. The sensitivity results guide the management by appropriate antibiotics.

3.6 Wound Management [3,6,8,16,17,19-24,35]

According to a study, most of the wounds were open wounds (79.2%), superficial wounds were 17.4%, and 0.6% was fracture with 0.2% had amputation.

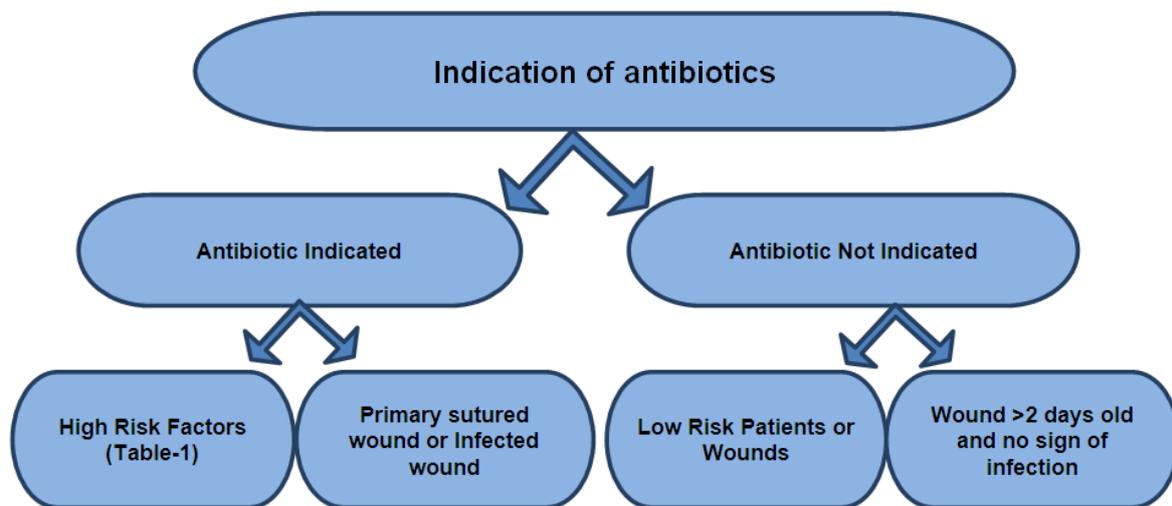


Fig. 3. Indication of Antibiotics

Table 3. Antibiotics for prophylaxis or treatment [9,10,19-22]

First line Antibiotics	Amoxicillin + Clavulanic acid (Co-Amoxyclav)
Patients allergic to Penicillin	<ul style="list-style-type: none"> • Metronidazole +Doxycycline or • Metronidazole + Oxytetracycline or • Cephalosporine, Fluroquinolone or Co-Trimoxazole(SMX-TMP) + Clindamycin or • Ceftriaxone + Metronidazole
Penicillin Resistant Pasteurella	Second, third or extended spectrum Cephalosporine

Studies have shown that adequate wound cleaning is very important to reduce the incidence of infections. Minor wounds can be cleaned with soap and water in A&E or trauma clinic. If local infiltration is needed, care should be taken to infiltrate using the intact skin around the wound.

The irrigation volume should be titrated to the extent of the wound as per 100-200 mls per square inch of the wound. Most of the wound needed about 250-500 mls of normal saline irrigation. It is preferably done by using a 20 or 35 ml syringe with 18-19 gauge blunt needle to provide propulsion force and enough pressure to attain proper cleansing. Normal Saline can be used for irrigation. Concentrated Povidone iodine, hydrogen peroxide, or ethyl alcohol shouldn't be used to avoid tissue damage or toxicity. Any foreign bodies should be removed and devitalized or necrotic tissue should be debrided.

Great debate exists whether to repair structures immediately, or after a second look at 48 hours of intravenous antibiotics. But minor relatively clean or facial wounds can be closed primarily after proper irrigation and debridement. Puncture wounds, wounds older than 8 hours or with any sign of infection shouldn't be sutured. Minor animal bites in adults should be repaired in the A&E whereas severe injuries or in case of children the repair should usually be performed in the operating theatre. Immobilization and elevation are crucial to the affected limb.

3.6.1 Surgical management [3,8,14,16,17,19,22-27,38-40]

The surgical management in animal bites is to avoid immediate mortality in severe life-threatening injuries, followed by wound debridement and thorough washout to prevent infection. In addition to debridement and washout, repair of damaged structures, wound closure and reconstruction can be required to achieve the best cosmetic and functional outcome. Study showed 2.3% patients needed surgical treatment and mostly were toddler (2.8%).

Many literatures suggested that, most of the animal bites can be closed primarily after adequate surgical treatment, but special care should be given in high-risk wounds. Primary suturing of wounds can improve the scar quality and cosmetic appearance without increasing the risk of infection.

Mitnovetski and Kimble, suggest avoiding primary closure of cat bite in hand and reviewing the wounds in 24 to 48 hours for the possibility of delayed primary closure. The facial laceration of dog bite wounds should be primary closed immediately after formal and thorough irrigation and debridement. On comparing primary closure to delayed closure, there is no difference of infection rate in the wounds.

Most of the injuries are either head and neck or extremities. So, A Plastic or a Hand surgeon should manage the bite injuries and their related infections. The management of such injuries needs to encompass appropriate antibiotics, a low threshold for surgical intervention, and early mobilization after a short period of splinting to afford the injured limb the best possible chance to recover fully. Associated fractures and tendon/nerve injuries in animal bites should be managed in the same way as open/contaminated injuries, with initial stabilization and permanent fixation at a secondary stage. On top of that more than 20% patients may need some forms of reconstruction.

Patients with serious dog bite laceration on limbs could be benefited from NPWT (Negative Pressure Wound Therapy). NPWT reduced the infection rate and shortened recovery time. Low negative pressure (-75 mm Hg) is preferable than high negative pressure (-125).

The time of management appeared to be critical, as early treatment resulted in lower infection rate and improved cosmetic appearance regardless suturing or not. Furthermore, wounds located at the head and face demonstrated better results. A short period of splinting followed by early active mobilization with early physiotherapy is of benefit in order to prevent adhesions from forming that would ultimately hinder the return of the injured limb to full range of movement.

3.6.2 Pain management [17]

Most patients will achieve effective pain management with over the counter analgesics. If a patient requires more intense pain control, paracetamol with codeine is indicated.

3.7 Immunization

3.7.1 Tetanus [17,19,20]

Tetanus after animal bites is rare but all guidelines advise tetanus prophylaxis, with

immunoglobulin and toxoid to be administered to patients with a history of two or fewer immunizations.

Administer tetanus booster (tetanus, diphtheria toxoid [Td] or tetanus, diphtheria, acellular pertussis [Tdap]) (if none given in past 3 years) or initiate primary series in non-vaccinated individuals, or if vaccination status is unknown (Table 4).

For prophylaxis of animal bites with tetanus, the cut off of tetanus doses is 3 doses. Patients with no strict knowledge of the tetanus coverage or have received three doses or less throughout they should be receiving the tetanus and diphtheria vaccination in addition to the immunoglobulin if needed. Whereas the counterparts who received more than three doses would not be in need for further coverage against tetanus.

3.7.2 Rabies [17,41]

Rabies is a lethal zoonosis caused by lyssa viruses, which is a neurotropic virus transmitted from animal to humans by bite, scratch, or licking on wound or on mucosa. Rabies prone countries may need Post Exposure Prophylaxis (PEP). Rabies free countries usually don't need PEP

after dog or cat bite except some exception (e.g. travelers, people works with imported animals). Some of the countries already declared as rabies free including UK. According to UK Green book (Chapter 27, v 3-0, page 331) no case of indigenous human rabies from animals other than bats has been reported in the UK since 1902.

The indications for post-exposure vaccination, with or without Rabies Immunoglobulin (RIG), depend on the type of contact with the suspected rabid animal. World Health Organization (WHO) guidelines described three types of contacts (Table 5).

According to WHO recommendation no prophylaxis is necessary after a grade I contact, whereas immediate vaccination and local treatment of the wound is recommended after a grade II contact (+ RIG for immuno-compromised patients), and immediate vaccination associated to the administration of RIG and local treatment of the wound, after a grade III contact for patients not previously vaccinated. WHO also advised to stop treatment if animal remains healthy throughout an observation period of 10 days or is proved to be negative for rabies by a reliable laboratory using appropriate diagnostic techniques.

Table 4. Tetanus Prophylaxis

Wound type	Tetanus Prophylaxis
Clean Wounds	<ul style="list-style-type: none"> Fully immunised with up to date booster- No vaccine Not immunised/ immunocompromised/unknown/ Incomplete/Not up to date booster. TT+ Complete the immunization
Tetanus prone wounds Soil or manure contamination/ >6 hours/ FB/ Puncture wounds	<ul style="list-style-type: none"> Fully immunised with up to date booster- TIG only Not immunised/ immunocompromised/unknown/ Incomplete/Not up to date booster.
Compound fracture/Devitalised tissue	<ul style="list-style-type: none"> TT+ TIG + Complete the immunization

Table 5. WHO wound grading for rabies

Grade	Wound condition	Vaccination
I	Touching or feeding animals, licks on intact skin;	Not required
II	Nibbling of uncovered skin, minor scratches or abrasions without bleeding, licks on slightly abraded skin;	Vaccination+ wound management (RIG for immunocompromised patient.
III	Single or multiple transdermal bites or scratches (with bleeding), licks on broken skin; contamination of mucous membrane with saliva from licks, contacts (superficial or deep bites or scratches, contact with a wound or mucous membrane) with bats.	Vaccination + RIG + wound management

3.8 Referral [17,19]

Dog or cat bite patient should be referred to secondary care for following cases:

- High-risk patients specially children, immunosuppressive and comorbid patients. (Table 1)
- High-risks wounds (Table 1)
- Facial wounds (excluding very minor wounds).
- Wounds which need closure.
- Bites where the severity of the injury is difficult to assess.
- Bites which need reconstructive surgery.
- Bites to poorly vascularized areas e.g. ear cartilage/nose cartilage.

If an animal has bitten a child, consider childcare issues. Follow local policies for referral of children at risk.

If there is a risk of exposure to rabies, seek immediate advice from the Virus Reference Department of the Health Protection Agency.

3.9 Monitoring and Follow-Up [17,19,20]

All patients should be followed up closely wherever managed by primary care or discharged from secondary care. For non-infected wounds, patients should be warned about possible infection and educate about the sign and symptoms of infection and when to contact hospital without delay. For infected wounds, patients should routinely be reviewed in 24 and 48 hours to check the response of treatment with advise to attend sooner for review if getting worse and feeling unwell.

For post-operative patients- clear post-operative instructions about wound care, follow up plan and physiotherapy should be given in written. PEP for Rabies (if at risk) - Advise the patients to observe the offending animal (if possible) and attend for vaccination as per schedule.

3.10 Patient and Family Education [8,17,38,42,43]

Patient and family education aims to involve them in management of current problem as well as prevention of future bites. Education about wound care, mobilization and early identification of complications is important, especially onset of infections.

Establish treatment goals with the patient including preventing infection or treating existing infection, reducing scarring, treating pain, preventing tetanus and rabies infections, and reducing psychological trauma. Educate about the importance of finding and observing the offending animal relation with rabies vaccination.

There is no direct evidence that educational program can reduce dog bite rates in children and adolescents. Children are highly susceptible to bite injury. One study showed 63% of bite injury patients were children under the age of 18. Educating children who are less than 10 years old in school settings could improve their knowledge, attitude and behavior towards offending animals.

Children who watched the educational videos of testimonials on dog-bite prevention had increased safety knowledge, higher perceived vulnerability, and less risky simulated behaviors with dogs compared with the comparison group.

3.10.1 Following advice may help to prevent future bites [19,2]

Avoid-

- Running or screaming in the presence of a dog.
- Greeting a dog with an outstretched hands
- Petting a dog without letting it sniff them first.
- Humanizing the dog (for example allowing it to sleep on the furniture, beg for food), and do not hug or kiss it, as this makes it more difficult for the dog to distinguish between animal and master, and may increase the risk of biting.
- Desexing, microchipping, and registration of dog and cat also advised to reduce the incidence of bite.

4. CONCLUSION

Dog and cat bites are fairly common injuries. In this review, we have checked the information from different sources and tried to compile it in a simplified way. Hope, this article will help the health care professionals from all levels, for the management and prevention of the dog and cat bite injuries.

CONSENT

Informed consent: no informed consent was required for the development of the literature.

ETHICAL APPROVAL

It is no ethical approval was required being a literature review.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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