

What's Eating You? Bedbugs Revisited (*Cimex lectularius*)

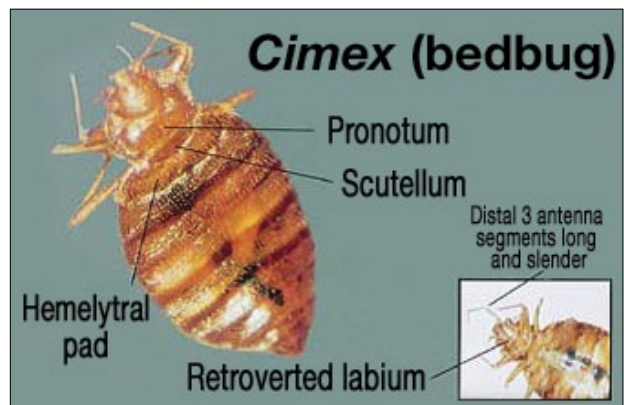
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The common bedbug, *Cimex lectularius*, is a member of the family Cimicidae and the genus *Cimex*. Belonging to the order Hemiptera, its relatives include reduviid bugs as well as common garden pests such as stink bugs, aphids, and cicadas.¹ Bedbugs are distributed in temperate and tropical regions worldwide.² In the last 10 years, the number of US households affected by these insects has markedly increased³ and bedbugs have become a serious urban pest worldwide.⁴ This resurgence of bedbug infestations has renewed interest in the biology and toxicology of these insects.⁵

Overview

Adult bedbugs are wingless, roughly oval in shape, flattened, and approximately 5- to 6-mm long. The adults are a deep red-brown color.² They possess widely spaced compound eyes—one on each side of a pyramid-shaped head—and slender antennae. A small semicircular to triangular scutellum, or sclerotic plate, covers the dorsal surface of the body, and the retroverted labium (mouthpart) has 3 segments that reach the base of the first pair of legs (Figure).⁶ On the distal extremities, the tarsus is composed of 3 segments with claws. The female has a ventral notch or paragenital sinus on the posterior abdomen, whereas the male has a paramere only on one side of the posterior abdomen.⁵

Bedbugs are obligate hematophagous ectoparasites that feed on warm-blooded mammals, mainly



Bedbug anatomy.

humans.² The life cycle of *C lectularius* includes 5 nymphal stages followed by adulthood, and progression through each nymphal stage requires nutrients provided by the blood meal.⁷

Bedbugs are nocturnal insects⁶; they generally avoid light, hide during the day, and feed at night while humans are sleeping. Hiding places usually are within close proximity of suitable hosts such as between cracks, in seams in mattresses, in crevices in box springs, on backsides of headboards, in spaces under baseboards, on loose wallpaper, and behind hanging pictures.² The insects are attracted to warmth and carbon dioxide (ie, sleeping humans). At night, they grasp and pierce human skin with their forelegs and inject saliva that contains nitric oxide, apyrase, and an anticoagulant.^{3,8,9}

Management and Treatment

Bites from bedbugs often are noted in linear groups of 3, sometimes referred to as breakfast, lunch, and dinner.⁶ The bites usually present with pruritic erythematous papules at the feeding sites. Most

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cutaneous manifestations resolve within 1 week,² but systemic reactions from bedbug bites including asthma, generalized urticaria, and anaphylaxis have been reported.¹⁰ Treatment of cutaneous reactions to bites is aimed at symptomatic relief; topical corticosteroids and antipruritic agents most commonly are used. Superinfected bites may be treated with topical or systemic antibiotics.² Systemic reactions to bedbug bites are rare but can cause anaphylaxis. Therapy for these reactions includes intramuscular epinephrine, antihistamines, and corticosteroids.^{2,11,12}

Prevention and Control of Bedbug Infestation

Bedbugs have been detected in many cities, especially New York City. *Cimex lectularius* can spread in communities through ventilation ducts, holes in walls, water pipes, or gutters.¹³ They also can travel longer distances and can be transported by humans in clothing, luggage, and furniture. Increased levels of international travel, trade, and immigration have contributed to the increasing prevalence.¹⁴

To reduce the risk for exposure to bedbugs, individuals should regularly examine the mattress seams and behind headboards when sleeping in unfamiliar environments, such as hotel rooms.¹⁵ Wearing pajamas that cover as much of the skin as possible also has been reported to be beneficial.³

The increase in the bedbug population has overwhelmed many local health departments, leaving them unable to respond to all infestation concerns.¹⁶ In August 2010, the Centers for Disease Control and Prevention and US Environmental Protection Agency issued a joint statement that promoted an integrated pest management approach to bedbug control using the following methods: applying heat treatment, vacuuming, using nonchemical pesticides, and using chemical pesticides judiciously.¹⁷ Room heat treatments more frequently are being used, and a treatment time of less than 6 hours usually is effective in controlling bedbug infestations in a room.¹⁸ *Cimex hemipterus* survival largely is affected by both temperature and relative humidity.⁵ Steamers and rapid freezing equipment can kill bedbugs on contact.¹⁹

Bedbugs are approximately the size of small ticks and may be difficult to find. Blood-stained feces on mattress seams and a pattern of bites in exposed areas are highly suggestive of bedbug infestation. The pattern of bites may be linear or may resemble prurigo nodularis. Monitoring tools such as the Cimex Detection Case 3000 (CDC 3000), NightWatch bedbug monitor, and homemade dry ice traps can be used to detect bedbug infestation.⁴ Interceptor traps are devices that are carefully positioned under bed

legs to capture bedbugs. Most traps use heat or semiochemicals to attract bedbugs. Semiochemicals are behavior-modifying and physiologic-modifying chemicals that lure *C lectularius*. Examples of semiochemicals include carbon dioxide and kairomones.²⁰ Pheromones also have been reported to have the potential to control bedbugs. Bedbugs rely on chemical signaling for mating; therefore, interference with mating behavior may be a method of managing bedbugs in the future.²¹

Insecticides applied to walls, floors, and cracks in furniture are effective tools in eliminating bedbug infestations.³ Natural pyrethrins and synthetic pyrethroids, including deltamethrin, cyhalothrin, and permethrin, have been used for bedbug control. Unfortunately, the extensive use of this class of insecticides has resulted in resistance in bedbug populations.¹⁴ Zhu et al²² investigated the distribution of 2 mutations in bedbug populations and established that target site-based mutations are the key mechanism for reported pyrethroid resistance. Seong et al¹⁴ showed that the use of quantitative sequencing and filter contact vial bioassay facilitates the detection and monitoring of pyrethroid-resistant bedbugs.

Chlorfenapyr, an insecticide agent that disrupts oxidative phosphorylation in insect mitochondria, is an effective insecticide for the control of pyrethroid-resistant bedbugs. Although chlorfenapyr does not cause a quick knockdown, its long residual activity on surfaces make it suitable for bedbug control.²³ Propoxur still is effective in killing bedbugs, but because of its potential association with cancer, potential developmental detriments, and central nervous system effects, its use is being debated and currently is prohibited in residential housing.²⁴

Different plant species have been used to repel and kill bedbugs in the Lao countryside. The identification of active components in certain plants may aid in the development of effective and inexpensive repellants and/or insecticides in the future.²⁵ Researchers are working with the US Environmental Protection Agency to develop new compounds to control bedbugs.¹⁹ New treatment methods and preventive approaches to bedbugs may decrease the prevalence of bedbugs worldwide.

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