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Comprehensive management of insect bites: Pharmacological interventions and best practices in pharmacy care

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Abstract
A class of arthropods, insects are important for human health; prominent clinical concerns are bug bites. Along with factors affecting individual sensitivity, this research investigates medically significant insects, their classification, and the limited epidemiological data on insect bites in India. Clinical symptoms of bites from mosquitoes, bed bugs, fleas, flies, and other species are described in great detail including conditions such hypersensitivity to mosquito bites Epstein-Barr virus NK (HMB-EBV-NK), Skeeter syndrome, and papular pruritic eruption of HIV/AIDS. We review the immunogenic elements of mosquito and bed bug saliva as well as new perspectives on papular urticarial encompassing its epidemiology, stages of skin reactions, and hypersensitivity mechanisms. Supported by data from clinical trials, novel medicines include spinosad, benzyl alcohol lotion, and dimethicone help to advance management of pediculosis capitis. Furthermore, underlined are non-chemical lice treatments and the genetic mechanism of knockdown resistance (kdr). Emphasizing complete pharmacy care for efficient management, the review finally addresses insects as disease vectors, preventive measures for bug bites, and health hazards related with mosquito coil smoking.

Keywords: Insects, bug bites, India, benzyl alcohol lotion, dimethicone, bed bugs, papular urticaria

Introduction

A major focus of dermatological and systemic health issues, insect bites and stings call for meticulous clinical attention and treatment. Classed under arthropods, insects have a segmented body including the head, thorax, and abdomen; they also have a chitinous exoskeleton and jointed appendages. Although not all insects bite—mosquitoes, bed bugs, fleas, and flies are among the ones that can produce localized reactions including erythema, pruritus, and swelling as well as systemic effects including hypersensitivity and vector-borne infections. Through their venom, bodily fluids, or allergies, non-biting insects include beetles and butterflies as well as stinging insects such bees, wasps, and ants can also cause skin responses. Comprehensive control of bug bites calls for a multidisciplinary strategy combining pharmacological interventions like antihistamines, corticosteroids, and new treatments with best practices in prevention including repellents, protective gear, and environmental control. Adoption of evidence-based methods to minimize the clinical and public health consequences of insect bites, tailored treatment strategies, and patient education all depend on pharmacy care in great part [1, 2, 4, 9].

Epidemiology of insects in India

Insect bite reactions are common in dermatology, with varying prevalence influenced by factors like age, genetics, immunity, and environment. Studies show a prevalence of 5.3% in children under 14 in Pondicherry and 10.6% in children under five in Calcutta, peaking during rainy seasons. Tailored prevention is vital for high-risk groups in regions with ecological and seasonal variations.

Table 1: Classification of medically and dermatologically significant insects

Order	Suborder/Family	Examples [5, 16, 17, 19, 27]	Common Name [1, 3]
Diptera	Nematocera (long-horned flies)	Culicidae: Mosquitoes Psychodidae: *Phlebotomus*, *Lutzomyia* (sandflies) Simuliidae: *Simulium damnosum* (black flies), *Simulium posticatum* (Blandford fly) Ceratopogonidae: *Culicoides*, *Leptoconops* (biting midges, "punkies", "no-see-ums")	Mosquitoes, Sandflies, Black flies, Biting midges
	Brachycera (short-horned flies)	Tabanidae: *Tabanus* (horse flies), *Chrysops* (deer flies), *Haematopota* (clegs) Rhagionidae: Snipe flies Chloropidae: Eye flies, Fruit flies Muscidae: House flies, Lesser house flies, Stable flies, Tsetse flies Hippoboscidae: Flat flies, Louse flies Calliphoridae: Blow flies Sarcophagidae: Flesh flies Oestridae: Botflies	House flies, Horse flies, Deer flies, Tsetse flies
Siphonaptera	Tungidae, Pulicidae, Ceratophyllidae	*Pulex irritans* (human flea), *Ctenocephalides canis* (dog flea), *Ctenocephalides felis* (cat flea), *Xenopsylla cheopis* (rat flea), Bird fleas	Fleas
Hymenoptera	-	Bees, Wasps, Ants	Stinging insects
Phthiraptera	Anoplura	Pediculidae: Pediculus humanus humanus (body louse), Pediculus humanus	LIce

		capitis	
Hemiptera	Cimicidae, Anthrocoridae, Reduviidae, Pantatomidae	Cimex: *Cimex lectularius* (bed bugs), *Cimex hemipterus* (tropical bed bugs), *Cimex pipistrelli* (bat bugs) Oeciacus: Swallow bugs Haematosiphon: Mexican chicken bugs Reduviidae: Kissing bugs, Assassin bugs, Cone-nosed bugs	Bed bugs, Kissing bugs
Thysanoptera	-	Thrips	Thrips
Coleoptera	-	Beetles	Beetles
Dictyoptera	-	Cockroaches	Cockroaches
Orthoptera	-	Locusts	Locusts
Lepidoptera	-	Butterflies, Moths	Butterflies, Moths

Pathophysiology of insect bites

Localized inflammatory reaction

When an insect bites, it injects saliva into the skin, which contains a variety of pharmacologically active chemicals including anticoagulants, vasodilators, and immunomodulatory molecules. These compounds hinder the body's innate immune response, disrupt platelet aggregation, and promote inflammation, causing redness, swelling, and itching at the bite site [8].

Hypersensitivity reactions

Insect bites frequently cause hypersensitivity reactions, which are divided into categories I, III, and IV. Type I hypersensitivity results in fast wheal-and-flare responses mediated by immunoglobulin E (IgE), but type IV hypersensitivity can cause delayed reactions such as papules and vesicles. Repeated exposure to insect antigens can exacerbate immune responses, causing more severe skin reactions [7].

Systemic anaphylaxis

Severe cases may proceed to systemic anaphylaxis, which is distinguished by a sudden onset of respiratory distress, generalized urticaria, and cardiovascular collapse. This life-threatening disease is mediated by IgE and must be treated immediately with epinephrine. Individuals who are prone to anaphylaxis should carry epinephrine auto-injectors [9].

Disease-specific mechanisms

Certain insect bites are connected with distinct pathophysiological pathways. Skeeter syndrome, for example, is a severe local inflammatory reaction that resembles cellulitis and is caused mostly by hypersensitivity to mosquito saliva. Certain insect elements can cause vasodilation and capillary permeability, leading to diseases such as eruptive pseudo-angiomatosis [10].

Inflammatory cytokine release

Insect bites trigger the release of pro-inflammatory cytokines, including IFN-γ, TNF-α, and IL-6. Cytokines can cause long-term inflammation and delayed hypersensitivity reactions in certain individuals [11].

The role of skin microflora and odor

Human skin microflora helps attract certain insects by producing odoriferous chemicals that impact biting behavior. Pregnancy, alcohol consumption, and sweat composition can all influence bite vulnerability and pathophysiology [10].

Classification of insects causing bites

Mosquitoes

Female mosquitoes of the family Culicidae, including species like Aedes aegypti, Anopheles, and Culex, consume blood to support egg-laying. They belong to the order Diptera and are significant vectors of diseases.

Medical Significance: Mosquitoes are capable of transmitting diseases including malaria, dengue, chikungunya, and Zika virus. Their bites frequently induce localized pruritic wheals as a result of salivary allergies [6].

Ticks

Ticks, arachnids from the family Ixodidae and order Parasitiformes, attach to host skin for extended feeding periods. They are notable vectors of various diseases.

Medical Significance: Established vectors of Lyme disease, Rocky Mountain spotted fever, and tick-borne encephalitis [6, 7].

Fleas

Siphonaptera fleas are wingless ectoparasites that prey on mammals and birds. Ctenocephalides felis and Pulex irritans are common fleas.

Medical Significance: Fleas serve as vectors for bubonic plague and murine typhus. Their bites produce pruritic papules.

Bedbugs

Bedbugs, nocturnal blood-feeders in the order Hemiptera and family Cimicidae, are abundant in sleeping regions.

Medical Significance: Bites result in linear arrangements of erythematous papules and pruritus, however their capacity to spread diseases remains unsubstantiated [22].

Lice

Head lice, a Phthiraptera obligate ectoparasite, feed on blood and infest hair.

Medical Significance: Lice bites induce pruritus and subsequent infections; nonetheless, they do not transmit significant diseases [23].

Additional biting insects

Black flies: Recognized for their excruciating bites and capacity to induce onchocerciasis.

Horseflies: Agonizing bites frequently followed by allergic responses.

Kissing Bugs: Vectors of Chagas disease (Trypanosoma cruzi).

Venomous versus non-venomous bites

Venomous bites

Apis (honeybees), Vespidae (wasps), and Formicidae (ants) inject venom through stingers. Pain, swelling, and allergic reactions can result from its venom.

Kissing bugs inject deadly saliva that contains anticoagulants and allergens.
Tsetse flies possess saliva that contains toxins, which induce regional discomfort and systemic
symptoms such as trypanosomiasis [11].

Non-venomous bites
Bites that do not contain venom but may induce irritation from salivary enzymes and allergies.
Mosquitoes: Introduce saliva that contains anticoagulants.
Fleas and bedbugs: Saliva induces allergic responses in the absence of venom.
Lice: Bite discomfort results from anticoagulants present in their saliva [24].

Localized reactions
Insect bites typically elicit localized reactions as a result of the immunological response to allergens and enzymes present in insect saliva. These reactions generally manifest as erythematous macules or papules, followed by pruritus and edema at the bite site. In certain instances, scratching intensifies the irritation, possibly resulting in excoriations and subsequent bacterial infections. Although these reactions are typically self-limiting, severe localized inflammation, shown by Skeeter syndrome (a hypersensitivity to mosquito saliva), may resemble cellulitis and necessitate medical care [15].

Systemic reactions
In highly sensitive people, insect bites can elicit systemic reactions, including urticaria, fever, and widespread rashes. Anaphylaxis is the most severe systemic reaction, characterized as a life-threatening IgE-mediated hypersensitivity that can arise from insect bites or stings, particularly from bees or wasps. Symptoms comprise respiratory distress, hypotension, and angioedema, necessitating prompt administration of epinephrine. Less severe systemic effects, including weariness and flu-like symptoms, may occur after bites by vectors such as ticks or mosquitoes, especially when they carry diseases [14].

Infectious consequences
Insects are key carriers of infectious diseases, creating a global health threat. Mosquitoes transmit malaria and dengue, resulting in serious problems. Ticks carry Lyme disease, which is characterized by fever and rash, and sandflies cause leishmaniasis in tropical places. Fleas can transmit bubonic plague and murine typhus.
The gravity of these diseases highlights the necessity of preventive strategies against bug bites [25].

Pharmacological interventions
Localized therapies
Topical therapies are widely used to treat localized bug bite symptoms. Antihistamines such as diphenhydramine relieve itching, and corticosteroid creams like hydrocortisone 1% reduce inflammation and redness. Antiseptics such as povidone-iodine and chlorhexidine serve to prevent infection and improve wound care. Furthermore, analgesics and emollients like calamine lotion or aloe vera gel alleviate inflammation and facilitate skin healing [26].

Systemic therapies
Systemic treatments are used for severe reactions, whereas oral antihistamines such as cetirizine and loratadine treat widespread itching and urticaria. Systemic corticosteroids, such as prednisone, may be administered to decrease the immune response and prevent consequences in cases of substantial inflammation or hypersensitivity.
Secondary bacterial infections caused by scratching or other reasons may be treated with medications like amoxicillin or clindamycin, contingent upon the infection's severity and the probable pathogen [28].

Antivenoms and antitoxins
Antivenoms or antitoxins may be crucial for bites or stings from poisonous insects such as bees, wasps, or alien species like scorpions, especially in areas where these species are common. Venom-specific immunotherapy may be utilized in instances of severe anaphylaxis caused by Hymenoptera stings. This method neutralizes hazardous effects and reduces additional harm [29].

Management of comorbid conditions
Disease-carrying insect bites necessitate pharmacological treatment. Artemether-lumefantrine and chloroquine are necessary malaria treatments. Ribavirin treats arboviral illnesses like Crimean-Congo hemorrhagic fever. Antibiotics like doxycycline or amoxicillin treat bug-borne bacteria like Lyme disease.
Effective care of these disorders also entails addressing secondary symptoms and consequences to guarantee comprehensive healing [30].

Non-pharmacological interventions
Utilization of ice packs
Ice packs serve as a straightforward and efficacious treatment for bug bites. Utilizing a cold compress or ice encased in a cloth on the affected region for 10 to 20 minutes will markedly alleviate swelling, erythema, and discomfort. This method functions by anesthetizing the region and diminishing blood circulation, therefore lessening the inflammatory reaction. Direct application of ice to the skin should be avoided to prevent frostbite. This method is most beneficial within the initial six hours after a bite or sting and is advised for minor symptoms [31].

Wound irrigation and bandaging
Thorough cleaning and treatment of insect bites are crucial to avert subsequent illnesses. The impacted region must be cleansed with soap and potable water to eliminate irritants and any possible pathogens introduced during the biting. For open wounds or significant abrasions, the application of a thin layer of antiseptic such as povidone-iodine can further diminish the risk of infection. Applying a sterile bandage can safeguard the region from contaminants and pathogens. If dirt or debris is entrenched in the wound, a tetanus shot may be warranted if the immunization history is unclear [15].

Utilization of herbal remedies and traditional medicine
To treat insect bites, herbal and traditional remedies are used. Aloe vera gel and tea tree oil are relaxing and antimicrobial, while neem oil repels and reduces infla`mmation. Alternative therapies include baking soda paste and witch hazel reduce itching and irritation. To relieve bites or prevent them, lavender, eucalyptus, and

citronella essential oils are diluted. It is essential to utilize these remedies correctly to prevent skin irritation or allergic reactions [27].

Preventive strategies

Use of insect repellents

Insect repellents prevent bites and vector-borne diseases. The most effective chemical repellents are DEET and Picaridin. DEET, developed by the U.S. Army in the 1940s, repels mosquitoes and ticks for 12 hours at 20-30% concentrations. DEET is nontoxic when applied properly, although it can irritate skin and damage plastics and spandex. Picaridin, a pepper plant-derived synthetic substance, works like DEET without odor, grease, or fabric damage. It provides long-lasting insect protection at 7% to 20% dosages.

Natural options, like oil of lemon eucalyptus, can be beneficial, offering protection for up to six hours; but, they are less durable and unsuitable for children under three years of age [32].

Protective attire and bed nets

Donning protective attire is an effective method to limit exposure to bug bites. Light-hued, closely woven textiles assist in repelling ticks and mosquitoes, whilst darker shades tend to attract a greater number of insects. Moreover, applying Permethrin, a synthetic insecticide, to clothing and bed nets establishes a durable protective barrier. Clothing coated with permethrin retains efficacy after numerous washing, whilst bed nets impregnated with this chemical can avert mosquito bites during sleep, so substantially diminishing the risk of malaria and other illnesses [12].

Ecological Initiatives

Regulating the environment is essential for diminishing bug populations. Eliminating stagnant water from locations such as flowerpots, buckets, and sewers eradicates breeding sites for mosquitoes. Routine gutter maintenance and appropriate trash disposal also reduce the habitats of biting insects. In agricultural contexts, integrated pest management strategies, including the introduction of natural predators or the application of larvicides, can efficiently regulate pest populations. These steps are crucial for the long-term prevention of insect-borne illnesses [33].

Role of Pharmacist in insect bite management

Patient education on symptom identification and management

Pharmacists often treat bug bite patients first, making symptom identification education crucial. Patients often debate whether a bite requires immediate medical attention or home care. Pharmacists teach patients to recognize localized symptoms such erythema, edema, and pruritus from mosquito, bedbug, and flea bites. Systemic symptoms including fever, rash, and nausea may indicate dengue fever or Lyme disease. Pharmacists use visual aids, checklists, and literature to help patients understand bite presentations. Images of the "bull's-eye" Lyme disease rash may help people recognize early symptoms and seek medical treatment.

Pharmacists inform travelers about the dangers of bug bites in endemic areas and underscore the significance of preventive measures. Recommending insect repellents such as DEET or Picaridin for travel to malaria-endemic regions underscores their dedication to public health education [4].

Guidance on proper medication utilization

Effective drug counseling is fundamental to pharmacist assistance in the management of bug bites. Pharmacists instruct patients on the application of topical therapies, such calamine lotion and hydrocortisone cream, to alleviate regional pruritus and edema. For secondary bacterial infections resulting from scratching, suitable topical or oral medications such as mupirocin or amoxicillin are recommended. Pharmacists guarantee optimal therapeutic outcomes and mitigate the danger of pharmaceutical misuse by elucidating appropriate administration procedures and dosages [2, 4, 10].

In cases of more severe allergic responses, pharmacists play a crucial role in informing patients about oral antihistamines such as cetirizine, highlighting their efficacy in alleviating symptoms of urticaria or angioedema. They offer essential training on the utilization of epinephrine auto-injectors for anaphylaxis, illustrating the administration of a dosage in emergencies and addressing when to pursue additional medical assistance. A pharmacist may advise that a patient exhibiting throat tightness or respiratory distress following a wasp sting should promptly utilize their auto-injector and contact emergency services [34].

Furthermore, pharmacists assist patients with chronic diseases, including asthma or immunological weaknesses, by modifying bug bite management strategies to reduce problems. They may recommend that these folks utilize higher-concentration repellents or combo therapy for improved protection [18, 20, 34].

Recognizing indicators for physician referral

Identifying the appropriate moments to send patients to a physician is an essential competency that pharmacists contribute to the care of bug bites. Specific warning indicators, including indications of systemic infections, extended swelling, and manifestations of cellulitis or abscess development, necessitate prompt medical intervention. A patient exhibiting disseminated erythema, pyrexia, or purulent lesions may be suffering from cellulitis, necessitating a referral for oral or intravenous antibiotics [13, 21].

Pharmacists assume a proactive role in assuring adequate care for high-risk populations, including children, pregnant women, and immunocompromised patients. For instance, they may recommend that pregnant women obtain prompt medical care if they exhibit symptoms following exposure to mosquitoes that transmit the Zika virus, due to the potential dangers of fetal anomalies [10].

Pharmacists work with healthcare teams, providing insights that enhance diagnostic accuracy and patient outcomes. This integrative approach emphasizes their crucial role in early detection and prompt intervention [16].

Special consideration on special population

Pediatric and geriatric populations

Bug bites are especially harmful to children and the elderly due to their physiological differences. Mosquito or fire ant bites in children can cause severe edema or systemic symptoms like fever and restlessness. Due to hypersensitivity to bites, children may develop papular urticaria, chronic pruritic sores. This generation needs age-appropriate insect repellents such low-concentration DEET or Picaridin [2].

In geriatric individuals, impaired immune responses and comorbidities such diabetes or peripheral vascular disease increase the risk of cellulitis or secondary bacterial infections. Pharmacists must educate patients about wound care and identify infection signs such growing erythema or increased bite warmth [17].

Pregnant or lactating women

Pregnant and nursing women necessitate meticulous monitoring to prevent detrimental effects from mosquito bites and the pharmacological treatments employed. They have an elevated risk for infections such as the Zika virus and malaria, which may result in significant difficulties for the fetus, including congenital anomalies. Preventive actions, including the utilization of insecticide-treated bed nets and repellents such as Picaridin, are imperative. Nevertheless, products such as Oil of Lemon Eucalyptus (PMD) have to be avoided owing to insufficient safety data within this demographic [32].

Patients with pre-existing allergies or comorbid conditions

People with severe allergies might have anaphylactic reactions to insect bites or stings, especially from bees or wasps. Pharmacists can provide epinephrine auto-injectors and instructions for anaphylaxis. If necessary, pharmacists should encourage patients to carry extra tablets and refer them to allergy specialists for venom immunotherapy. Wound management is crucial for diabetics and immunosuppressed people to prevent cellulitis and sepsis. These patients should be advised by pharmacists to practice good hygiene, use antiseptics, and watch for systemic infections like fever and chills.

Complications and emergency Management

Management of severe allergic reactions and anaphylaxis

Anaphylaxis is a critical condition that necessitates immediate injectable epinephrine delivery. Pharmacists must instruct patients on recognizing signs such as throat swelling, respiratory discomfort, and hives, underscoring the necessity for prompt intervention. In juvenile situations, epinephrine dosages are weight-dependent, and pharmacists can provide families with suitable auto-injectors, such EpiPen Jr. or standard EpiPens [27].

Post-anaphylaxis management entails the administration of oral antihistamines, such as cetirizine, and systemic corticosteroids, such prednisone, to avert the recurrence of symptoms. Pharmacists ought to coordinate follow-up consultations with allergists for thorough management.

Conclusion

Complex drug, preventative, and patient education treatments are needed to treat bug bites. Insect bites can cause localized cutaneous reactions or severe systemic consequences, highlighting the need to understand insect saliva's immunogenicity and the health risks of diverse species' bites. Pharmacists advise on wound care, identify early infection indicators, and recommend customized treatments, especially for at-risk groups like the elderly, pregnant women, and those with pre-existing allergies or comorbidities.

Insect repellents and environmental control are vital for reducing insect bites and vector-borne diseases. Continuous research and education will be needed to develop effective insect-related health treatments and prevention methods. Optimizing insect bite management through collaboration between healthcare providers, patients, and communities improves patient outcomes and public health.

References

1. Smallegange RC, Verhulst NO, Takken W. Sweaty skin: an invitation to bite? Trends Parasitol,2011:27:143-8.
2. A Andy. The Role of Drug Utilization Review (DUR) in Enhancing Patient Safety and Reducing Medication Errors in Pharmacies. International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences, 2020.
3. Burns DA. Diseases caused by arthropods and other noxious animals. In: Burns T, Breathnach S, Cox N, Griffiths C, editors. Rook's textbook of dermatology. 8th ed. Chichester: Wiley-Blackwell, 2010, 38.1-38.61.
4. A Andy. The Role of HIPAA in Protecting Patient Privacy in Pharmacy Practices: Challenges and Innovations in the Digital Age. International Journal for Multidisciplinary Research,2020:2(10):1-9.
5. Romero A, Martín L, Hernández-Núñez A, Arias D, Castaño E, Borbujo J. Eruptive pseudoangiomatosis. Actas Dermosifiliogr,2007:98:138-9.
6. Karppinen A, Brummer-Korvenkontio H, Petman L, Kautiainen H, Hervé JP, Reunala T. Levocetirizine for treatment of immediate and delayed mosquito bite reactions. Acta Derm Venereol,2006:86:329-31.
7. Doggett SL, Russell R. Bed bugs - what the GP needs to know. Aust Fam Physician,2009:38:880-4.
8. Keystone JS. Of bites and body odour. Lancet,1996:347:1423.
9. Cohen JI, Kimura H, Nakamura S, Ko YH, Jaffe ES. Epstein-Barr virus-associated lymphoproliferative disease in non-immunocompromised hosts: A status report and summary of an international meeting, 8-9 September 2008. Ann Oncol,2009:20:1472-82.
10. A Andy. The Critical Role of Pharmacists in Managing Drug Allergies: Enhancing Collaboration Between Patients and Providers. International Journal of Innovative Research and Creative Technology, 2021, 7(6).
11. Karthikeyan K, Thappa DM, Jeevankumar B. Pattern of pediatric dermatoses in a referral center in South India. Indian Pediatr,2004:41:373-377.
12. Port GR, Boreham PFL, Bryan JH. The relationship of host size to feeding by mosquitoes of the Anopheles gambiae Giles Complex (Diptera, Culicidae). Bull Entomol Res,1980:70:133-144.
13. A Andy. Advancements and Challenges in Medication Therapy Management: Improving Patient Outcomes Through Enhanced Pharmacist Interventions. International Journal for Multidisciplinary Research, 2023, 5(2).
14. Tokura Y, Ishihara S, Tagawa S, Seo N, Ohshima K, Takigawa M. Hypersensitivity to mosquito bites as the primary clinical manifestation of a juvenile type of Epstein-Barr virus-associated natural killer cell leukemia/lymphoma. J Am Acad Dermatol,2001:45:569-578.

15. Lindsay S, Ansell J, Selman C, Cox V, Hamilton K, Walraven G. Effect of pregnancy on exposure to malaria mosquitoes. Lancet,2000:355:1972.
16. Burgess IF, Lee PN, Kay K, Jones R, Brunton ER. 1,2-Octanediol, a novel surfactant, for treating head louse infestation: identification of activity, formulation, and randomised, controlled trials. PLoS One,2012:7:e354.
17. Marshall AG. The ecology of ectoparasitic insects. London: Academic Press, 1981.
18. Oka K, Ohtaki N, Kasai S, Takayama K, Yokozeki H. Two cases of eruptive pseudoangiomatosis induced by mosquito bites. J Dermatol,2012:39:301-305.
19. Mellanby K. Man's reaction to mosquito bites. Nature,1946:158:554.
20. Palin V, Mölter A, Belmonte M, *et al*. Antibiotic prescribing for common infections in UK general practice: variability and drivers. J Antimicrob Chemother,2019:74:2440–2450.
21. Peduzzi P, Concato J, Kemper E, *et al*. A simulation study of the number of events per variable in logistic regression analysis. J Clin Epidemiol,1996:49:1373–1379.
22. Lantner R, Reisman RE. Clinical and immunologic features and subsequent course of patients with severe insect-sting anaphylaxis. J Allergy Clin Immunol,1989:84:900–906.
23. Vos B, Köhler J, Müller S, Stretz E, Ruëff F, Jakob T. Spiking venom with rVesv 5 improves sensitivity of IgE detection in patients with allergy to Vespula venom. J Allergy Clin Immunol,2013:131:1225–1227.
24. Belhocine W, Ibrahim Z, Grandné V, Buffat C, Robert P, Gras D, *et al*. Total serum tryptase levels are higher in young infants. Pediatr Allergy Immunol,2011:22:600–607.
25. Schwartz LB, Metcalfe DD, Miller JS, Earl H, Sullivan T. Tryptase levels as an indicator of mast cell activation in systemic anaphylaxis and mastocytosis. N Engl J Med,1987:316:1622–1626.
26. van Doormaal JJ, van der Veer E, van Voorst Vader PC, Kluin PM, Mulder AB, van der Heide S, *et al*. Tryptase and histamine metabolites as diagnostic indicators of indolent systemic mastocytosis without skin lesions. Allergy,2012:67:683–690.
27. Purkar S. R., Dandgvhal, K.R. and Chikhale, H.U. "A Review on Indian Covid-19 Vaccination Facts." Annals of pharma research,2021:9(7):520-524
28. Keyzer JJ, de Monchy JG, van Doormaal JJ, van Voorst Vader PC. Improved diagnosis of mastocytosis by measurement of urinary histamine metabolites. N Engl J Med,1983:309:1603–1605.
29. Reisman RE. Intentional diagnostic insect sting challenges: a medical and ethical issue. J Allergy Clin Immunol,1993:91:1100.
30. Hauk P, Friedl K, Kaufmehl K, Urbanek R, Forster J. Subsequent insect stings in children with hypersensitivity to Hymenoptera. J Pediatr,1995:126:185–190.
31. Murphy EE, Slavin RG. Decreased incidence of stings in venom-sensitive patients following venom immunotherapy. Allergy Proc,1994:15:57–59.
32. Dhamne SA, Dandagvhal KR, Pingale PL, Amrutkar SV. Corrective and Preventive Action: An Imperative Quality Management Perspective in Pharmaceutical Industry. International Journal of Pharmaceutical Quality Assurance,2022:13(2):95-102.
33. Oude Elberink JN, De Monchy JG, Van Der Heide S, Guyatt GH, Dubois AE. Venom immunotherapy improves health-related quality of life in patients allergic to yellow jacket venom. J Allergy Clin Immunol,2002:110:174–182.
34. Krishna MT, Ewan PW, Diwakar L, Durham SR, Frew AJ, Leech SC, *et al*. Diagnosis and management of hymenoptera venom allergy: British Society for Allergy and Clinical Immunology (BSACI) guidelines. Clin Exp Allergy,2011:41:1201–1220.