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Antibiotic Prescribing for the Management of Mammalian Bite Wounds in Outpatient Settings: A Systematic Review of Prescribing Patterns and Guideline Concordance

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Abstract

Mammalian bites, including human bites, are a significant cause of morbidity and outpatient treatment, where antibiotic prescribing is central to wound management. Prominent guidelines concur that amoxicillin-clavulanate (co-amoxiclav) is the recommended first-line empirical antibiotic, and a Cochrane systematic review has analysed the effectiveness of antibiotic prophylaxis in this context. However, while individual studies have described real-world prescribing for bite wounds, this literature has not been systematically synthesised, appraised, or compared with guidance to date. This systematic review examined international antibiotic prescribing practices for mammalian bite wounds in outpatient settings and assessed adherence to guidelines where available. The review was registered with the International Prospective Register of Systematic Reviews (PROSPERO).

A search was conducted across PubMed and Europe PMC (Europe PubMed Central) in August 2026. Studies were eligible if they reported both antibiotic prescribing rates and antibiotic agents in patients presenting with mammalian bites in an outpatient department setting. After abstract review and full-text screening, nine studies meeting the inclusion criteria were identified. All were retrospective observational studies published between 2012 and 2026, cumulatively covering 2,977 patients across six countries. Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Studies Reporting Prevalence Data.

Our review found a wide range of prescribing rates for mammalian bites, from 45.1% to 99.2%, with a median of 77.8%. In seven of the nine studies, co-amoxiclav was the dominant agent, accounting for 74.2% to 96.6% of prescriptions. A notable exception came from a South African publication, which reported that cloxacillin, an antistaphylococcal agent lacking activity against *Pasteurella multocida*, constituted 59.2% of prescriptions despite local guidance recommending co-amoxiclav. While treatment and prophylaxis data were often mixed, when reported separately, prophylactic prescription durations consistently exceeded guidance, and in one study, 27.5% of patients receiving prophylactic antibiotics did not meet any qualifying criteria. Limitations include the retrospective design of the included studies, incomplete data and possible reporting bias, clinical heterogeneity, and a search limited to two databases and English-language publications. This makes our findings difficult to generalise to other populations and settings.

Given the growing threat of antimicrobial resistance, bite wound prescribing represents an underexplored and appropriate target for stewardship intervention.

Categories: Emergency Medicine, Public Health, Infectious Disease
Keywords: animal bite, antibiotic prescribing patterns, antibiotic prophylaxis, bite wounds, guideline concordance, mammalian bite, outpatient management

Introduction And Background

Mammalian bites are estimated to account for 1-2% of emergency department attendances in the United Kingdom [1]. Globally, the burden is higher still, with tens of millions of injuries attributed to dog bites alone [2]. Children are disproportionately affected, with the peak incidence of bites occurring between the ages of five and nine years [3].

Infection risk following mammalian bite wounds is affected by the mechanical nature of the bite itself and oral microbiological carriage and therefore varies by species. For example, dog bites are associated with an infection risk of 5-20%, while cat bites carry up to a 50% infection risk owing to their dense oral flora and deep punctures [4]. The specific microbiological inoculum differs from species to species but typically includes *Pasteurella*, *Streptococcus*, and *Staphylococcus,* as well as various anaerobes [5].

Antibiotics are a cornerstone of wound management. They play a role in both prophylaxis, defined as preventing infection in a currently uninfected wound, and treatment of an already established wound infection. While guidelines vary somewhat, antibiotics are universally recommended for infected wounds, while prophylaxis is generally advised on a selective basis for wounds at high risk of infection. Recommended duration also differs according to the indication, with infected wounds warranting a longer course of treatment. Prescriptions appropriate for infected wounds would therefore often be unnecessary or inappropriately long for prophylaxis. When an antibiotic is required, national guidance in the UK offers a clear recommendation for amoxicillin-clavulanate (co-amoxiclav) as empirical first-line treatment of mammalian or human bites [6]. This is echoed by advice from the American Academy of Pediatrics (AAP), and the Infectious Diseases Society of America (IDSA) also offers co-amoxiclav as an example for infected bites [7,8]. Appendix 1 summarises guidelines cited by our included publications.

The effectiveness of antibiotic prophylaxis for mammalian bites was assessed in a 2001 Cochrane review, which demonstrated a significant reduction in infection following human bites and bites of the hand. This finding did not generalise to bites from other species or at other sites. The review was most recently updated in 2008 but examined only the efficacy of antibiotics rather than assessing how they are used in practice [9]. A number of observational studies have described actual prescribing practices in emergency departments or other outpatient settings. However, they are predominantly single-centre or regional, differ in population and setting, and report inconsistent outcomes, so the nature of everyday prescribing remains unclear. The growing threat of antimicrobial resistance has further increased the importance of understanding how antibiotics are used in practice [10]. Compared with other infections such as urinary tract infections and community-acquired pneumonia, mammalian bites have received little attention in the broader antimicrobial stewardship literature.

The unresolved question is therefore not whether antibiotics should be given after a bite, but how they are given in practice: to what proportion of patients, which antibiotics, via what route, for how long, and whether these choices are concordant with guidance. Answering this requires the existing observational evidence to be synthesised, examined for variable and common themes, and compared with recommendations. This will facilitate the identification of targets for stewardship, given that efforts to inform appropriate antibiotic use can only be viewed through the lens of real-world prescribing behaviour.

Therefore, this review aims to systematically appraise the literature addressing outpatient prescribing practices for mammalian bites and assess adherence to guidelines where these are available. The primary outcomes were the proportion of patients presenting to an outpatient setting with a mammalian bite who were prescribed an antibiotic and the relative frequency of each antibiotic prescribed. Secondary outcomes were the administration route, the course duration, the indication for antibiotic treatment, and guideline concordance.

Review

Methods

We performed a systematic review of existing full-text literature, designed in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The systematic review was based on literature searches conducted in August 2026. It was registered with the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD420261482031 prior to data extraction but after the commencement of screening.

Eligibility Criteria

Studies were included in this review if they reported both the antibiotic agent and the prescribing rate in patients of any age presenting to an outpatient setting with a mammalian bite. Studies addressing a mixed population of patients receiving inpatient and outpatient management were considered eligible for inclusion if the patients initially presented to an outpatient or emergency department setting, even if a proportion were subsequently admitted for further management. Various study designs were considered eligible, including prospective and retrospective cohort studies, cross-sectional studies, audits, service evaluations, and case series of three or more patients. Language was restricted to English, and publications from before 2000 were excluded. Literature was excluded if it predominantly focused on inpatient or surgical settings where outpatient data could not be extracted or if it reported on a mixed cohort of bite and non-bite wounds without the possibility of disaggregating the two. Grey literature, conference abstracts, and unpublished studies were excluded due to a lack of peer review.

Search Strategy and Study Selection

PubMed and Europe PMC were used to collect relevant literature in August 2026. The following search was used for PubMed, with tags adapted for other databases: ("dog bite"[TIAB] OR "cat bite"[TIAB] OR "animal bite"[TIAB] OR "human bite"[TIAB] OR "bite wound"[TIAB] OR "bite injury"[TIAB] OR "mammal bite"[TIAB]) AND ("antibiotic"[TIAB] OR "antimicrobial"[TIAB] OR "antibiotic prophylaxis"[TIAB] OR "antibiotic treatment"[TIAB] OR "co-amoxiclav"[TIAB] OR "amoxicillin"[TIAB] OR "prescribing"[TIAB]) AND ("primary

care"[TIAB] OR "general practice"[TIAB] OR "emergency department"[TIAB] OR "urgent care"[TIAB] OR "outpatient"[TIAB] OR "community"[TIAB] OR "walk-in"[TIAB] OR "minor injury"[TIAB]).

Duplicate records were excluded, and all remaining records identified underwent independent title and abstract screening by two reviewers based on the above inclusion criteria. Further dual review of the full texts of the articles was then undertaken for appropriate studies. Disagreements between reviewers were resolved through discussion.

A supplementary search of WHO Global Index Medicus was conducted in October 2026 using the same protocol as above and an adapted search string (Appendix 2).

Data Extraction

Both reviewers independently extracted data from each included study. Study characteristics extracted were first author, year, country, study setting, study design, sample size and demographics, and bite type. The primary outcomes were the proportion of patients prescribed an antibiotic and the relative frequency of each antibiotic prescribed. Secondary outcomes extracted were indication, prescription duration, route, and guideline concordance where reported. For each outcome, the denominator used by the study was also recorded. Discrepancies were resolved by re-review and discussion.

Risk of Bias Assessment

An assessment of the quality and risk of bias of included studies was performed independently by two reviewers, and disagreements were resolved through discussion. The reviewers were not blinded to the title, author, or institution of the study. The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Studies Reporting Prevalence Data was used because the primary outcome measured from each included study was a proportion [11]. The item-level decision rules used are provided in Appendix 3. No overall score was assigned to each publication, and bias appraisal did not influence eligibility. Tools for comparative studies, such as Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I), were considered but were felt to be inappropriate as no included study compared exposed and unexposed groups. Because the chosen checklist is not specifically designed for publications reporting prescribing, limitations unique to these study designs may not be captured. A full appraisal of limitations is contained in the Discussion.

Synthesis Methods

Due to the descriptive nature of this review and substantial clinical heterogeneity, a meta-analysis or pooled effect estimate was considered inappropriate. A narrative synthesis was therefore constructed with findings organised according to the Synthesis Without Meta-Analysis (SWiM) guideline [12]. Results were grouped by outcome: proportion of patients prescribed antibiotics, which antibiotics were prescribed and at what rate, prescribing indication, prescription route, prescription duration, and concordance with guidance. No studies were prioritised, and when presented in a table, studies were ordered by date of publication. We used the proportion of patients prescribed an antibiotic at their index presentation as a standardised metric, summarised with the unweighted median and the range. Guideline concordance was assessed as reported by each study and, where not reported, compared with the cited recommendation or national guideline for the country. Other outcomes are presented as reported by each study, with denominators defined and presented separately. Numerators were back-calculated from percentages where required. No estimates were made for unreported data.

Heterogeneity of prescribing proportions was explored descriptively, and publications were compared across publication date, country and World Bank income classification, study setting, study design, bite type, and prescribing indication. These groupings were defined post hoc. Patterns across these domains are described without making broader inferences, and no statistical analysis was performed to identify significant differences between subgroups. No certainty analysis was conducted.

To determine whether the requirement for prescribing data at the level of the individual agent affected overall prescribing rates due to the exclusion of otherwise relevant material, a post hoc sensitivity analysis was performed. This repeated the synthesis of prescribing proportions and added studies excluded solely for lacking data on individual antibiotic choices (Appendix 4).

Protocol Amendments

The risk of bias tool was changed from ROBINS-I to the JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data before commencing bias appraisal, as the latter was considered to be more appropriate given the descriptive nature of the studies [11]. Following peer review, we performed an additional post hoc search of WHO Global Index Medicus to ensure adequate literature coverage, especially from low- and middle-income countries (Appendix 2); performed a post hoc sensitivity analysis including studies excluded solely for lack of data on individual antibiotic agent selection (Appendix 4); restructured the narrative

synthesis according to the SWiM guideline; and included a post hoc descriptive exploration of heterogeneity. The PROSPERO registration has been updated to reflect these changes.

Results

Study Selection

PubMed and Europe PMC databases were searched as outlined in the Methods, identifying 137 articles in total. Fifty-four duplicates were removed. Eighty-three articles therefore underwent initial screening, of which 48 were excluded based on the title and abstract. Thirty-five publications were sought for retrieval, of which five were inaccessible (Appendix 5). Thirty therefore underwent further full-text review, and after reviewer discussion of disagreements, nine studies met the inclusion criteria. They were therefore included in the final analysis and data synthesis. The PRISMA flow diagram is outlined in Figure *1*. A supplementary post hoc search of WHO Global Index Medicus to assess coverage did not identify any additional eligible studies (Appendix 2).

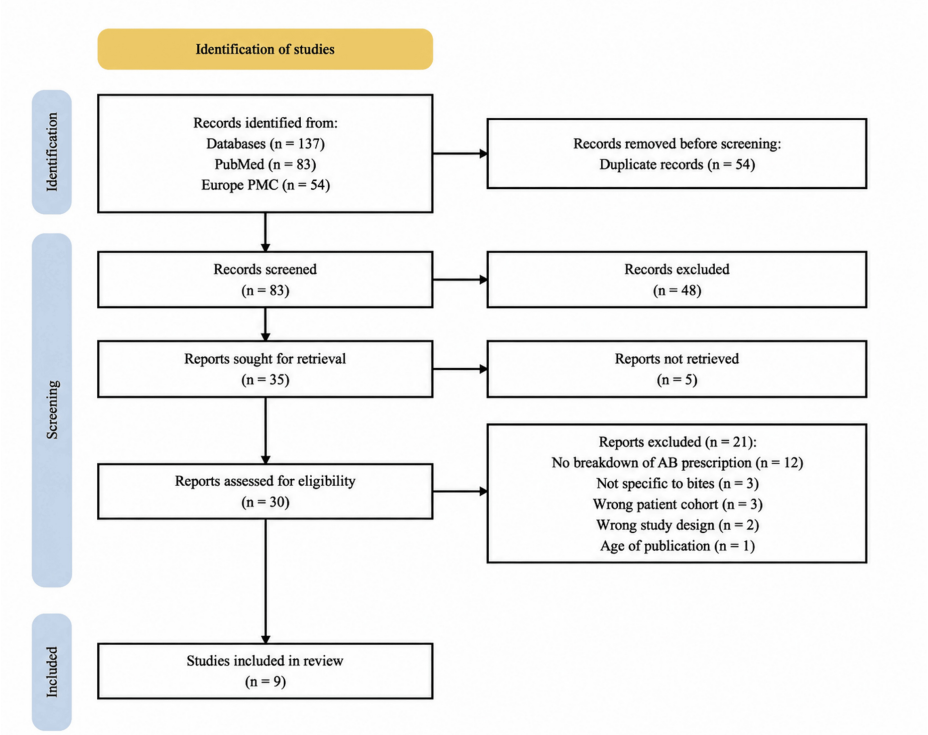

FIGURE 1: PRISMA flow diagram of study selection

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Study Characteristics

Nine retrospective observational studies published between 2012 and 2026 were included, cumulatively covering a total of 2,977 patients (Table *1*). No other study types met the inclusion criteria. Four studies were conducted in the United States, and one in each of the United Kingdom, Australia, South Africa, France, and Turkey. Seven were from high-income countries, and two from upper-middle-income countries. Six studies addressed paediatric presentations exclusively, and three studies analysed a mixed cohort of children and adults. Six studies reported exclusively on dog bites, with one reviewing horse and donkey bites and two reviewing mixed cohorts of mammalian bites. Sample sizes ranged from 36 to 741 patients.

Study	Year	Country (World Bank income level)	Source of prescribing data	Setting	Population	Bite species	N
Ogden et al. [13]	2012	USA (high)	Retrospective record review	Single children's hospital ED	Children	Mixed mammalian	741
Mendoza et al. [14]	2015	France (high)	Retrospective record review	Adult ED	Mixed age	Mixed mammalian	304
Nkomo et al. [15]	2020	South Africa (upper-middle)	Retrospective record review	Single centre emergency department	Mixed age	Dog	269
Bucak et al. [16]	2020	Turkey (upper-middle)	Retrospective record review	Single children's hospital ED	Children	Horse, donkey	36
Baxter et al. [17]	2020	Australia (high)	Retrospective record review	Two EDs	Mixed age	Dog	336
Coyle et al. [18]	2024	USA (high)	Retrospective record review	2 EDs and 7 urgent care centres	Children	Dog	672
Maduemem et al. [19]	2025	UK (high)	Retrospective record review	Paediatric ED	Children	Dog	172
Waltman et al. [20]	2025	USA (high)	Retrospective record review	Paediatric trauma centre ED	Children	Dog	356
Dalton et al. [21]	2026	USA (high)	Retrospective record review	Paediatric tertiary surgical	Children	Dog	91

TABLE 1: Characteristics of included studies

ED: emergency department.

Antibiotic Prescribing Rates

There was substantial variation in antibiotic prescribing rates across the included studies, ranging from 45.1% to 99.2% of included patients, with a median of 77.8%. Full prescribing rates for all included studies are presented in Table *2*. The lowest antibiotic prescribing rate was found in a South African emergency department by Nkomo et al., with the highest reported by Waltman et al. in a United States level one paediatric trauma centre managing facial dog bites [15,20]. The remaining seven studies reported prescribing rates between 61% and 96.7%. A post hoc sensitivity analysis was performed, including an additional eight studies that were excluded from our primary analysis because they did not report data at the individual agent level but did report a total prescribing rate (Appendix 4). This shifted the upper bound of the range to 100%, with no effect on the lower bound. The median decreased from 77.8% to 77.3%. The largest additional publication was a claims-based database study of 22,911 paediatric dog bite presentations by Davis et al., which found a prescribing rate of 56.9% [22].

Study	Indication	Denominator	Antibiotic prescribed (%)
Ogden et al. [13]	Mixed (93.1% prophylactic)	Total patients (n = 741)	61.0%
	Overall (82.1% prophylactic)	Total patients (n = 304)	74.0%
Mendoza et al. [14]	Infected	Not specified	91.1%
	Non-infected	Not specified	87.4%
Nkomo et al. [15]	Not specified	Total patients (n = 269)	45.1%
Bucak et al. [16]	Not specified	Total patients (n = 36)	77.8%
Baxter et al. [17]	Mixed (92.3% prophylactic)	Total patients (n = 336)	89.0%
Coyle et al. [18]	Prophylaxis	Encounters (n = 672)	91.5%
Maduemem et al. [19]	Not specified	Total patients (n = 172)	74.4%
Waltman et al. [20]	Prophylaxis	Total patients (n = 356)	99.2%
Dalton et al. [21]	Not specified	Total patients (n = 91)	96.7%

TABLE 2: Antibiotic prescribing rate

Antibiotic Agent Selection

Co-amoxiclav was the most frequently prescribed antibiotic in seven of the nine included studies, with a proportion ranging from 74.2% to 96.6% in these publications. Full antibiotic selection data for all included studies are presented in Table *3*. Two studies, Nkomo et al. and Dalton et al., identified departures from this trend. In South Africa, Nkomo et al. reported that 59.2% of patients received cloxacillin, while co-amoxiclav accounted for 17.5% of prescriptions [15]. In the United States, Dalton et al. found that ampicillin-sulbactam was administered intravenously in 67.8% of patients in the emergency department [21]. Across all included studies, a range of other antibiotics were reported in smaller proportions, including but not limited to trimethoprim-sulfamethoxazole, clindamycin, doxycycline, cefazolin, and combination therapies.

Study	Denominator, n	Most common agent, %	Other agents >1%	Route of administration	Duration (format as reported)
Ogden et al. [13]	Patients given AB (n = 451)	Co-amoxiclav, 85%	Clindamycin + co-trimoxazole 2%; other (including cephalexin, cefdinir, amoxicillin) 13%	Not reported	2–3 days 6%; 4–7 days 40%; >7 days 54%
Mendoza et al. [14]	Patients given AB (n = 224)	Co-amoxiclav, 83.5%	Pristinamycin 5.4%; doxycycline 4.0%; amoxicillin 4.0%; other combinations or undocumented 3.1%	Not reported	7.4 days (mean)
Nkomo et al. [15]	Patients given AB (n = 120)	Cloxacillin, 59.2%	Amoxicillin 20.8%; co-amoxiclav 17.5%; metronidazole 9.2%; gentamicin 3.3%; erythromycin 2.5%	Not reported	Not reported
Bucak et al. [16]	Patients given AB (n = 28)	Co-amoxiclav, 96.6%	IV cefuroxime + metronidazole 3.4%	96.6% oral, 3.4% IV	Not reported
Baxter et al. [17][a]	Non-infected wounds given AB in ED/ward (n = 178)	Co-amoxiclav, 53.9%	Co-amoxiclav 53.9%, pip-taz 36%, 1st gen cephalosporin 15.7%	51.1% IV	Not reported
	Non-infected wounds given AB at discharge (n = 271)	Co-amoxiclav, 87.0%	Co-amoxiclav 87%, nitroimidazole 4.1%, tetracycline 2.6%	Not reported	
Coyle et al. [18]	Total prescriptions (n = 638)	Co-amoxiclav, 91.2%	Clindamycin 3.9%; co-trimoxazole 3.1%; other 1.6%	97% oral; 3% initial IV dose	6.62 days (mean) 1-5 days 49.8%; 6-7 days 28.7%; 9-14 days 21.5%
Maduemem et al. [19]	Patients given AB (n = 128)	Co-amoxiclav, 74.2%	Agent not documented, 23.4%; topical chloramphenicol, 1.6%	Not reported	3 days 12.6%; 5 days 26.3%; 7 days 12.6%; unknown 48.4%
Waltman et al. [20]	Patients given AB (n = 353)	Co-amoxiclav, 91.2%	Co-trimoxazole + clindamycin 3.4%; clindamycin 1.5%; doxycycline 1.1%; amoxicillin 1.1%; more than one antibiotic, other 1.1%	Not reported	3–5 days 47.6%; 7 days 37.7%; ≥10 days 12.5%; missing documentation 2.2%
Dalton et al. [21]	Patients given AB (n = 87)	Ampicillin-sulbactam, 67.8%	Co-amoxiclav 25.3%; cefazolin 11.5%; co-trimoxazole 4.6%; clindamycin 4.6%; ceftriaxone 3.4%; metronidazole 2.2%; vancomycin 2.2%; gentamicin 1.1%; piperacillin–tazobactam 1.1%; unknown 2.2%	Ampicillin-sulbactam given IV; 98.9% on orals at discharge	8.9 days (mean)

TABLE 3: Antibiotic agents, route of administration, and duration

Percentages for antibiotic agents are of those who received any antibiotic, unless otherwise stated.

[a]Table data relate to the prophylaxis group only. Most of the infected cohort were wound culture-positive, affecting prescribing.

Co-amoxiclav: amoxicillin-clavulanate; Co-trimoxazole: trimethoprim-sulfamethoxazole; ED: emergency department.

Prescribing Indication

Prescribing indication was reported inconsistently, with few studies clearly disaggregating prophylaxis and

treatment of established infection. The publications by Coyle et al. and Waltman et al. were unique in describing cohorts of entirely prophylactic prescriptions [18,20]. Baxter et al. reported that 92.3% of prescriptions were prophylactic [17]. Ogden et al. and Mendoza et al. presented mixed populations, but each noted that uninfected bites comprised 93.1% and 82.1% of presentations, respectively [13,14]. Mendoza et al. also offered separate subgroup prescribing rates for uninfected and infected bites, although these subgroup denominators were not reported [14]. The four remaining studies did not clearly state the prescribing indication for their cohorts.

Route of Administration

Route of administration was reported in four of the nine included studies. Coyle et al. reported that 97% of prescriptions in Ohio emergency departments were oral, with the other 3% intravenous [18]. Similarly, Bucak et al. reported that 3.4% of patients were treated via the intravenous route, with the rest of the prescriptions being oral [16]. Frequent initial intravenous dosing was identified in two studies. While Dalton et al. found that 98.9% of their cohort were discharged on oral antibiotics, at least 67.8% of patients received an initial intravenous agent in the emergency department [21]. Similarly, in Baxter et al., 51.1% of patients with non-infected wounds receiving antibiotics in the ED were administered at least one intravenous dose [17].

Prescription Duration

Antibiotic duration was reported in six of the nine included studies and is presented in full in Table *3*. Of these studies, two reported a mean duration exclusively, three reported only categorical intervals, and one reported both a mean and intervals. Mean prescription durations ranged from 6.6 to 8.9 days. Among the studies reporting prescription duration in categories, the most common durations varied: 1-5 days in Coyle et al., 3-5 days in Waltman et al., 5 days in Maduemem et al., and >7 days in Ogden et al. [13,18,19,20].

Concordance

As outlined in Table *4*, six studies cited formal guidance, two referred to expert opinion, and one made no reference to existing guidance or literature. Co-amoxiclav was the most frequently prescribed antibiotic in seven of the nine studies, and when authors or their cited guidelines directly recommended an antibiotic agent, co-amoxiclav was always one of the first-line options or the only first-line option. Where agent concordance with guidelines was directly measured in the publication itself, Ogden et al. reported 87% adherence, and Waltman et al. reported 94.6% [13,20]. The two studies where co-amoxiclav was not the most commonly prescribed antibiotic were Nkomo et al., in which cloxacillin accounted for 59.2% of prescriptions despite cited South African guidance advising co-amoxiclav, and Dalton et al., where 67.8% of patients received ampicillin-sulbactam intravenously in the emergency department before switching to an unspecified oral agent [15,21].

Study	Guidance cited	Agent concordance	Duration standard and finding	Other findings
Ogden et al. [13]	AAP	As per authors: 87% appropriate agent	2–3 days for uninfected wounds (authors' definition); 6% received recommended duration	—
Mendoza et al. [14]	Expert opinion	Authors state co-amoxiclav: Co-amoxiclav 83.5%	2–5 days (prophylaxis); mean prophylaxis duration 7.4 days	—
Nkomo et al. [15]	Engelbrecht et al. [23]	Guidance recommends co-amoxiclav: Cloxacillin most frequent 59.2%; co-amoxiclav 17.5%	Not assessed	—
Bucak et al. [16]	Expert opinion	Authors state co-amoxiclav: Co-amoxiclav 96.6%	Not assessed	No specific guidance exists for horse or donkey bites
Baxter et al. [17]	Australian Therapeutic Guidelines	Guidance recommends co-amoxiclav: Co-amoxiclav 87.0% on discharge, 59.0% in hospital; 36% IV piperacillin-tazobactam in-hospital	Not assessed	27.5% of prophylaxis recipients met no guideline-defined high-risk criterion
Coyle et al. [18]	IDSA, AAP	Authors state co-amoxiclav; Co-amoxiclav 91.2%	3–5 days (IDSA; prophylaxis); mean 6.6 days	Authors concluded antibiotics were ‘often prescribed outside guidelines’
Maduemem et al. [19]	None cited; compared with UK NICE NG184	Guideline recommends co-amoxiclav: Co-amoxiclav 74.2%	Not assessable (indication not reported)	—
Waltman et al. [20]	AAP	As per authors: 94.6% appropriate agent	3–5 days (authors’ definition); 52.4% exceeded recommended duration	25% of co-amoxiclav prescriptions below 65% of recommended 45 mg/kg/day dose
Dalton et al. [21]	AAP	Not assessable (unspecified oral agent at discharge)	3–5 days (AAP); mean 8.9 days	—

TABLE 4: Assessment of guideline concordance

AAP: American Academy of Pediatrics; IV: intravenous; IDSA: Infectious Diseases Society of America; UK: United Kingdom; NICE: National Institute for Health and Care Excellence; NG184: NICE guideline 184.

Where assessed by the authors, prescription durations exceeded recommendations. Ogden et al. stated that only 6% of patients received the recommended duration of antibiotic therapy, and 52.4% of prescriptions in Waltman et al. exceeded the suggested prescription length [13,20]. Mean prophylaxis durations of 7.4 days in Mendoza et al. and 6.6 days in Coyle et al. both exceeded their recommended durations of 2-5 and 3-5 days, respectively [14,18]. Dalton et al. explicitly cited AAP guidance of 3-5 days for infection prophylaxis in their study, compared with a mean duration of 8.9 days, though the indication for their prescriptions was not clarified in the text [21].

Other concordance issues were noted by Baxter et al. [17]. They stated that 27.5% of patients who received infection prophylaxis did not meet any guideline-defined high-risk criteria and that 36.0% of patients receiving prophylaxis in hospital received intravenous piperacillin-tazobactam despite this being reserved for moderate/severe infection. Waltman et al. found that 25% of co-amoxiclav prescriptions were below 65% of the recommended 45 mg/kg/day dosage [20].

Risk of Bias Assessment

Assessment of the risk of bias was undertaken for all included studies using the JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data [11]. Item-level judgements are shown in Table *5*, with decision rules in Appendix 3. In summary, Ogden et al. used a convenience sample (Q2). Sample size adequacy was rated as inappropriate in three samples as per the JBI-suggested formula (Q3) [11]. The

coverage of the identified sample was unclear in three publications (Q5), and the method of identifying bite presentations was unclear in six (Q6). Documentation of the prescribing rate was inadequate in two studies (Q7). Response rate was not applicable to retrospective record reviews (Q9).

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Ogden et al., 2012 [13]	Y	N	Y	Y	Y	Y	Y	Y	N/A
Mendoza et al., 2015 [14]	Y	Y	Y	Y	Y	U	N	Y	N/A
Nkomo et al., 2020 [15]	Y	Y	N	Y	Y	Y	Y	Y	N/A
Bucak et al., 2020 [16]	Y	Y	N	Y	Y	U	Y	Y	N/A
Baxter et al., 2020 [17]	Y	Y	Y	Y	Y	U	Y	Y	N/A
Coyle et al., 2024 [18]	Y	Y	Y	Y	U	U	Y	Y	N/A
Maduemem et al., 2025 [19]	Y	Y	N	Y	U	U	N	Y	N/A
Waltman et al., 2025 [20]	Y	Y	Y	Y	Y	Y	Y	Y	N/A
Dalton et al., 2026 [21]	Y	Y	Y	Y	U	U	Y	Y	N/A

TABLE 5: JBI critical appraisal checklist results

Q: question; Q1: sample frame appropriate; Q2: participants sampled appropriately; Q3: sample size adequate; Q4: subjects and setting described in detail; Q5: data analysis with sufficient coverage; Q6: valid methods for condition identification; Q7: condition measured in a standard, reliable way; Q8: appropriate statistical analysis; Q9: response rate adequate (N/A for all, retrospective record reviews); JBI: Joanna Briggs Institute.

Exploration of Heterogeneity

The proportion of patients prescribed an antibiotic varied with study characteristics (Tables *1*, *2*). In particular, the highest prescribing rates were reported in specialist settings, with 99.2% and 96.7% of patients treated with antibiotics in the paediatric trauma centre ED of Waltman et al. and the tertiary surgical centre of Dalton et al., respectively [20,21]. In general emergency departments, the proportion of patients prescribed antibiotics ranged from 45.1% to 91.5%. Newer studies also tended to report higher prescribing rates, though these two observations are difficult to disentangle, as Waltman et al. and Dalton et al. are also the two most recent publications [20,21]. Comparison of studies addressing paediatric and mixed populations demonstrated total prescription rates ranging from 61.0% to 99.2% in studies involving children exclusively and from 45.1% to 89.0% in studies without an age restriction. No clear pattern emerged from the review of prescribing rates by income, with the two studies from World Bank upper-middle-income countries, South Africa and Turkey, reporting figures of 45.1% and 77.8%, respectively [15,16]. Every included study was a retrospective record review, and eight of the nine reported exclusively or predominantly on dog bites, precluding meaningful comparison of prescribing rates by study design or bite species. Similarly, variation by prescribing indication could not be examined because of the frequent absence of reporting in this domain.

Discussion

Our results demonstrated considerable diversity in prescribing behaviours for mammalian bite wounds in outpatient settings. The proportion of patients prescribed antibiotics varied widely and was highest in specialist settings. Antibiotic choice was generally consistent and aligned with cited guidance, but prescription duration and indication differed from recommendations, with prophylactic courses typically longer than advised. The evidence base in this systematic review was small and came predominantly from studies of paediatric populations and dog bites, with incomplete reporting and heterogeneous methodology. That said, this review offers the first synthesis of observed bite-wound prescribing and highlights priorities for further evaluation both at individual sites and for mammalian bite prescribing more broadly.

Co-amoxiclav dominated across seven of the nine studies included in this review, with these publications coming from Australia, France, Turkey, the United Kingdom, and the United States [13,14,16-20]. This generally matched the first-line recommendations of guidelines cited by the studies themselves. The two exceptions to this trend came from Dalton et al. in the United States, where intravenous ampicillin-sulbactam was commonly given as an initial agent [21], and Nkomo et al. in South Africa, where cloxacillin was most frequently prescribed [15]. With the exception of the United States, countries were represented by a single study, meaning that findings from individual sites cannot be taken to represent national prescribing behaviours generally, and broad regional comparisons should be avoided. Concordant agent selection also does not necessarily mean that prescribing was appropriate, as this also depends on indication, prescription

duration, prescription route, and patient factors, all of which were inconsistently reported.

The predominant use of ampicillin-sulbactam identified by Dalton et al. is defensible from a stewardship perspective as an initial agent prior to oral step-down, as it has generally equivalent coverage to co-amoxiclav [21]. That said, discharge prescriptions after oral switch were not reported, so concordance with guidelines on leaving hospital could not be assessed. However, even where co-amoxiclav dominated, there was nuance and deviation from guidance within publications. In Baxter et al., intravenous piperacillin-tazobactam was used in over one-third of patients receiving in-hospital prophylaxis, though cited recommendations reserved this agent for treatment of moderate-to-severe infection, preferring co-amoxiclav for prophylaxis [17]. Piperacillin-tazobactam also has anti-pseudomonal action, so unnecessary use can create selective pressure for resistance and damage the gut microbiome [24]. Regional variation also exists for lower-prevalence agents. For example, pristinamycin (a streptogramin antibiotic not found in any other included studies) accounted for 5.4% of prescriptions in the French cohort of Mendoza et al. [14], and the combination therapy of clindamycin and co-trimoxazole is favoured across multiple US sites [13,18,20]. This could reflect rates of allergy, specialist microbiology advice, patient factors, or early culture results, as well as clinical non-adherence, and is therefore less likely to warrant significant concern from a stewardship perspective.

However, the most clinically important deviation from the pattern of co-amoxiclav predominance comes from the work of Nkomo et al., where cloxacillin accounted for 59.2% of prescriptions [15]. This anti-staphylococcal agent has a narrower spectrum of coverage than co-amoxiclav, with little Gram-negative activity. Crucially, it also has no meaningful activity against Pasteurella multocida, a key bacterium implicated in infected bite wounds. The rationale for cloxacillin predominance is not discussed by Nkomo et al., but prescribing does not reflect the local guidance of Engelbrecht et al., who explicitly cite co-amoxiclav as the preferred antibiotic for the management of dog bites [23]. The predominance of cloxacillin in this cohort may therefore reflect either prescriber preference or agent availability. Regardless of the specific rationale, it represents a potentially clinically meaningful gap in antimicrobial coverage and may merit further analysis from a patient safety perspective.

Prescription duration was reported inconsistently across included publications, with means, categorical intervals, and absent data found in the literature. Additionally, prophylaxis and treatment of established infection were often not disaggregated. This limited interpretability because each of these indications warrants a different duration. That said, where durations were directly compared with guidance, prophylactic courses were generally longer than recommended. Unnecessarily long courses increase exposure to antibiotics and therefore increase the burden of side effects and selection for resistance. Factors contributing to this non-adherence to guidance could include undocumented risk factors or infection; clinical complexity beyond guideline parameters; or a failure of guidance to reflect the realities of real-world perceptions of infection risk. In addition, recommended durations differ between guidelines and, as in the case of the Australian eTG, have changed over time, with clinical practice potentially lagging behind. Overall, these findings suggest a possible pattern of prolonged prescriptions but do not fully establish a trend.

Reporting on prescription indication was often missing, limiting assessment of whether antibiotics were required. Two studies exclusively examined prophylaxis, with three more examining mixed populations where prophylactic prescribing dominated. Four did not report on indication. However, taken together, multiple lines of evidence indirectly suggest that antibiotics are prescribed more often than guidelines would support. In Baxter et al., the one publication that directly commented on indication compared with guidance, over a quarter of treated wounds did not possess high-risk features that warranted a prescription [17]. In general, prescribing rates were high across most studies despite non-infected wounds accounting for the majority of presentations where this was reported and high-risk features being required in this scenario. In Coyle et al., for example, the overall prescribing rate was 91.5% despite the indication being entirely prophylactic, leading the authors themselves to conclude that there was a ‘tendency to prescribe outside current guidelines’ [18]. A 2001 Cochrane review of treatment for bites found the benefit of prophylaxis to be limited to bites from humans and hand bites, making widespread prescribing beyond guidance harder to justify [9]. That said, none of these findings are conclusive; for example, high-risk features warranting prophylaxis may not have been documented, which is an inherent limitation of retrospective record review.

This review has limitations at the level of both the included studies and the review itself. Firstly, with respect to the included literature, all nine publications were retrospective and observational and therefore carry an inherent risk of documentation bias. For example, appropriate prescribing decisions may appear non-concordant with guidelines if high-risk features were not noted in the clinical record. Furthermore, appraisal for bias revealed that the process for identifying cases was inadequately described in six of the nine studies. Secondly, prophylaxis and treatment of established infection were not always disaggregated. Each of these scenarios comes with a unique set of recommendations, so the scope for drawing conclusions about the concordance of prescribing behaviours is reduced. Thirdly, most studies came from Western high-income settings, were based in hospitals, and addressed paediatric populations and dog bites. This limits the generalisability of findings to other settings, patient cohorts, and especially bites from other species, given the extent to which dogs predominate in the reviewed literature. Finally, the JBI checklist for prevalence studies was principally designed for the assessment of disease prevalence reporting, not prescribing [11]. We

mitigated this with a set of defined decision rules, but factors such as documentation of prescribing indication, risk factors, and definition of denominators were not addressed. We therefore considered these factors narratively throughout the review.

The review itself had several limitations. Firstly, our primary search was restricted to two databases (PubMed and Europe PMC) and to English-language research, with grey literature and conference abstracts excluded. This could have excluded relevant data, especially from resource-poor countries where prescribing behaviours may differ most substantially from guidelines [25]. That said, an additional post hoc search of the WHO Global Index Medicus did not reveal any further publications meeting the primary inclusion criteria. Secondly, the requirement for studies to include data at the level of individual antibiotic agents excluded some research that reported overall prescribing rates. We therefore conducted an additional post hoc sensitivity analysis of overall prescribing rates, including these omitted studies, with only minimal effect on the median. Thirdly, considerable heterogeneity meant that results were synthesised narratively without statistical testing, and studies used different variables as denominators for certain figures, limiting direct comparison. These comparisons may also have been confounded.

Conclusions

This review identifies multiple possible avenues for future research. The aforementioned limitations of retrospective record reviews could be overcome by prospective research with standardised outcome reporting. Studies from under-represented sites, including lower-income settings, are also needed. This would facilitate direct comparisons between settings to determine how different prescribing behaviours translate to clinical outcomes. The justification for differences between guidelines, such as those concerning prescription duration, may also merit review. At the level of individual sites, the work of Nkomo et al. warrants detailed follow-up to determine whether the recorded predominance of cloxacillin reflects local prescribing practices or is reflective of South African practice more widely, and whether this trend is associated with poor patient safety outcomes given its narrower antimicrobial coverage.

In conclusion, this systematic review found a wide range of prescribing rates for mammalian bites. Co-amoxiclav was the most frequently prescribed antibiotic in most studies, generally in line with guidance, though there were notable exceptions. Where course durations were reported, they generally indicated a tendency for prescriptions to exceed recommended durations, and multiple findings suggest that antibiotics may be prescribed more often than supported by guidance. The drivers of possible non-adherence are unclear but could include clinician knowledge gaps, research artefacts, or a need for guidance revision. However, our findings remain uncertain and are subject to limitations arising from incomplete documentation and difficulties in generalising to other populations and settings. As antimicrobial resistance continues to rise, mammalian bites remain an underexplored target for stewardship research.

Appendices

Appendix 1: Summary of key guidelines referenced by included studies

Guideline	Country	Version/date	Source	Who should get prophylaxis	First-line agent	Penicillin-allergy alternative	Route	Prophylaxis duration	Treatment duration
NICE NG184 [6]	UK	Published November 4, 2020	Primary	Varies by species. None if skin is unbroken. Offer for human or cat bites that break skin and draw blood. Dog/other pet bites that draw blood: offer if penetrating bone/joint/tendon/vessels, deep/puncture/crush, or visibly contaminated; consider if high-risk site or comorbidity	Co-amoxiclav	Doxycycline + metronidazole (adults and 12–17 y); co-trimoxazole (<12 y)	Oral if possible; IV review within 48 h	3 days	5 days (up to 7 with review)
IDSA SSTI guideline [7]	US	2014 update; *Clin Infect Dis* 59:e10–52	Primary	Pre-emptive therapy for immunocompromised, asplenic, advanced liver disease; oedema of affected area, moderate-severe wounds (esp. hand/face injuries), possible periosteum/joint penetration	Agent active against both aerobes and anaerobes such as co-amoxiclav	Not specified	Not specified	3–5 days	Not specified
AAP Red Book [8]	US	32nd ed.	Primary	Pre-emptive therapy for immunocompromised, asplenic, advanced liver disease; moderate-severe wounds (esp. hand/face injuries), oedema of the affected area possible periosteum/joint penetration; cat bites	Co-amoxiclav (oral), ampicillin-sulbactam (IV)	Extended-spectrum cephalosporin or co-trimoxazole + clindamycin	Not specified	3–5 days	Not specified
eTG Antibiotic [17]	Australia	2020	Baxter et al. (2020)	Delayed presentation ≥8 h; puncture not adequately debrided; hand/foot/face; deep tissue involvement; open fracture; immunocompromise; cat bite	Co-amoxiclav	Not specified	Oral unless moderate to severe infection	3 days	5 days for mild, not given for moderate/severe
Engelbrecht et al. [23]	South Africa	NA	Primary	High-risk patients, such as those with vascular compromise, depressed immunity, diabetes mellitus and asplenia. High-risk wounds: puncture and crush; wounds of the hands and lower extremities; wounds older than 12 hours; risk of rabies	Co-amoxiclav	Quinolone or clindamycin + co-trimoxazole	Not specified	Not specified	Not specified

TABLE 6: Summary of key guidelines referenced by included studies

NICE: National Institute for Health and Care Excellence; UK: United Kingdom; IDSA: Infectious Diseases Society of America; SSTI: skin and soft tissue infection; US: United States; AAP: American Academy of Pediatrics; IV: intravenous; eTG: electronic Therapeutic Guidelines; NA: not available.

Appendix 2: Search string

A supplementary search was performed for missed literature, especially from low- and middle-income countries. The full search string is included below; it was performed on October 27, 2026.

(ti:("dog bite" OR "cat bite" OR "animal bite" OR "human bite" OR "bite wound" OR "bite injury" OR "mammal bite") OR ab:("dog bite" OR "cat bite" OR "animal bite" OR "human bite" OR "bite wound" OR "bite injury" OR "mammal bite"))

AND

(ti:("antibiotic" OR "antimicrobial" OR "antibiotic prophylaxis" OR "antibiotic treatment" OR "co-amoxiclav" OR "amoxicillin" OR "prescribing") OR ab:("antibiotic" OR "antimicrobial" OR "antibiotic prophylaxis" OR "antibiotic treatment" OR "co-amoxiclav" OR "amoxicillin" OR "prescribing"))

AND

(ti:("primary care" OR "general practice" OR "emergency department" OR "urgent care" OR "outpatient" OR "community" OR "walk-in" OR "minor injury") OR ab:("primary care" OR "general practice" OR "emergency department" OR "urgent care" OR "outpatient" OR "community" OR "walk-in" OR "minor injury"))

The translated search strategy initially returned two records. To reduce the risk of missing relevant literature, we repeated the search without the care-setting terms. This returned 22 records.

JH screened records at title and abstract level, then at full text, against the review's eligibility criteria, with verification by SB.

This supplementary analysis identified no further studies eligible for inclusion, despite using a different database and broadening the search strategy to further increase sensitivity (Figure 2). This suggests that our primary search strategy is unlikely to have missed a substantial body of evidence.

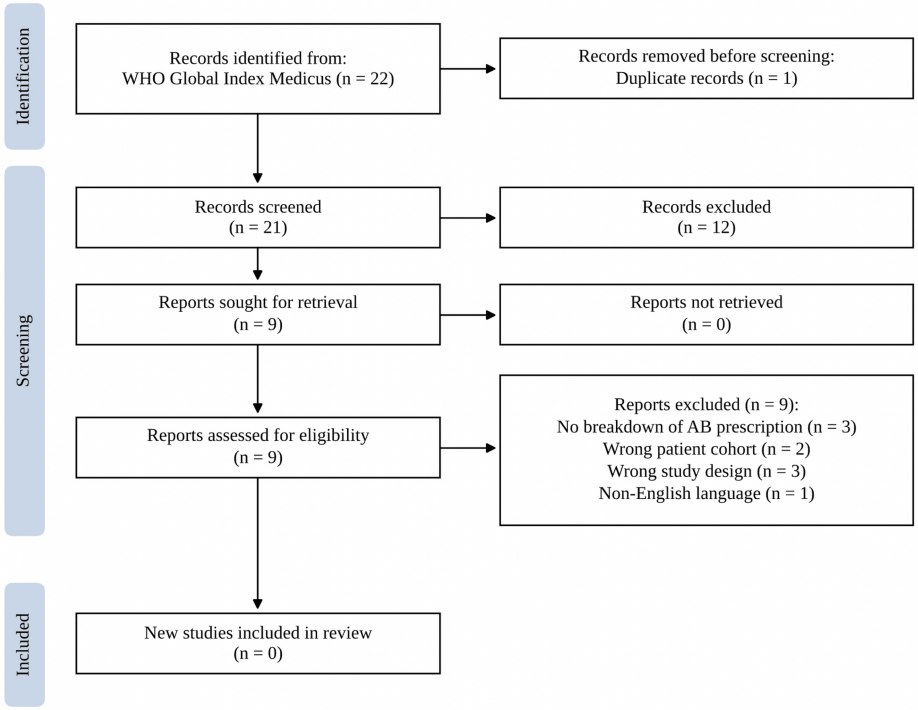

FIGURE 2: Supplementary search conducted through WHO Global Index Medicus

Appendix 3: JBI critical appraisal checklist

JBI critical appraisal checklist for studies reporting prevalence data: decision rules
Q1. Sample frame judged against each study's own stated target population (e.g. paediatric ED bite presentations)
Q2. Judgement of sampling methods
Q3. Sample size judged against n needed to estimate the study's observed prescribing proportion with precision of 5% at 95% confidence: $n = 1.96^2 \times P(1-P) / 0.05^2$.
Q4. Judgement of setting detail
Q5. Judgement of eligible patients lost from the analysis (e.g. records unavailable). N if losses > 10% of patients.
Q6. Judgement of how cases were identified (e.g., coding, keyword search, manual record review).
Q7. Judgement of ascertainment of primary outcomes. N if >10% missing
Q8. Judgement of statistical analysis.
Q9. NA - no participant response in retrospective record review

TABLE 7: JBI critical appraisal checklist for studies reporting prevalence data: decision rules

JBI: Joanna Briggs Institute; Q: question; ED: emergency department; n: sample size; P: observed prescribing proportion; N: no; NA: not applicable.

Appendix 4: Supplementary prescribing rate analysis

Study	Synthesis group	Year	Country	Setting	Population	Indication	N	Prescribed (n)	Prescribed (%)
Ogden et al. [13]	Primary	2012	USA	Paediatric ED	Children	Mixed	741	452	61.0%
Mendoza et al. [14]	Primary	2015	France	Adult ED	Adults	Mixed	304	225	74.0%
Nkomo et al. [15]	Primary	2020	South Africa	ED	Mixed age	Not specified	269	120	45.1%
Bucak et al. [16]	Primary	2020	Turkey	Paediatric ED	Children	Not specified	36	28	77.8%
Baxter et al. [17]	Primary	2020	Australia	ED	Mixed age	Mixed	336	299	89.0%
Coyle et al. [18]	Primary	2024	USA	Paediatric ED/urgent care	Children	Prophylaxis	672	615	91.5%
Maduemem et al. [19]	Primary	2025	UK	Paediatric ED	Children	Not specified	172	128	74.4%
Waltman et al. [20]	Primary	2025	USA	Paediatric trauma centre	Children	Prophylaxis	356	353	99.2%
Dalton et al. [21]	Primary	2026	USA	Paediatric tertiary surgical	Children	Not specified	91	88	96.7%
Merchant et al. [26]	Supplementary	2007	USA	Trauma centre ED	Adults	Mixed	388	300	77.3%
Tabbara et al. [27]	Supplementary	2012	Switzerland	Single centre ED	Mixed age	Mixed	104	63	60.5%
Birdsey et al. [28]	Supplementary	2015	Australia	Single centre ED	Not stated	Mixed	160	89	55.6%
Chavez et al. [29]	Supplementary	2019	Mexico	Surgical referral centre	Mixed age	Mixed	416	416	100.0%
Davis et al. [22]	Supplementary	2023	USA	ED/outpatient (insurance claims, MarketScan)	Children	Initial visit, wounds not coded as infected	22,911	13,043	56.9%
Means et al. [30]	Supplementary	2023	USA	Trauma centre ED	Children	Mixed	1438	1158	80.50%
Ehrhard et al. [31]	Supplementary	2023	Switzerland	Single centre ED	Adults	Mixed	759	624	82.2%
Stoclet et al. [32]	Supplementary	2025	France	Single centre ED	Mixed age	Mixed	5081	3233	63.3%

TABLE 8: Supplementary prescribing rate analysis

Appendix 5: Reports sought but not retrieved

Study (author, year)	Title	Journal/Source	Retrieval attempts	Reason not retrieved	Potential relevance (from abstract)
Bower (2001)	Managing dog, cat, and human bite wounds	The Nurse Practitioner	Two	Full text not available online	Probable review article
Thomas (1987)	Man's best friend?: a review of the Austin Hospital's experience with dog bites	Medical Journal of Australia	Two	Full text not available online	Likely relevant
Bula Rudas (2018)	Human and Animal Bites	Paediatrics in Review	Two	Full text not available online	Probable review article
Del Peral Samaniego (2019)	Dog bites, a current problem in our environment	Revista Cirugía Pediátrica	Two	Full text not available online	Likely relevant
Edlich (1986)	Emergency department management of mammalian bites	Emergency Medicine Clinics of North America	Two	Full text not available online	Probable review article

TABLE 9: Reports sought but not retrieved

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Sarah Barrie, Jack Hughes

Acquisition, analysis, or interpretation of data: Sarah Barrie, Jack Hughes

Drafting of the manuscript: Sarah Barrie, Jack Hughes

Critical review of the manuscript for important intellectual content: Sarah Barrie, Jack Hughes

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