

## BEDBUGS (BED BUGS): THE BASIC KNOWLEDGE

By

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### Abstract

The common bed bug, *Cimex lectularius*, is an obligate blood-feeding ectoparasite that preferentially feeds on humans. All stages feed on blood and require a blood meal to molt (nymphs) and reproduce (adults). Differential diagnosis of bed bug bites is difficult and insufficient to determine the bed bugs or their extent. Infestation is a worldwide epidemic due to emergence of insecticide-resistant strains.

**Key words:** Bedbugs, Epidemiology, Medical importance, Recommendations, General review

### Introduction

Bedbugs (also written Bed bugs) are true bugs of the Order Hemiptera. Bed Bug evolved from the Bat Bug which feed on Bats in caves. 100,000 years ago Neanderthal man lived in caves and was also fed upon by these bugs. Eventually, the bat bug evolved into a new species we call the Bed Bug. All insects within this order have wings that are half membranous and half sclerotic. The early writings about bed bugs appeared in ancient Egypt around 400 BC and the oldest bed bug found is an Egyptian fossil from 3500 years ago. They were also reported in early Roman and Greek writings. In bedbugs, the membranous portion of the wing is vestigial, and only the sclerotic portion of the wing is visible (Saenz *et al*, 2014). Bedbugs belong to the family Cimicidae. Cimicids commonly infest human, bird and bat habitats. As parasites they are unique because they are obligate blood feeders but do not remain on the host to complete their lifecycle; rather they move to adjacent areas and hide in the surrounding habitat. Human disease occurs from the direct feeding by one or several species of bedbugs, though it is uncommon for multiple bedbug species to be present in a single case. Bedbugs may feed on the patient within their residence or in sites where the person sleeps or remains quiescent for periods of time. These bugs may be related to birds or bats roosting in or around the house, and when the primary host migrates, hungry bedbugs

range in search of an alternate food source (Whyte *et al*, 2001).

Bedbugs have flat oval bodies, are reddish brown in color, and similar in size to a dog tick. Eyes are widely separated. They have retroverted mouthparts with the labium slender and elongate, forming a three segmented rostellum (rostrum). Wings are reduced to hemelytral pads, with membranous hindwings vestigial or absent. Pronotum has a concave anterior margin that receives the head. Bristles project laterally along the pronotum margins, starting behind the eye and continuing along the lateral edge. Bristles also can be observed on the dorsal surface. Antennae have four segments, distal three antennal segments being long and slender. Abdomen has eleven segments that expand during feeding, exposing intersegmental membranes (Walpole and Newberry, 1998).

### Review and Discussion

Bed bugs were mentioned in ancient Greece as early as 400 BC, and were later mentioned by Aristotle. Pliny's *Natural History*, first published *circa* AD 77 in Rome, claimed bed bugs had medicinal value in treating ailments such as snake bites and ear infections. (Belief in medicinal use of bed bugs persisted until at least the 18<sup>th</sup> century, when Guettard recommended their use in the treatment of hysteria). The name bed bug derives from the preferred habitat of *Cimex lectularius*: warm houses and especially near or inside beds and bedding or other sleep areas. Bed bugs are mainly active at night, but

are not exclusively nocturnal. They usually feed on their hosts without being noticed (Doggett and Russell, 2009). *Cimex lectularius* and *C. hemipterus* are the two species of bedbug most commonly affect humans. *C. lectularius* is found in temperate climates, and *C. hemipterus* is most prevalent in tropical ones. Adult *C. lectularius* range in size from 5 to 7mm, while nymphs (juveniles) may be 1.5mm. *C. hemipterus* is somewhat longer than *C. lectularius*. Ranges of these species overlap, and bugs of different species may interbreed, though with the limited success of viable offspring. Other species that use humans as incidental hosts & correct identification was important to determine proper control measures and potential disease vector (Newberry, 1988).

They are obligatory hematophagous (bloodsucking) insects. Most species feed on man only when other prey was unavailable (Storey, 2010). They obtain all the additional moisture they need from water vapor in surrounding air. Bed bugs are attracted to their hosts primarily by carbon dioxide, secondarily by warmth, and also by certain chemicals. Bedbugs prefer exposed skin, preferably the face, neck, and arms of a sleeping person (Singh et al, 2012). Prior to a blood meal, adult bedbugs are browner in color. After feeding, the color appears more dull red, and their body elongates and is no longer flat. Smaller nymphs are translucent prior to feeding and bright red immediately after feeding (Liebold et al, 2003).

Human bedbugs are present throughout the world and tropical bedbugs are limited to equatorial regions. Occasionally, the tropical bedbugs may appear in more temperate areas because of international travel. Other species are distributed depending on their primary hosts. Infestations are considered more common in poorer areas, but they can also frequently occur in other areas where people regularly travel, or among people who have used sites frequented by others. Within multifamily and institutional facilities, bedbugs will move among rooms from a focal point

or may spread as people and effects move within the facility (Kells, 2006).

Bedbugs seldom inhabit the resting surface of beds or chairs. Instead, they hide in the cracks and crevices associated with the mattresses, cushions, bed frames and other structures. The female deposits her eggs in these areas, gluing them to the surface. The eggs hatch in 4 to 10 days.

Bedbugs often feed while the victim is sleeping, but feeding also may occur when the victim is quiescent or is preoccupied, such as watching a movie. They are attracted by warmth and carbon dioxide. They inject an anticoagulant to aid with their feeding and usually feed without detection by the host. A complete blood meal is taken in about 5 to 10 minutes (Thomas et al, 2004).

In the developing world, bedbugs commonly inhabit the cracks and crevices of mud and daub houses, as well as the thatched roof. In refugee camps, infestations are common. In a refugee camp in Freetown, Sierra Leone, bedbugs were found in 98% of rooms evaluated, with many more being recovered during the night when they feed. Eighty-six percent of the residents of the camp demonstrated wheals from bedbug bites (Gbakima et al, 2002).

Bedbugs move at about the same rate that a ladybug walks. They move by active displacement to feed (bite) during the night. Bed, mattress, sofa, and/or curtains are the most frequently infested places. Bedbugs spend the majority of their lives hiding in harborages, especially during the daytime. Bedbug infestations have also been detected across a wide range of travel accommodations, regardless of their comfort and hygiene levels (Delaunay, 2012).

Clinical manifestations: Bedbugs typically bite at night on exposed areas of skin. Bites typically occur on the face, neck, hands, and arms, and may be noted upon awakening or one to several days after the bites. In some patients, the onset of symptoms may be delayed for up to 10 days. The bite itself is painless (Sansom et al, 1992).

Not all individuals react to bites, and a bedbug bite most often appears as a small punctum without a surrounding reaction (Goddard and deShazo, 2009). Some patients may have only asymptomatic purpuric macules. In one questionnaire-based study (n=474), approximately 30 percent of individuals living in bedbug-infested dwellings reported a lack of bites or skin reactions. Elderly people may be less likely to develop symptoms than younger individuals (Potter *et al*, 2010).

When a reaction occurs, a bedbug bite can present as a 2 to 5mm erythematous maculopapular lesion or wheal with a central hemorrhagic punctum (Cleary and Buchanan, 2004). These are frequently pruritic. Other patients may have more severe reactions with bullae. Antihistamines might suppress reaction and interfere with a patient's ability to detect an infestation (Fletcher *et al*, 2002).

Untreated individual lesions usually resolve in one week. New lesions typically accumulate as older lesions heal. Occasionally, bedbug bites can become secondarily infected and present with impetigo or cellulitis. Excoriated or impetiginized lesions might take several weeks to resolve (deShazo *et al*, 2012).

Bedbug bites are also thought to appear as papular urticaria or may mimic conventional urticarial. Patients with papular urticaria may demonstrate IgG against *C. lectularius*, *Culex pipiens*, and *Pulex irritans* (Scarupa and Economides, 2006).

Antigens in bedbug feces may play a role in asthma in some countries (Abou Gamra *et al*, 1991). These authors concluded that of interest was the significant relation between the positivity in asthmatic patients to the antigens of *C. lectularius* abdominal extract and cotton dust extract. But, the precipitin tests gave negative results in both the asthmatic and control group.

Diagnosis: Bedbug bites are difficult to distinguish from other bites. A linear series of bites found on awakening is often associated with bedbugs, but does not occur in all cas-

es. The “linear feeding” may occur as a single bedbug probes multiple times looking for a productive capillary or from multiple bedbugs feeding along a zone of exposed skin. Bedbug feeding tends to cause restlessness in some people during sleep, so bites may be widespread as new areas of skin are exposed (Abdel-Naser *et al*, 2006).

Small infestations of bedbugs are very difficult to detect and an infestation may be suspected if specks of feces or blood are found on linens, mattresses, or behind wallpaper. Caste skins from bedbugs moulting to successive instars also may be found. Additionally, bedbugs produce a pungent odor that is recognizable to those familiar with it. However, this odor typically occurs only with chronic and widespread infestations and so is not helpful in excluding a diagnosis of bedbug bites. Bedbug bites are difficult to distinguish from other bites. A linear series of bites found on awakening raises the likelihood of bedbugs.

The differential diagnosis includes: 1- Scabies; however, scabies tends to affect both covered and uncovered skin, and the skin typically shows burrows. (The prominent clinical feature of scabies is itching. It is often severe and usually worse at night. The pruritus is the result of a delayed type-IV hypersensitivity reaction to the mite, mite feces, and mite eggs (Currie and McCarthy, 2010). The essential lesion is a small, erythematous, nondescript papule, often excoriated and tipped with hemorrhagic crusts. It is not a dramatic lesion and not always easy to detect. More striking, when present, is the burrow. The pathognomonic when correctly identified, the burrow is a thin, grayish, reddish, or brownish line that is 2 to 15mm long. Burrows are often absent, however, or obscured by excoriation or secondary infection. Miniature wheals, vesicles, pustules, and rarely bullae may also be present. The distribution of scabies usually involves the sides and webs of the fingers, the flexor aspects of the wrists, the extensor aspects of the elbows, anterior and posterior axillary

folks, the skin immediately adjacent to the nipples (especially in women), the periumbilical areas, waist, male genitalia (scrotum, penile shaft, and glans), the extensor surface of the knees, the lower half of the buttocks and adjacent thighs, and the lateral and posterior aspects of the feet. The back is relatively free of involvement, and the head is spared except in very young children (Morsy *et al*, 2003). 2- Other biting arthropods, especially fleas and parasitic mites, can produce bites similar to bedbugs. Bites of insects may be a minor nuisance or may lead to serious medical problems, including the transmission of insect-borne illnesses and severe allergic reactions. Arthropods that commonly bite humans include all blood sucking insects as well as ticks and small number of spider (Morsy, 2012). 3- *Cheyletiella* mites and other mite species (often associated with pet cats, dogs, rabbits, or both domestic and wild birds) are a common cause of grouped bites (Morsy *et al*, 1999; Mazyad *et al*, 2001; Saleh *et al*, 2013). 4- Vesicular disorders unrelated to bites, such as dermatitis herpetiformis, can also have the similar appearance. Dermatitis herpetiformis (DH) is an uncommon autoimmune cutaneous eruption associated with gluten sensitivity. Affected patients typically develop intensely pruritic inflammatory papules and vesicles on the forearms, knees, scalp, or buttocks. The vast majority of patients with DH also have an associated gluten-sensitive enteropathy (Salmi *et al*, 2011). In most of these patients, the enteropathy is asymptomatic. Patients with DH may experience cutaneous, oral, and gastrointestinal manifestations related to gluten-sensitivity. Intensely pruritic conditions that present with excoriations and inflammatory papules, such as atopic dermatitis, scabies, and the other arthropod bites should be considered (Weedon, 2010). 5- Delusional parasitosis can present with symptoms similar to bedbug infestations. Sabry *et al*. (2012) reported that entomophobia or acarophobia, parasitic dermatophobia (PD) or delusional parasitosis (DP)

is a disorder in which affected individuals has the mistaken but unshakable belief (delusion) that they are infected by insects, spiders, scorpion, ticks, mites, parasitic worms, bacteria, or other living organisms. As with all delusions, this belief cannot be corrected by reasoning, persuasion, or logical argument. To avoid them, they may always be cleaning rooms, floors, doors, windows and scratching. Many affected individuals are quite functional; for the minority, delusions of parasitic infection may interfere with usual activities. DP cases are increasing worldwide as an extremely unrepeatable disorder.

Histopathology: Skin biopsies of bedbug bites are not typically performed because the diagnosis can usually be made clinically and the histopathologic findings are nonspecific. Urticaria-like lesions often demonstrate variable edema in the upper dermis and a perivascular inflammatory infiltrate that contains lymphocytes, eosinophils, and mast cells. A small number of interstitial eosinophils may also be present (Weedon, 2010). Bullous bedbug bites may exhibit intraepidermal edema, subepidermal edema, and a mixed dermal inflammatory infiltrate. Also, histopathologic features consistent with cutaneous vasculitis were reported in a patient with bullous lesions (Tharakaram, 1999).

Diseases transmission: Human bedbugs have not been proven to be competent vectors of diseases. However, pathogens have been detected on and in them, including: 1- Hepatitis B: Some studies and experiments have suggested that bedbugs could be a vector for hepatitis B (Jupp *et al*, 1983). Hepatitis B DNA was detected in bedbugs and their excrement up to six weeks after an infected meal (Silverman *et al*, 2001). However, a Gambian study of spraying insecticide found a decrease in exposure to bedbugs but no effect on hepatitis B infections (Vall Mayans *et al*, 1994). 2- Bedbugs have been implicated as a possible secondary vector of American trypanosomiasis or Chagas' disease (Jörg, 1992). 3- Hepatitis C and HIV: Bedbugs appear unlikely to transmit hepatic

tis C or HIV (Jupp and Lyons, 1987). *Wolbachia* species (Gram-negative alpha-proteobacteria) were detected in bedbugs. These bacteria were found to infest a variety of arthropods and helminths. They are implicated in Mazzotti reactions associated with the treatment of onchocerciasis. The Mazzotti test consists of a 50 mg oral dose of diethylcarbamazine (DEC), which leads to microfilarial death and associated symptoms of worsening pruritus about 20 to 90 minutes later; an acute papular rash with edema, fever, cough and musculoskeletal symptoms may also occur. Symptoms generally reach a peak at about 24 hours and then subside over the next 48 to 72 hours. In some cases, severe systemic reactions can develop, including pulmonary edema, visual loss, collapse, and death. In the United States DEC was not available for this indication. *Wolbachia* symbionts are maternally inherited intracellular bacteria that were detected in numerous insects including bed bugs. Infections with *Wolbachia* species of F supergroup seemed to be prevalent in the Cimicinae subfamily (*Cimex* and *Oeciacus* genera). Their significance as pathogens in the setting of bedbug infestation remains to be determined (Siddiqui, and Raja, 2015). 4- Some obligate symbionts with a mutualistic nature-like *Buchnera* in aphids and *Wigglesworthia* in tsetse were reported to contribute to host fitness (Douglas, 1998). 5- Swallow bug (*Oeciacus vicarius*), which is similar in appearance to the bedbug, may be a vector for certain arboviruses. Thus, proper insect identification is important (Brouqui and Raoult, 2006). 6- Salazar *et al.* (2015) and Leulmi *et al.* (2015) reported the vectorial competence of *C. lectularius* for *Trypanosoma cruzi* and *Bartonella quintana* transmissions in laboratory experiments. In addition, bed bug infections by *Burkholderia multivorans* were reported by Saenz *et al.* (2013) who screened different bed bug populations in the United States. 7- Bedbug infestations can produce significant psychosocial stressors. Goddard and de Shazo

(2012) reported that in some individuals, psychological sequelae resulting from bed bug biting events include nightmares, flashbacks, hypervigilance (to keep bugs away), insomnia, anxiety, avoidance behaviors, and personal dysfunction depression, social isolation, and even suicidal thoughts. These symptoms are suggestive of posttraumatic stress disorder (PTSD). They concluded that individuals who experience bed bug bites developed moderate-to-severe negative emotional symptoms after infestations. These individuals should be identified in the course of their interactions with health professionals so that appropriate mental health care may be provided. 8- There are numerous reports in the lay media of a variety of mental health issues associated with bed bug infestations. The few peer-reviewed articles on this subject document (Rieder *et al.*, 2012). 9- Bed bugs do not transmit MRSA. Although there were reports of persons developing methicillin resistant *Staphylococcus aureus* (MRSA) infections, such as boils or abscesses associated with bed bug bites, it turns out the bed bugs really weren't directly at fault. The cases of MRSA infections associated with bed bug bites are actually an example of scratching leading to minor skin trauma and subsequent secondary bacterial infections. In these cases, people who are carriers of MRSA scratch at the itchy bite sites and provide a port of entry for the MRSA to get in and under the skin and predisposing to the secondary infection (Kraft, 2011).

Treatment: Bedbug bites do not typically require treatment. In patients with severe pruritus, it is reasonable to try symptomatic management with topical corticosteroids and /or the systemic antihistamines (Bernardeschi *et al.*, 2013). Patients should be advised to maintain good hygiene and avoid scratching so as to prevent infection. If secondary infection occurs, it should be managed with antibiotics as appropriate. Cellulitis is a common problem caused by spreading bacterial inflammation of the skin, with redness,

pain, and lymphangitis. Up to 40% of affected people have systemic illness. Erysipelas is a form of cellulitis with marked superficial inflammation, typically affecting lower limbs and face. The most common pathogens in adults were streptococci and *Staphylococcus aureus*. Cellulitis and erysipelas can result in local necrosis and abscess formation (Oh, 2015). The hosts of bedbug infestations may experience moderate to severe levels of stress, anxiety, and depression. Clinicians should inquire about symptoms of stress and depression, and in some cases treatment may be required. Bedbug bite reactions are considered to be of minor medical significance. However, the not-uncommon bullous reactions to bedbug bites reflect the presence of a local, highly destructive, cutaneous vasculitis. The histologic features of these reactions resemble those occurring in the Churg-Strauss syndrome. Therefore, efforts to prevent further bites and monitor for evidence of systemic vasculitis should be made in patients with bullous reactions to bedbug bites. Topical treatment with high potency corticosteroids may be useful in bullous reactions treatment (deShazo *et al*, 2012). But, antihistamines can suppress the symptoms and signs of bites and so may reduce the patient's ability to detect an ongoing infestation.

The management of bedbug infestation hinges on identification of the bug. In the developed world the management of bedbug infestation hinges on identification of the bug. If bat bugs or swallow bugs are identified, bat roosts and bird nests should be eliminated and an approved residual insecticide should be applied to control surviving bugs. These bugs live for prolonged periods without food or water, so starvation by host absence from an area is not an effective control method. If human bedbugs are identified, control requires the combination of nonchemical controls and chemical insecticide applications. Inspection of the residence must be carefully performed to find all of the hiding areas. While most bedbug infesta-

tions located adjacent to the feeding sites, some bedbugs spread to other areas and apartments (Lee *et al*, 2008).

Human bedbug control: Several insecticides are available, and at least three formulations should be used to avoid control failures because of insecticide resistance or missed areas harboring live bugs. Supplemental non-chemical controls include vacuuming, laundering, and freezing articles. Washing and drying items in a dryer on a hot setting is adequate to kill bedbugs in the clothing or linens; the dryer should be placed on the hottest setting the fabric can withstand.

Heat treatment of living spaces is an alternative to the use of insecticides to eliminate bedbugs from the home. Equipment is available that can heat rooms to a lethal temperature. All stages of bedbugs can be killed at 50°C (122°F). An exposure time of 90 minutes was required for temperatures between 48 & 50°C (Masetti and Bruschi, 2007).

Thorough control of human bedbug infestations requires an experienced pest management professional and victims should be advised against attempting control measures themselves. In cases where the patient is destitute and cannot afford a complete treatment, and the landlord was unwilling to help, bedbug numbers could be reduced by thorough removal measures. Removal usually includes using a thin plastic card (or business card) or a thin bladed paint scraper to dig bedbugs out of cracks and crevices. Dislodged bedbugs can be killed manually or removed with tape. If the patient has a vacuum cleaner or hair dryer, these may also remove or kill bedbugs. These practices would reduce bedbug bites, but would not eliminate the population and the practices will have to be repeated (CDC, 2011).

Bat bugs and swallow bugs: If bat bugs or swallow bugs are identified, bat roosts and bird nests should be eliminated and an approved residual insecticide should be applied to control surviving bugs. These insects live for prolonged periods without a host, so starvation by host absence from an area is

not an effective control method and may result in bug movement to other areas. Balvín *et al.* (2012) reported that bedbugs' original hosts were likely bats, and the bedbugs are still common in their roosts. Using morphometry and sequences of mitochondrial cytochrome oxidase subunit I & 16S genes, showed that the populations on bats and humans are largely isolated and differ in morphology. They estimated the time of splitting into bat- & human-parasitizing groups using the isolation-with-migration model. They added that it predated the expansion of modern human from Africa. The gene flow between bat- and human-parasitizing bedbugs is limited and asymmetric with prevailing direction from human-parasitizing populations to the bat-parasitizing populations. The differentiation of the populations fits the concept of host races and supports the idea of sympatric speciation. They concluded that contradict formulated hypotheses suggesting bat roosts as a source of bedbug's resurgence as a human pest and extend the known host range of the bedbug by two bat species.

When a roost cannot be eliminated, such as when the bird or bat is protected by law, an approved residual insecticide can be applied in the area between the roost and the site of human habitation. After the primary host has abandoned its nest, more aggressive measures can be used in vacated areas. The insects may enter the house through cracks in walls and doorways. These can be sealed or treated with an appropriate insecticide. Peeling paint and cracked plaster must be eliminated. However, attempts to seal all openings in a room or house (such as caulking between the walls and baseboards) are unlikely to be successful and may actually prevent insecticide treatments from penetrating into areas where bedbugs hide.

Various insecticides have been used in the developing world. Dichlorvos and similar organophosphate insecticides showed to be effective in this setting. The residual effect of insecticides varies, and some have reduced efficacy on mud, wood, and fabric.

Permethrin has only the intermediate activity against bedbugs, but can be used to impregnate clothing with residual effect (Fletcher and Axtell, 1993).

Pyrethroid-treated bed-nets have proved effective in controlling the number of bites, but resistance to permethrin is emerging as a result of this control method. Where possible, the use of bed nets should be periodically discontinued and replaced with other insecticides that have a different mode of action such as dichlorvos (Le Sueur *et al.*, 1993). A program of rotating insecticides is necessary to manage insecticide resistance. The organic content of mud daub walls has a significant effect on the residual effect of some insecticides, and products such as microencapsulated insecticides will counteract these absorptive materials (Gao *et al.*, 1984).

Insect repellents are not particularly effective against bedbugs. Several repellents have been tried for personal protection. DEET (N, N-diethyl-3-methylbenzamide, formerly called N, N-diethyl-m-toluamide) causes bed bugs to take progressively smaller meals in face of increasing concentrations of the repellent. Paradoxically, there is a theoretical concern that this may increase the risk of spreading some diseases, as the bedbugs continue to bite one individual after another in search of a full meal (Kumar *et al.*, 1995). But, Bashir *et al.* (2013) reported case of pyrethroid-induced toxic acute tubular necrosis (ATN). A 66-year-old healthy woman receiving no prior nephrotoxic medications presented with extreme weakness, decreased urine output, and acute kidney injury. She had administered multiple applications of a bedbug spray (permethrin) and a fogger (pyrethrin), exceeding the manufacturer's recommended amounts. She was found to have severe nonoliguric acute kidney injury associated with profound hypokalemia. Kidney biopsy revealed toxic ATN with extensive tubular degenerative changes and cytoplasmic vacuolization. They concluded that bedbug insecticides containing pyrethroids must be used with caution.

In general, insect repellants are not recommended for the management of bedbugs. A comprehensive control program that includes insecticide treated bed-nets, elimination of the cracks and crevices, insecticidal sprays of infested sites, and direct removal of bedbugs is more likely to be effective for reducing bites (Jupp *et al*, 1991).

Daily cleaning of the sites (leaving no crannies, paneling, peeling wallpaper) combined with information campaigns for the housekeeping personnel can minimize the risk of infestation by increasing the chance of early discovery of recently arrived bedbugs (Meek, 2008). Renovation aims eliminate a maximum of hiding and dark places, transform the room into an unfriendly environment for bedbugs in an area designed to facilitate their detection, and perform non-chemical eradication. Mattress covers can prevent mattress infestation and facilitate the fight against bedbugs. Some available methods enhance bedbug detection. Among them is the dog trained to detect bedbugs by sniffing their odor, but success relies on good training for the dog and dog owner's entomological knowledge (Pfiester *et al*, 2008).

But, no preventive measure is ideal, and basic preventive measures include: staff information, cleaning, renovation, and better bedbug detection (Doggett, 2011).

### Conclusion

In recent years, *Cimex lectularius* became a major public health concern in urban communities. Bed bugs are notoriously difficult to control, and their bites are not tolerated by most people. Extensive bedbug infestations produce a pungent odor that is recognizable to those familiar with it during work, travel, or sleep. Pruritic bites can be managed symptomatically with topical corticosteroids or systemic antihistamines. Antibiotics are indicated for secondarily infected.

Management of bedbug infestations starts with identification of bug and primary host (e.g., human, bat or bird). If bat bugs or swallow bugs are identified, then roosts or nests should be eliminated whenever possi-

ble, with subsequent applications of insecticides. Control of human bedbug infestations requires an experienced pest management professional and the victims must be advised against attempting control measures by themselves.

### Recommendations

There is an urgent public health need for materials and methods to reduce bed bug distribution and spreading worldwide, even within countries. If bedbugs are not detected directly, infestation may be suspected when specks of blood containing dung are found on linens, mattresses, or behind wallpaper. Extensive bedbug infestations produce a pungent odor that is recognizable to those familiar with it. Human bedbugs have not been convincingly demonstrated to be competent vectors for disease. Pruritic bites can be managed symptomatically with topical corticosteroids or systemic antihistamines. Patients may require antibiotics if bites become secondarily infected. Management of infestations starts with their identification and thus primary host. If bat bugs or swallow bugs are present, then roosts or nests must be eliminated whenever possible, with insecticides subsequent applications. Control requires an experienced pest management professional and victims must be advised not to attempt control measures themselves.

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