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Presentation and management of insect bites in out-of-hours primary care: a descriptive study

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ABSTRACT

Objectives To describe the population presenting to out-of-hours primary care with insect bites, establish their clinical management and the factors associated with antibiotic prescribing.

Design An observational study using routinely collected data from a large out-of-hours database (BORD, Birmingham Out-of-hours general practice Research Database).

Setting A large out-of-hour primary care provider in the Midlands region of England.

Participants All patients presenting with insect bites between July 2013 and February 2020 were included comprising 5774 encounters.

Outcome measures This cohort was described, and a random subcohort was created for more detailed analysis which established the clinical features of the presenting insect bites. Logistic regression was used to model variables associated with antibiotic prescribing.

Results Of the 5641 encounters solely due to insect bites, 67.1% (95% CI 65.8% to 68.3%) were prescribed antibiotics. General practitioners were less likely to prescribe antibiotics than advanced nurse practitioners (60.5% vs 71.1%, p<0.001) and there was a decreasing trend in antibiotic prescribing as patient deprivation increased. Pain (OR 2.13, 95% CI 1.18 to 3.86), swelling (OR 2.88, 95% CI 1.52 to 5.46) and signs of spreading (OR 3.45, 95% CI 1.54 to 7.70) were associated with an increased frequency of antibiotic prescribing. Extrapolation of the findings give an estimated incidence of insect bite consultations in England of 1.5 million annually.

Conclusion Two-thirds of the patients presenting to out-of-hours primary care with insect bites receive antibiotics. While some predictors of prescribing have been found, more research is required to understand the optimal use of antibiotics for this common presentation.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This unique out-of-hours primary care data set provides new insights into this common and under-researched presentation.
- ⇒ Using free-text searching of routinely collected data allowed good data capture with a high degree of confidence.
- ⇒ For the first time, detailed free-text analysis of a random subcohort helps identifies predictors of prescribing behaviour through quantitative methods.
- ⇒ Findings were limited by poor documentation quality in some areas.

INTRODUCTION

Symptoms caused by insect bites are a familiar presentation to clinicians in primary care. A study in UK general practice between 1999 and 2003 reported the mean weekly incidence of insect bites presentations to be 5.4 per 100000 population.[1] This estimate has not been verified so uncertainty exists around the incidence of insect bites. People bitten by insects may seek medical care because of symptoms due to inflammatory or/and hypersensitivity reactions, cellulitis or vector (insect)-borne diseases, for example, malaria.[2 3] Although the majority of bites only cause minor symptoms, anaphylaxis and sepsis are potential serious complications. For this study we have used the colloquial term ‘insect’ but this includes all arthropods as in practice people often will not know the species involved.

Clinical guidance recommends analgesia and oral antihistamines in the management of insect bites, or oral steroids if the reaction is large, although the evidence for recommendations is lacking.[4 5] Antibiotics are recommended when there are signs and symptoms of infection with flucloxacillin being first line in the UK due to it being relatively narrow-spectrum with good activity against common pathogens in skin infections such as *Staphylococcus aureus* and *Streptococcus pyogenes*.[6] However, due to common clinical features, such as erythema and swelling, it can be difficult to differentiate between hypersensitivity responses, inflammatory reactions and infective processes. A survey of general practitioners (GPs) found the presence of systemic signs, spreading erythema and patient comorbidities would influence their antibiotic prescribing decisions, and 73% of respondents felt confident they could differentiate between inflammatory and infective responses.[7] GPs also reported flucloxacillin is the most commonly prescribed antibiotic for infected insect bites,[7] which is consistent with National Institute for Health and Care Excellence guidance on skin infections[6] although the proportion of patients presenting to primary care with insect bites that receive antibiotics is unknown. Insect bites are more common in the summer[1] and there is similar seasonality to flucloxacillin prescribing, with the prescribing rate in July being 33% higher than that in December.[8] This study also found that 3.2% of prescriptions were associated with a clinical code of 'insect bite' which would explain some, but not all, of the seasonal prescribing pattern. However, this may underestimate the incidence of insect bites as other codes such as 'cellulitis' (6.2%), 'rash/skin symptoms' (2.0%) or anatomical sites (eg, 'infected toe/finger' 2.5%) may have an underlying insect bite aetiology.

Given concerns about overprescribing of antibiotics and resulting antimicrobial resistance,[9] it is important to have a better understanding of the incidence and management of insect bites. The aim of this study is to describe the population presenting to out-of-hours primary care with suspected insect bites, establish the clinical management of these patients and gain insight into factors associated with antibiotic prescribing. This will allow an estimate of the national incidence of insect bites and the associated antibiotic use.

METHODS

Study design

This was an observational study using routine data from the Birmingham Out-of-hours general practice Research Database (BORD).

Setting

BORD is a database of all consultations undertaken by a large out-of-hours general practice provider (Badger Group) from July 2013 until July 2020 (inclusive). In England, general practice is split into core hours (08:00–18:30, Monday to Friday) and out-of-hours (all other times including national holidays). Out-of-hours care is generally provided by separate organisations from those providing core hour services (the patient's usual GP) and cover a larger geographical area. Clinical encounters in BORD were recorded on the Adastra patient management system.[10] The consultations encompass the whole range of primary care outside of core hours general practice provided to a population of around 1.5 million people in the West Midlands region of England. The region includes a wide variation in ethnicities, cultures and socioeconomic status. The database contains coded and free-text information including patient demographic details, clinical observations, diagnostic classifications, prescribing information and outcome. Clinicians have unique identifiers, and patient identifiers are consistent across multiple contacts. Face-to-face clinical encounters take place in treatment centres across the area as well as in patients' homes. Telephone encounters are also included. Neither Adastra or BORD has direct linkage to core hours general practice or secondary care systems.

Participants

We included all patient encounters that involved insect bites and their sequelae from July 2013 (the start of the database) until the end of February 2020 (to avoid any effects of the COVID-19 pandemic). Insect bite encounters were identified using free-text searches for 'insect', 'bite' or 'bitten'. These consultations were screened to verify inclusion and stratify as either 'insect bite being the sole cause (or most likely cause) of the consultation' or 'multiple reasons for the consultation, insect bite was one of them'. Consultations with multiple problems were excluded from the outcome and prescribing analysis as consultation outcomes and prescriptions could not clearly be attributed to insect bites. Stings and infestations were excluded as the Clinical Advisory Group (CAG) felt these would be managed differently. Coding was undertaken independently by two clinicians. A random selection of 100 encounters were screened for inclusion by both clinicians to check inter-rater reliability (IRR) (online supplemental table 1).

The demographic characteristics extracted included: age, sex and socioeconomic status as recorded by Townsend Deprivation Index.[11] Other variables were; month of consultation, clinician type (GP or advanced nurse practitioner (ANP)), re-attendance (within 7 days) and contact mode (telephone, face-to-face in clinic or home visit).

A subcohort of 500 completed consultations where insect bite was the sole reason for the encounter was randomly generated for more detailed analysis. The sample size of 500 was chosen to allow modelling with the given variables and estimating a required sample size of 10 outcomes per df.[12] Free text was interrogated to extract clinical features: time since onset (days), size of bite/reaction, presence of swelling, pain, itch, discharge, sings of spreading, systemic upset/unwell (either subjective documentation or abnormal physiological observations such as fever), presence of comorbidities identified as relevant by the CAG (diabetes, immunosuppression, eczema or peripheral vascular disease) and whether Lyme disease was suspected. Treatments tried prior to the index consultation and those recommended by the clinician were also identified. Coding was undertaken independently by two clinicians with a random sample of 50 consultations double coded to check IRR (online supplemental table 2).

The full BORD data set and Open Prescribing data for the locality[13] were used to compare overall antibiotic (flucloxacillin) prescribing patterns.

Outcomes

All prescriptions issued by the consulting clinician were extracted and classified. Consultations that indicated that the patient was referred to hospital (either through the emergency department or directly to another specialty) were identified.

Statistical analysis

Demographic and clinical characteristics were described using summary statistics. Prescriptions were categorised and summarised.

Univariable and multivariable logistic regression models were used to explore factors associated with decisions to prescribe antibiotics. Multivariable models excluded patients with missing demographic data. Unless stated otherwise the text refers to the multivariable adjusted model. Variation of antibiotic prescribing by month of the year was explored graphically and compared with total prescribing within the database and by prescribing across the region (Birmingham and Solihull Clinical Commissioning Group). Antibiotic prescribing rates for doctors and ANPs were compared using Pearson's χ^2 test. Statistical analyses were performed using Stata V.14.

Patient and public involvement

Patient representatives were involved in establishing BORD and included in discussions about the use of routinely collected data in this way. Patients were not directly involved in this research project.

RESULTS

Consultation and participant characteristics

A total of 5774 encounters were identified to be due, or partially due to insect bites representing 0.87% of all encounters over the study period (figure 1). These patients were seen by 466 different clinicians with a median number of encounters per clinician of 3 (SD 26.7, minimum 1, maximum 273). Around two-third of patients were women and 36.9% of this cohort were between 21 and 40 years old (table 1). The population was skewed towards higher deprivation with 32.3% of patients being in the most deprived quintile.

Management of insect bites

Of the patients who only presented due to insect bites, 67.1% (3783/5641) were prescribed antibiotics of which 82.1% (3107/3783) were oral flucloxacillin (table 2). Only 2.0% of patients were referred on for further care.

Out of the 500 subcohort, 29.6% (95% CI 25.6% to 33.8%) had tried one or more treatments prior to the encounter, with antihistamines being the most common (17.8% of encounters, (95% CI 14.5% to 21.3%) (online supplemental table 3). Antihistamines were recommended by the clinician (but not prescribed) in about a

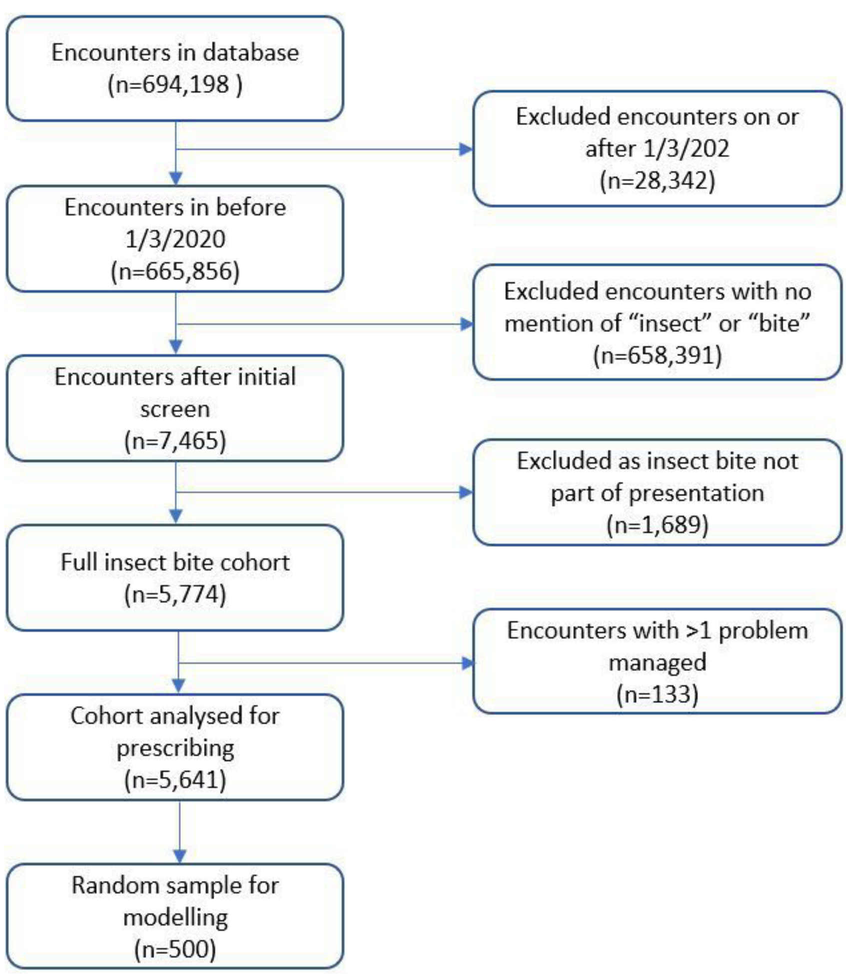

Figure 1 Consolidated Standards of Reporting Trials diagram.

Table 1 Characteristics of cohort and the random sample of 500 patients selected for further analysis

	Full cohort N (%)	500 sample N (%)
Sex		
Female	3642 (63.1)	318 (63.6)
Male	2126 (36.2)	181 (36.2)
Unclassified	6 (0.1)	1 (0.2)
Age		
<1	11 (0.2)	1 (0.2)
1–5	221 (3.8)	16 (3.2)
6–10	305 (5.3)	31 (6.2)
11–20	656 (11.4)	67 (13.4)
21–30	1076 (18.6)	89 (17.8)
31–40	1058 (18.3)	89 (17.8)
41–50	982 (17.0)	92 (18.4)
51–60	718 (12.4)	58 (11.6)
61–70	401 (6.9)	29 (5.8)
71–80	222 (3.8)	12 (2.4)
80+	124 (2.2)	16 (3.2)
Townsend Deprivation Index Quintile (first representing lowest deprivation)		
First	868 (15.0)	70 (14.0)
Second	931 (16.1)	85 (17.0)
Third	907 (15.7)	77 (15.4)
Fourth	1103 (19.1)	95 (19.0)
Fifth	1860 (32.2)	163 (32.6)
Missing	105 (2.0)	10 (2.0)
Provider		
Doctor	1501 (26.0)	114 (22.8)
Nurse	758 (13.1)	76 (15.2)
Missing	3515 (60.9)	310 (62.0)
Location		
Treatment centre	5179 (89.7)	467 (93.4)
Telephone	516 (8.9)	25 (5.0)
Home visit	79 (1.4)	8 (1.6)
Re-attendance (within 7 days)	231 (4.0)	17 (3.4)
>1 problem	133 (2.3)	–
Antibiotics prescribed*	3783 (67.1)	354 (70.8)
Referred to hospital*	111 (2.0)	6 (1.2)

*Excluding patientients presenting with >1 problem

quarter of consultations and cold therapy was suggested in 15.2% (95% CI 12.2% to 18.7%) of encounters. Clinicians suspected Lyme disease in eight patients (1.6%, 95% CI 0.8% to 3.1%), five of whom were treated with antibiotics (one with azithromycin, one with flucloxacillin, two with doxycycline and one with both flucloxacillin and doxycycline) with the other three being directed to further care without treatment (one to the emergency department and two to their GP). Out of the 17 patients who were identified as having re-attended in 7days, 11 were prescribed antibiotics.

Table 2 Prescriptions issued to patients presenting with insect bites as the sole problem

Category	Item	N (%)
Oral antibiotics	Flucloxacillin	3107 (55.1)
	Clarithromycin	220 (3.9)
	Erythromycin	196 (3.4)
	Co-amoxiclav	121 (2.1)
	Phenoxymethylpenicillin	56 (1.0)
	Doxycycline	33 (0.6)
	Amoxicillin	21 (0.4)
	Clindamycin	16 (0.3)
	Other	13 (0.2)
	All	3783 (67.1)
Topical antibiotics	Fusidic acid	668 (11.8)
	Other	3 (0.05)
Oral antihistamine	Chlorpheniramine	583 (10.3)
	Cetirizine	285 (5.1)
	Loratadine	189 (3.4)
	Fexofenadine	123 (2.2)
	Other	6 (0.1)
Topical antipruritic	Calamine	43 (0.8)
	Crotamiton	42 (0.8)
	Other	17 (0.3)
Topical steroid	Hydrocortisone	635 (11.3)
	Other	55 (1.0)
Other topical	Emollient	18 (0.3)
	Other	13 (0.2)
Analgesia	Paracetamol	142 (2.5)
	Non-steroidal anti-inflammatory drug	84 (1.5)
	Weak opiate	43 (0.8)
Other	Prednisolone	48 (0.9)
	Dressings	35 (0.6)
	Other	19 (0.3)

Factors associated with antibiotic prescribing

The type of clinician was available for 39.0% (2202/5641) of all included consultations. Antibiotics were more commonly prescribed by ANPs (71.1%, 524/737) than GPs (60.5%, 886/1465 p<0.001).

Table 3 shows the association between variables and antibiotic prescriptions in the 500 consultations that underwent full notes review. In this 500 subcohort, demographic characteristics that were associated with differing antibiotic prescription frequency

Table 3 Antibiotic prescribing rates by demographics and clinical characteristics and univariable and multivariable logistic regression

Codes from reviewing notes/linked data	Options		Antibiotics prescribed	Unadjusted model (n=500)		Adjusted model (n=489)	
		(n)	%	OR	P value	OR	P value
Age	16–64*	373	75.4	1	.	1	
	<16	79	53.2	0.37	>0.001	0.4	0.002
	65+	37	61.5	0.52	0.063	0.76	0.57
Townsend Deprivation Index Quintile (first representing lowest deprivation)	First	70	84.3	1	.	1	
	Second	84	77.7	0.648	0.3	0.66	0.357
	Third	77	72.7	0.497	0.093	0.53	0.18
	Fourth	95	68.4	0.404	0.022	0.53	0.149
	Fifth	163	63.2	0.32	0.002	0.39	0.018
	Unreported	10	50	0.186	0.018	–	–
Sex	Female*	312	68.6	1	.	1	
	Male	177	74.6	1.346	0.155	1.47	0.13
	Unclassified	1	100	–			
Swelling	No/missing*	68	38.6	1	.	1	
	Yes	421	76.1	5.056	<0.001	2.88	<0.001
Discharge	No/missing*	443	69.6	1	.	1	
	Yes	46	82.6	2.074	0.07	1.09	0.847
Spreading	No/missing*	397	66.1	1	.	1	
	Yes	92	91.4	5.451	<0.001	3.45	0.003
Pain	No/missing*	357	66.3	1	.	1	
	Yes	132	83	2.475	<0.001	2.13	0.012
Unwell	No/missing*	433	69.6	1	.	1	
	Yes	56	80.4	1.787	0.099	1.27	0.548
Itch	No/missing*	407	71.9	1	.	1	
	Yes	82	65.1	0.726	0.209	0.7	0.233
Comorbidity	No/missing*	485	71.1	1	.	1	
	Yes	15	60	0.609	0.355	0.62	0.42
Contact type	Centre	467	75	1	.	1	
	Telephone	25	4	0.014	<0.001	0.02	<0.001
	Home visit	8	37.5	0.201	0.029	0.19	0.095

*Indicates reference category.

included age and deprivation. Younger (<16 years) patients were less likely to be prescribed antibiotics than 16–64 year olds (OR 0.34, 95% CI 0.22 to 0.71). There was a decreasing trend in antibiotic prescribing as deprivation increased, with patients in the fifth deprivation quintile having an OR of 0.39 (95% CI 0.18 to 0.85) compared with patients in the first (least deprived) quintile. Clinical features that were associated with an increase frequency of antibiotic prescription included: the presence of pain (OR 2.13, 95% CI 1.18 to 3.86), swelling (OR 2.88, 95% CI 1.52 to 5.46) and signs of spreading (OR 3.45, 95% CI 1.54 to 7.70). There were no strong associations with the presence of discharge, itch, systemic upset or comorbidity and antibiotic prescribing.

Seasonality of insect bites and antibiotic prescriptions

Over the study period, insect bites accounted for 21.3% (95% CI 20.7% to 22.0%) of flucloxacillin prescribing with most prescriptions being in the summer months (figure 2). The trend in seasonal flucloxacillin prescribing pattern in these out-of-hours data is similar to the overall flucloxacillin prescribing pattern for the locality (Birmingham and Solihull Clinical Commissioning Group[13]) suggesting that the burden of insect bite related infections are similar in

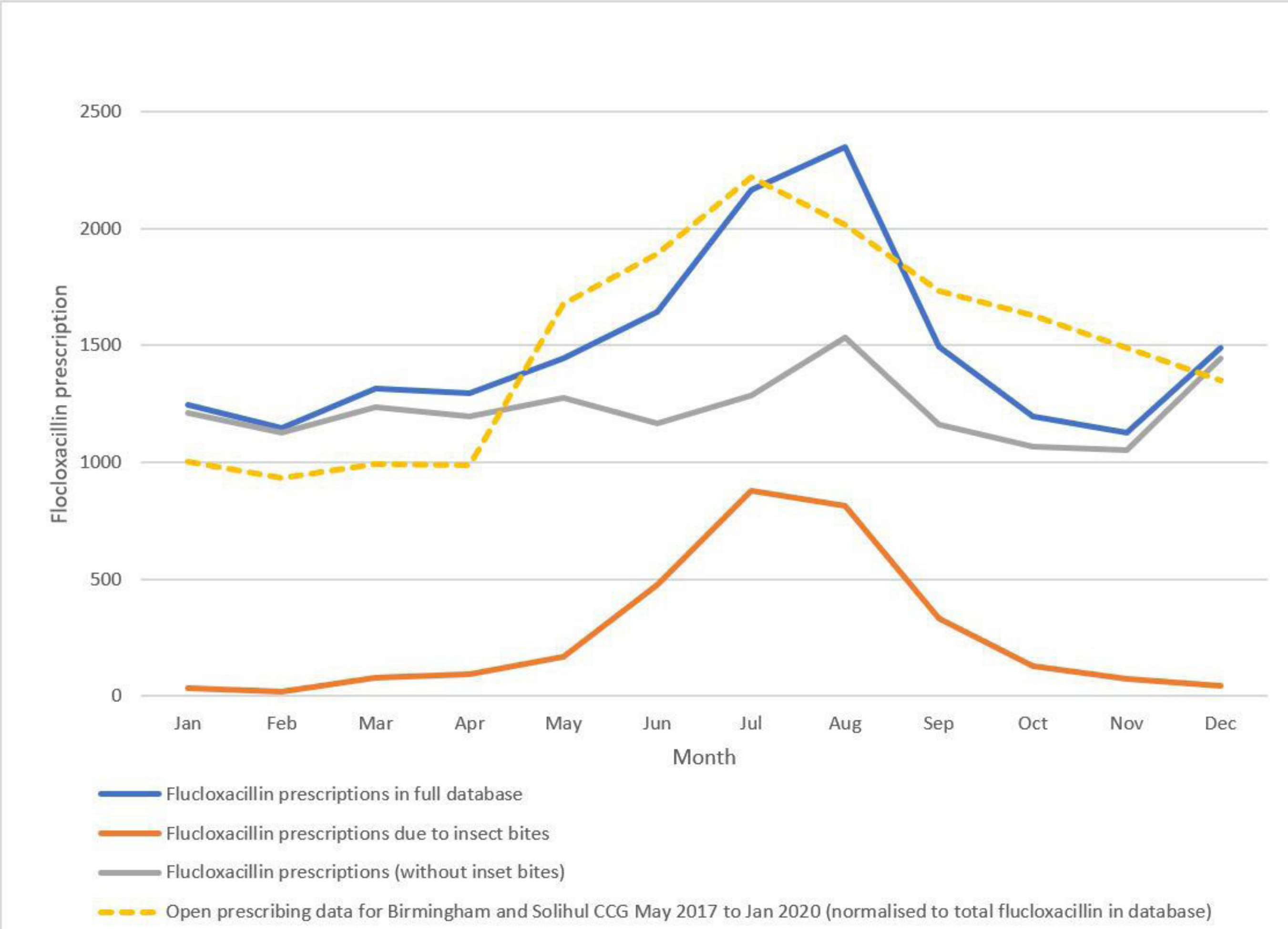

Figure 2 Flucloxacillin prescribing by month for the BORD database and the insect bite cohort July 2013 until February 2020 compared with normalised regional prescribing data May 2017 to Jan 2020.[13] BORD, Birmingham Out-of-hours general practice Research Database; CCG, Clinical Commissioning Group.

core hours general practice (figure 2). Using national flucloxacillin prescribing data and extrapolating a 21.3% attribution to insect bites, the estimated number of insect bites presenting to primary care in England was approximately 1.5 million annually (51.5/100 000 population per week) (online supplemental box 1).

DISCUSSION

Summary

Two-thirds of the patients presenting to out-of-hours care with an insect bite are prescribed antibiotics. Given the importance of antibiotic stewardship, and the significant contribution that insect bites make to overall flucloxacillin prescribing, this novel finding highlights the need to understand prescribing decisions for this common problem. Younger (<16 year old) patients were less likely to be prescribed antibiotics which may be due to this age group presenting with lower severity bites. The reduction in antibiotic prescribing observed with increasing levels of deprivation could be due to different thresholds to presentation, patient expectations, bias from prescribers (who may consciously or unconsciously prescribe differently depending on their perception of the patient's deprivation) or unknown confounders.

Strengths and limitations

By using free-text searches, this study avoids the potential under-reporting of insect bites that may occur through incomplete coding; a problem that is particularly seen with acute presentations.[14] Due to the use of electronic prescribing, the prescribing data is very reliable, and the size of the database and 7 years of data allow for estimations to be made with accuracy. The use of two experienced clinicians undertaking the coding, with good inter-rater reliability, allowed accurate extraction of clinical data, although there is always the potential for inaccuracies given the nature of clinical documentation and clinical judgement.

Some insect bite consultations may have been missed in the screening due to misspelling, and some may have been misclassified where diagnostic uncertainty existed. Some encounters were not completed; for example, if a patient started the consultation with a telephone call but then did not attend the treatment centre. The outcomes for these patients would therefore not be recorded and they may have received treatment by other means (eg, the emergency department or walk-in centre outside of the BORD database centres). It was also assumed that all antibiotic prescriptions were for immediate use, but it is possible some were issued in a 'delayed prescribing' approach, although this was not evident in the 500 encounters that were examined in detail.

Clinical features that are considered important in the literature and by the CAG include the size of the reaction, time since bite and location of bite.[7] It was not possible to analyse these factors because they were very poorly documented. However, the lack of documentation itself could indicate the low importance clinicians placed on these factors in prescribing decisions. Similarly, some clinical features (such as blistering) were documented but were not included in the prespecified list of important features so were not recorded in the coding framework.

Comparisons with the literature

Women made up nearly two-thirds of our cohort; consistent with previous research which showed that women were twice as likely to consult than men.[1] From our data we are unable to say whether this is because women are more likely to be bitten, more likely to have a significant reaction or more likely to present to out-of-hours care. In a significantly different geographical region (Burkina Faso), differences in human activity were thought to explain why men were predicted to receive more bites,[15] and research from Canada confirms that women are more likely to seek healthcare,[16] but to what extent these factors explain the gender variation we observed is unknown. The seasonal nature of insect bites previously reported in the UK is comparable with the seasonal pattern we have observed.[1]

Regarding antibiotic prescribing decisions; survey data suggested that systemic signs are an important factor.[7] We did not find that systemic upset was significantly associated with antibiotic prescribing. This was despite the fact that clinical observations were well recorded in the data set. The lack of statistical significance may, in part, be due to the fact that, despite 80.4% of these unwell patients being prescribed antibiotics, only 11.2% of patients fell into this category. Itch as a symptom did not increase propensity to prescribe antibiotics,[7] and this is supported by our data with a non-significant trend towards a lower odds of prescribing. Interestingly, the reducing odds of being prescribed antibiotics as deprivation increases is the opposite to trends when overall antibiotic prescribing rates are investigated[17 18] but when the indication for antibiotic prescribing is delineated, the association between prescribing rates and deprivation is inconsistent.[19] Since antibiotic prescribing rates for insect bites have not previously been reported, direct comparison is not possible.

The estimated annual incidence of insect bites in England extrapolating from the data in this study (51.5/100 000 population per week) is higher than previously reported (5.4/100 000 population per week[1]). Out-of-hours care was not separate from core hours general practice at the time of this study which may explain some of the discrepancy and it could be that the previous study under-reported insect bites or that assumptions made in the extrapolation of our data are erroneous (eg, the regional data may not be representative of national patterns). This does, however, raise questions about the true burden of insect bite related consultations in UK primary care.

Implications for research and practice

It is clear that treatment of infections associated with insect bites contribute significantly to antibiotic prescribing in primary care. While we have shed light onto which patients are being prescribed antibiotics and what is influencing this decision, there is more work to be done in understanding what features of insect bite reactions suggest infection, which reactions would benefit from antibiotics and by how much. Without clarity on these questions clinicians are unable to estimate the potential benefits of antibiotics for patients and therefore patients cannot weigh the benefits with the risks to make a decision. With the risks of antibiotics to the individual and the community becoming increasingly prescient, more research is needed to better inform decision-making in the management of insect bites.

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Contributors SJF conceived the study and the design was refined by all authors. SJF extracted the data and SJF and PJE undertook data coding. Statistical analysis was performed by SJF and PJE. The first draft of the manuscript was written by SJF and all authors works on editing and approved the final manuscript. SJF is the author responsible for the overall content as the guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by South Birmingham Research Ethics Committee (REC) on the 22 January 2019 (reference 19/WM/0010). This research was undertaken on routinely collected data as approved by the REC.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data sets generated and/or analysed during the current study are not publicly available due to data sharing restrictions but are available from the corresponding author on reasonable request.

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