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Antibiotic prescribing in patients who presented to the Emergency Department with dog bites: A descriptive review of current practice

Original Article

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Running Title

Antibiotic prophylaxis use in dog bites

Abstract

Objective: To describe the current practice of prophylactic antibiotic prescribing for patients presenting to the Emergency Department (ED) with a dog bite, and compare management against existing guidelines.

Method: We performed a descriptive retrospective study on all consecutive patients who presented to one tertiary teaching hospital and one regional district hospital in Southeast Queensland between the 1st of July 2017 and the 30th of June 2018 with a presentation of a dog bite. Data on demographics and management were collected from the electronic medical record using a standardised data collection tool. Risk factors supporting prophylaxis were taken from the electronic Therapeutic Guidelines (eTG).

Results: Of the 336 patients included for analysis, 299 received antibiotics, of which 23 were for established infection. 276 (82% of overall cohort) received a prescription for prophylactic antibiotics, either in hospital (ED or admitting ward) and/or on discharge. Of the 178 patients who received prophylactic antibiotics in hospital, 91 (51.1%) received intravenous (IV) antibiotics. Of the patients who presented to ED without a previously established infection 271 (86.6%) received prophylactic antibiotics on discharge. Over one quarter (27.5%) of patients who were given prophylactic antibiotics did not meet any high-risk factors as outlined in guidelines.

Conclusion: Prophylactic antibiotics are extensively used for patients with dog bites. There is scope to rationalise antibiotic use and route of antibiotic administration in patients with dog bites.

Key words: Antimicrobial stewardship, choosing wisely, dog bite, emergency department, prophylaxis

Introduction

Each year more than 100 000 Australians are injured by dogs (1). Dog bites account for 60.7 per 10 000 Emergency Department (ED) presentations in the paediatric population, and 12.9 per 10 000 ED presentations in the adult population (2).

Although most dog bites do not get infected, wounds from dog bites are deemed to be at higher risk of infection due to the polymicrobial nature of a dog's mouth. Commonly implicated micro-organisms include *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, *Citrobacter freundii*, *Enterobacter cloacae*, *Acinetobacter calcoaceticus*, and *Pasteurella* species (3) (4).

Patients presenting with infected wounds occurring within 12 hours of the bite are most commonly colonized with *Pasteurella* species, whereas patients presenting with infected wounds >24 hours after the bite are predominantly infected with staphylococci or anaerobes (3) (5) . The rate of developing an infection from a dog bite is unclear, with an overall rate estimated to be between 3 and 18% (6) .

Previous research into the use of prophylactic antibiotics for dog bites is limited (7). A 2001 Cochrane review looking at antibiotic prophylaxis of mammalian bite injuries included eight studies between 1982 and 1992. Six studies included 614 patients with dog bites, although the studies were small with methodological concerns including considerable loss to follow up (7, 8). Despite these limitations, this best available evidence found that prophylactic antibiotics were not associated with significantly reduced rates of infections. The type of wound (puncture, abrasion, laceration, crush) was also not associated with an effect on infection rates. Different subgroups were assessed, and bites to the hands was the only subgroup which significantly benefited from antibiotic prophylaxis (7).

Current management in Australian EDs often follows guidelines such as provided by the electronic Therapeutic Guidelines (eTG; see Table 1). The eTG recommended management for animal bites is thorough cleaning, debridement, irrigation, elevation and immobilization with prophylactic antibiotics (oral amoxicillin + clavulanate [875 +125mg] 12-hourly for 5 days) not necessarily required unless the injury poses a high risk of infection. High risk is

defined by eTG if the patient is immuno-compromised or if the following wound features are present: wound older than 8 hours, puncture wounds, wounds involving the hands, feet or face or deeper tissue structures (9).

Since these guidelines for mammalian bites are based on expert recommendations informed by literature with methodological limitations, they are open to individual clinician interpretation. This may contribute to overuse of antibiotics in this patient group. Misuse and overuse of antibiotics are associated with adverse events for the individual patient and represent a larger societal problem. It is estimated that 20% of all individuals prescribed antibiotics in hospital will experience one or more antibiotic-associated adverse event (10). Furthermore, antimicrobial resistance (AMR) is an increasing and significant problem with predictions that approximately 10 million deaths worldwide per year will be attributable to AMR by 2050 (11) (12). It is therefore critical that prescribing patterns are reviewed (13).

More literature is required to support appropriate prescribing practice with regards to dog bite prophylaxis. This study aims to describe the current practice of prophylactic antibiotic prescribing by ED clinicians for patients with dog bites.

Methods

This was a retrospective descriptive cohort study, with data collected on patients who presented to the ED with a dog bite between the 1st of July 2017 and the 30th of June 2018 at two hospitals: Gold Coast University Hospital, a tertiary facility with a dedicated children's ED, which overall had 107 000 attendances in 2017 and Robina Hospital, a general hospital with a mixed ED with 61 000 attendances in 2017. This study was approved by the Gold Coast Hospital and Health Service Human Research Ethics Committee (LNR/2018/QGC/45652).

Patients were identified from the Emergency Department Information System (EDIS) based on a diagnosis of "Bitten by a Dog" (W54) or had any of the following "DOG BIT", "DOG BITE", "DOGBITE", "BIT DOG" in free text of the triage notes. Patients who were identified in the original data search who presented with complaints unrelated to a dog bite were excluded. Patients who left prior to treatment being completed or were transferred were excluded.

Patient data were extracted from the electronic medical records using a pre-formatted data collection form modelled on a previous study (14). Data entry occurred in a de-identified study database using Excel ®. Data were collected by the medically-trained primary author (MB) on the patient demographics, bite information, antibiotic management, non-antibiotic management of the bites and any patient representations with any uncertainties reviewed by a senior researcher. If patients presented more than once, only the index presentation for data on demographics and type of wound was recorded. Unrecorded variables were deemed to be absent, and were therefore considered not to have been clinically important in the management of that specific patient by the treating doctor. We collected data on factors that eTG highlights to place patients at high risk for infection, and this included: i) a delayed presentation (wound older than 8 hours), ii) puncture wounds unable to be adequately debrided, iii) wounds involving the hands, feet or face, iv) wounds involving deeper tissue structures, and/or v) immunocompromised patients (9). These guidelines were recently updated to amend the antibiotic prescribing recommendations and to include patients with compound fractures and those who were bitten by cats (15) (Table 1). Patients were deemed to be immunocompromised based on co-morbidities listed in the patient charts, including significant (long-term or high dose) oral corticosteroid use, intravenous drug use, hepatitis C, chemotherapy, organ transplantation, or severe chronic neutropenia. Diabetes was also recorded as marker of immunocompromise and was separately reported (Table 2). Operative management included washout in theatre as well as any closure, grafting or repair that was required.

Patients included in the study were subsequently grouped into 3 categories; patients who were not prescribed antibiotics, patients who were prescribed antibiotics prophylactically and patients who were prescribed antibiotics for a previously established infection. Data were reported using descriptive statistics without inferential statistics.

Results

A total of 364 patients with an EDIS diagnosis related to a dog bite were identified during the study period. Twelve patients were excluded as they had a clear alternative diagnosis. An additional 16 patients were excluded as they left prior to treatment being completed or were transferred (*see Figure 1*). Of the 336 patients included in the cohort, the mean age was 35 years, 51.8% were male and bites to the hands were most common (37.8%) followed by limbs

(31.5%) and face (24.4%) (*see Table 2*). Within the cohort 37 patients (11.0%) did not receive any antibiotics and 276 patients (82.1%) received prophylactic antibiotics either in ED or on the wards and/ or as part of their discharge treatment. The remaining 23 patients (6.9%) who presented received antibiotic treatment for established infection.

Of the patients who received prophylactic antibiotic the most common location of dog bites were hands/fingers and face/neck (*see Table 2*). Injuries included punctures, lacerations and abrasions. Of the 276 patients who received prophylactic antibiotics, a small number of patients (3.6%) were considered immunocompromised and 4.3% had diabetes. In over one-third of these patients (37.7%) the time to presentation to hospital following the dog bite was not recorded. However, 89.4% of the patients with a recorded time to presentation, presented within 8 hours of the bite.

In this study, the patients who did not meet any of the high-risk criteria for antibiotic prescribing as recorded in the guidelines (immunocompromised, delayed presentation, bite on face/feet/hands, deep structure involvement, puncture wound), accounted for 27.5% of all the patients who were given prophylactic antibiotics. This included five patients who received intravenous (IV) antibiotics of which four were admitted to hospital.

Of the 276 patients who received prophylactic antibiotics, 178 received antibiotics in ED or on the ward, with 96 patients (53.9%) receiving Amoxicillin + Clavulanate. Over half (51.2%) of the patients who received antibiotics in ED or on the ward received their prophylactic antibiotics intravenously, 64 patients (36.0%) receiving Piperacillin-Tazobactam and the remaining 27 patients (15.2%) received a range of other antibiotics. On discharge 271 patients (86.6%) of all patients without established infection (n=313), received discharge antibiotics. The majority of these patients received Amoxicillin + Clavulanate (87.0%) on discharge.

Sixty-nine patients who received prophylactic antibiotics were admitted to hospital, with the majority of patients admitted for less than 24 hours, in order to receive operative management, with the longest hospital stay 4 days. All 54 patients who received operative management received antibiotics in-hospital. Of the patients who did not receive antibiotics only 1 patient was admitted to short stay for observation due to bleeding.

Thirty-one patients who received prophylactic antibiotics presented to hospital multiple times. Of those that were given prophylactic antibiotics, 14 patients (5.1%) had unplanned re-presentations. Causes of unplanned re-presentation included patient concerns of infection (3.3%), pain (1.4%) as well as haematoma formation (0.4%). Of the 37 who did not receive antibiotics two patients re-presented with concerns for infection. One was a pregnant patient who had a haematoma formation and the second patient was treated for sepsis.

Discussion

Current guidelines detail specific high-risk criteria that should be met before antibiotics are prescribed for a patient following a dog bite. Some of these recommendations are based on low-level evidence, potentially leading to decreased guideline adherence. This may explain practice variation with a tendency to overprescribe prophylactic antibiotics, as described in this study.

In this study over a quarter of the patients (27.5%) who received prophylactic antibiotics did not meet any of the guideline-defined high-risk criteria. In addition, although many of the patients received amoxicillin-clavulanic acid, the antibiotic recommended in the guidelines, over one-third of the patients who received prophylactic antibiotics in hospital were prescribed IV Piperacillin-Tazobactam. The eTG guidelines only recommended the use of Piperacillin-Tazobactam in cases of established moderate/severe infection. The use of such a broad spectrum antibiotic choice for prophylaxis reflects unnecessary escalation of antibiotic use. Some of these prescribing decisions likely reflect a complex web of causality, including incomplete understanding of pharmacokinetics, lack of understanding of guidelines or cognitive errors in decision making(16).

Our study demonstrated that more than 4 in 5 patients (82%) who presented to the ED with a dog bite received prophylactic antibiotics, with only 11% of patients not receiving antibiotics. In total, 91 patients received prophylactic intravenous antibiotics, representing one-third of patients who received prophylactic antibiotics and over half of all patients who received prophylactic antibiotics in-hospital. This possibly reflects a bias towards intravenous antibiotics and is consistent with previous ED literature (17). A preference for IV

administration may be the result of cognitive miserliness since a peripheral intravenous cannulae often is in situ (18), perceived higher efficacy of intravenous antibiotics compared to oral (19) or the (mistaken) belief that oral medications should not be given whilst a patient is fasted for surgery. Fifty-four patients met this condition, however, guidelines allow oral medications with small sips of water less than two hours pre-operatively and, in the absence of significant trauma which could delay gastric emptying, impending surgery is not in itself a reason for intravenous medication administration (20).

On further review of the high-risk features as outlined by eTG, a higher proportion of patients bitten on the hands/fingers, face/neck or feet were given antibiotics, compared to the patients who did not receive antibiotics (most of these had limb bites). More patients who presented with a puncture wound received prophylactic antibiotics when compared with patients who did not have a puncture wound. Only few patients in the study were considered immunocompromised, however it did appear this information was taken into account when considering prophylactic antibiotics, as all these patients received prophylactic antibiotics. Time to presentation following a dog bite should also be considered according to the guidelines. Most of the patients with a recorded time to presentation, presented within 8 hours of the bite. However, it should be noted that in a substantial proportion of the patients the information on the presentation time was not recorded and possibly played a limited role in the decision as to whether antibiotics were prescribed.

Data published in recent years about antibiotic use for dog bites is limited, with two meta-analyses providing the best summary information (7) (21). Whilst antibiotics may be beneficial in patients with high risk of infection, a large number of patients will be required to be treated for this potential benefit to be seen. These two meta-analyses have formed the backbone of discussion as to the use of prophylactic antibiotics for dog bites for the last 25 years. A 2003 article looking at the recommended antibiotic use following a dog bite at 14 Emergency Departments in the UK highlighted the lack of evidence base, with a recommendation that the use of antibiotics be limited to those already infected and those at high risk of infection (22). The result of our study demonstrates a persistence of the evidence-practice gap when it comes to antibiotic prescribing for dog bites, with a persistent tendency to (over)prescribe prophylactic antibiotics, including unnecessary use of (intravenous) broad-spectrum intravenous agents despite (low evidence-based) guidelines. Further qualitative research is

required to understand the exact reasons behind the antibiotic prescribing decisions to change prescribing habits in the future.

This study has several limitations inherent to its retrospective design. Data was incomplete for certain variables such as type of injury, wound management details and other surrounding contextual factors which may have provided additional information regarding the decision to prescribe antibiotics. If data on key variables (such as high-risk features for infection) were not recorded in the medical record then these data were considered absent. This assumption may have led to an underestimation of patients with high risk features. This study was conducted at two sites in the same healthcare district, which potentially limits the generalisability of the results and, further, there is the potential for abstractor bias. This study was conducted prior to recent changes to the recommended guidelines, which further tighten the criteria on which prophylactic antibiotics should be prescribed. If the study data were to be evaluated against the revised guidelines, the study would reflect an even greater overuse of antibiotics. It remains to be seen if these new changes to the guidelines will impact on antibiotic prescribing, the use of IV broad spectrum antibiotics and if the newly revised guidelines will have any impact on the proportion of patients receiving prophylactic antibiotics without any specific identified high-risk criteria. A future randomised clinical trial comparing placebo with standard treatment in patients without high-risk criteria may be required to change practice.

Conclusion

This study describes substantial practice variation and limited adherence to guidelines for antibiotic prescribing following a dog bite, including intravenous prophylactic prescribing in low risk patients. Prophylactic antibiotics are being prescribed to almost all patients who present at the ED with no clear relationship to the high-risk features. There is scope to rationalise use and route of prophylactic antibiotics, however the underlying reasons for current prescribing will require further research to improve rational and evidence-based prescribing.

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Conflicts of Interest

GK is a section editor for Emergency Medicine Australasia

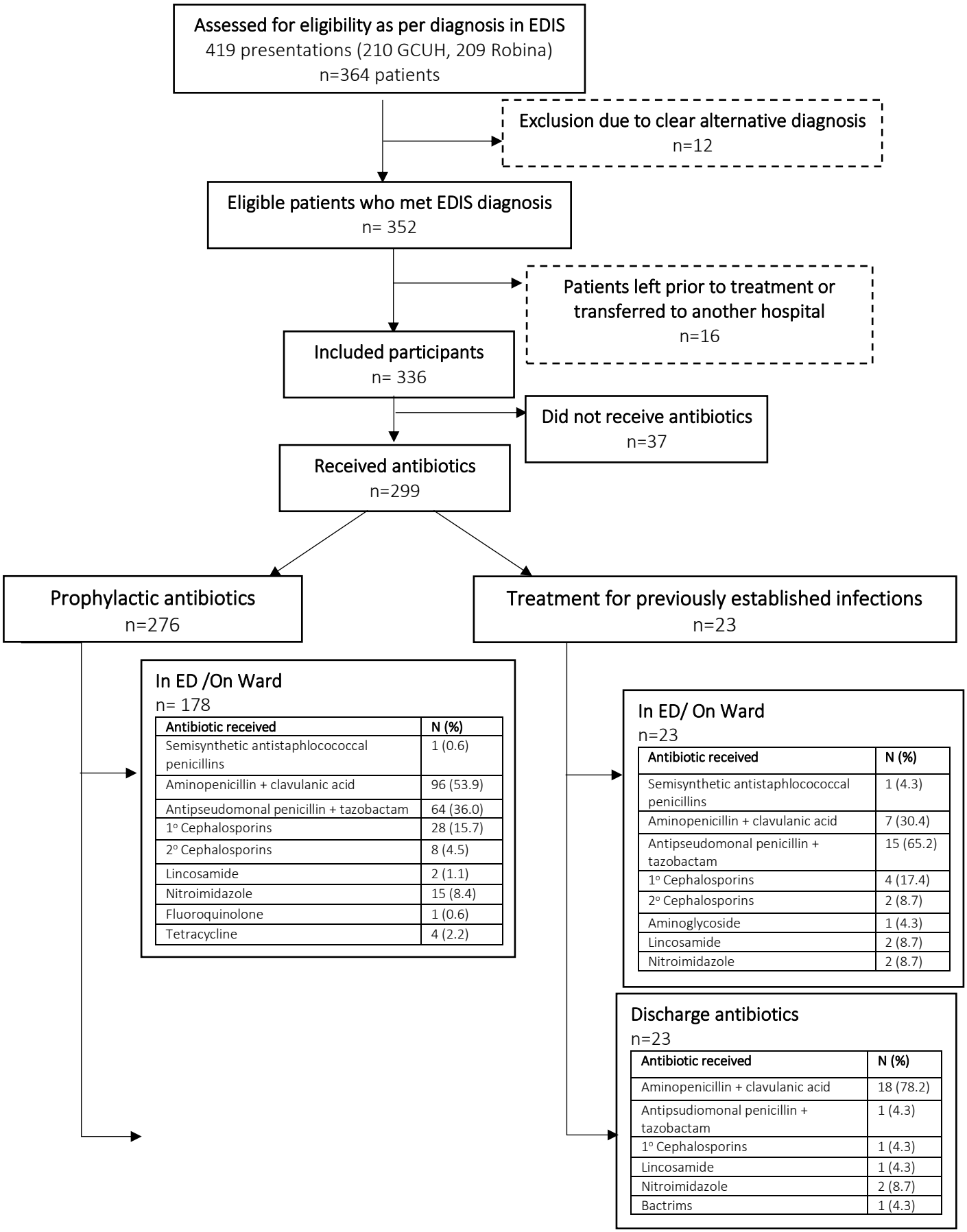
Table 1: eTG Therapeutic guidelines for recommended antibiotic prescribing in adult patients following a mammalian bite (Abridged version).

	Antibiotic guidelines prior to April 2019		Antibiotic guidelines after April 2019	
Prophylactically	Infection not established*	Amoxicillin + Clavulanate 875 +125mg orally 12 hourly for 5 days *If delayed access to oral therapy procaine benzylpenicillin 1.5g Intramuscular	Presumptive therapy for bite and clenched fist injuries if antibiotic therapy is indicated^	Amoxicillin + Clavulanate 875 +125mg orally 12 hourly for 3 days *If delayed access to oral therapy procaine benzylpenicillin 1.5g Intramuscular
Treatment for already established infections	Empirical therapy for established mild infection	Amoxicillin + Clavulanate 875 +125mg orally 12 hourly	Empirical therapy for localized bite and clenched fist injury infections, not associated with systemic feature or deep tissue involvement	Amoxicillin + Clavulanate 875 +125mg orally 12 hourly for 5 days
	Empirical therapy for established moderate to severe infection	Piperacillin + tazobactam Intravenously 4 +0.5g, 8 hourly	Empirical therapy for bite and clenched fist injury infections associated with systemic features or deeper tissues	Amoxicillin + Clavulanate Intravenously 1+0.2g 8 hourly or 6 hourly if bone infected

**Features required for prophylactic treatment to be indicated: Delayed presentation greater than 8 hours, puncture wounds that cannot be adequately debrided, wounds involving the hands, feet or face, deeper tissue structures or immunocompromised patients*

^Features required for prophylactic treatment to be indicated: Presentation to medical care delayed by 8 hours or more, puncture wounds that can not be adequately debrided, wounds involving the hands, feet or face, deeper tissues, open fractures, immunocompromised patients or the bite is from a cat

Figure 1: Flowchart of included patients and antibiotic prescriptions.



Discharge antibiotics

n= 271

Antibiotic received	N (%)
Aminopenicillin + clavulanic acid	236 (87.0)
1º Cephalosporins	4 (1.5)
2º Cephalosporins	1 (0.4)
Lincosamide	6 (2.1)
Nitroimidazole	11 (4.1)
Fluoroquinolone	5 (1.9)
Tetracycline	7 (2.6)
Bactrims	2 (0.7)
Unknown	11(4.1)

Table 2: The demographics, description of injury and treatment for patient who presented to the Emergency Department with dog bites in which they receive prophylactic antibiotics, no antibiotics or antibiotics for a previously established infection.

		Prophylactic antibiotics prescribed N=276	No antibiotics prescribed N=37	Antibiotics prescribed for established infection N=23
Demographics				
Gender, n (%)	Male	147 (53.3)	14 (37.8)	13 (56.5)
	Female	129 (46.7)	23 (62.1)	10 (43.5)
Age	Mean, years, ±SD	35 ± 21.0	29 ± 20.1	45 ± 22.1
	Number of patients ≤5years old, n (%)	21 (7.6)	5 (13.5)	0 (0.0)
	Number of patients ≥65years old, n (%)	30 (11.6)	2 (5.3)	4 (17.4)
Co-morbidities, n (%)	None	254 (92.0)	37 (100.0)	16 (69.6)
	Diabetes (T1DM, T2DM)	12 (4.3)	0 (0.0)	4 (17.4)
	Immunocompromised	10 (3.6)	0 (0.0)	3 (13.0)
Description of injury				
Time to hospital, n (%)	≤8hours	135 (48.9)	14 (50.7)	2 (8.7)
	>8 hours but ≤24 hours	11 (4.0)	1 (3.6)	5 (21.7)
	>24 hours	5 (1.8)	1 (3.6)	0 (0.0)
	Unknown	104 (37.7)	11 (39.9)	0 (0.0)
	Not applicable (e.g. prior presentation to GP 1st)	21 (7.6)	10 (36.2)	16 (69.6)
Site of bite, n (%)	Includes hands/ fingers	103 (37.3)	11 (39.9)	13 (56.5)
	Limbs	82 (29.7)	16 (58.0)	8 (34.8)
	Includes face/ neck	73 (26.4)	8 (21.6)	1 (4.3)
	Chest/ stomach/abdomen	1 (0.4)	1 (3.6)	0 (0.0)
	Feet/ toes	8 (2.9)	0 (0.0)	1 (4.3)
	Genitalia	3 (1.1)	0 (0.0)	0 (0.0)
	Multiple not including hands/finger or face/ neck	5 (1.8)	1 (3.6)	0 (0.0)
	Unknown	1 (0.4)	0 (0.0)	0 (0.0)
Type of injury, n (%)	Puncture (+/- laceration and/or abrasion)	117 (42.4)	10 (27.0)	6 (26.1)
	Laceration (+/- abrasion)	119 (43.1)	8 (21.6)	8 (34.8)
	Abrasion	14 (5.1)	9 (24.3)	0 (0.0)
	De-gloving	1 (0.4)	0 (0.0)	1 (4.3)
	Amputation/ de-tipping	4 (1.4)	0 (0.0)	0 (0.0)
	Unknown	21(7.6)	10 (27.0)	8 (34.8)

Treatment of injury:				
Primary washout, n (%)	ED	191 (69.2)	19 (51.4)	1 (4.3)
	OR	49 (17.8)	0 (0.0)	14 (60.9)
	GP/ Another hospital	7 (2.5)	4 (10.8)	4 (17.4)
	Self washout/ Home	15 (5.4)	0 (0.0)	3 (13.0)
	None recorded	13 (4.7)	7 (18.9)	0 (0.0)
	Not applicable	1 (0.4)	7 (18.9)	1 (4.3)
Wound Closures, n (%)	No	176 (63.8)	31 (83.8)	12 (52.2)
	Yes, in OR	47 (17.0)	0 (0.0)	7 (30.4)
	Yes, in ED/ on Ward	51 (18.5)	3 (8.1)	0 (0.0)
	Yes, by GP/ already completed (taken out in hospital or left in)	1 (0.4)	3	4 (17.4)
	Not applicable	1 (0.4)	0 (0.0)	0 (0.0)
Operative management, n (%)	Not applicable	213 (77.2)	37 (100.0)	8 (34.8)
	Washout	7 (2.5)	0 (0.0)	7 (30.4)
	Washout + Closure	23 (8.3)	0 (0.0)	6 (26.1)
	Washout + grafting	1 (0.4)	0 (0.0)	0 (0.0)
	Washout + repair	23 (8.3)	0 (0.0)	2 (8.7)
	Left prior to treatment/ transferred to another hospital	8 (2.9)	0 (0.0)	0 (0.0)
Admitted to hospital, n (%)	No	206 (74.6)	36 (97.3)	3 (13.0)
	Short stay unit	29 (10.5)	1 (3.6)	12 (52.2)
	Admitted	40 (14.5)	0 (0.0)	7 (30.4)
	Transferred to another hospital	1 (0.4)	0 (0.0)	1 (4.3)
Duration of stay, days	Average duration (Days), SD	1 ± 0.7	N/A	3.1± 2.0
Repeat presentations, n (%)	None	245 (88.8)	27 (73.0)	20 (87.0)
	Planned representation (continuation of care)	17 (6.2)	8 (21.6)	1 (4.3)
	Unplanned representation	14 (8.0)	2 (5.4)	2 (8.7)