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When bed bugs bite

Treating bed bug bites is straightforward; helping patients control and even prevent future infestations is another matter. Here's how you can help.

PRACTICE RECOMMENDATIONS

› Provide symptomatic relief for bed bug bites with antihistamines or corticosteroids. **C**

› Advise patients experiencing an infestation to consider the CDC's recommended integrated pest management program (eg, heat treatment, vacuuming, nonchemical pesticides) to increase the likelihood of successful extermination. **C**

Strength of recommendation (SOR)

- A** Good-quality patient-oriented evidence
- B** Inconsistent or limited-quality patient-oriented evidence
- C** Consensus, usual practice, opinion, disease-oriented evidence, case series

Bed bugs, *Cimex* spp, are a re-emerging public health problem in the United States. First recorded by the ancient Greeks,¹ bed bugs have plagued societies for centuries. In the United States, infestations peaked in intensity in the 1920s and 1930s, then were largely eliminated as a significant concern after World War II, thanks to synthetic, residual pesticides.² By the mid-1990s, bed bugs were so uncommon that specimens could not be obtained for medical education purposes.³

That has all changed.

Although commonly perceived as disproportionately affecting the underprivileged,⁴ bed bugs are equal-opportunity pests, infesting the most posh hotels, retailers, and theaters.^{5,6} According to one news report summarizing data from a national pest control firm, US cities with the highest infestation rates are, in descending order: Cincinnati, Columbus, Chicago, Denver, Detroit, Washington DC, New York, Philadelphia, Dayton, and Baltimore.⁷ Although bed bugs are not known to transmit infectious diseases, they are responsible for significant dermatitis, allergic reactions, and psychological distress.

Bed bug biology and behavior

The bed bug life cycle has 7 stages. All but the egg stage require blood meals before the arthropod can molt to the next stage. Bed bugs are attracted to their hosts by body heat and exhaled carbon dioxide, and they feed only through the skin. This makes baiting and trapping challenging, although it's a common extermination strategy for other domestic pests. Also, unlike cockroaches, flies, or other pests, bed bug infestations are not associated with hygienic deficiencies. Improved housekeeping does not significantly affect their populations; bed bugs feed on household inhabitants, not their spilled or improperly stored food. However, clutter does increase their chances of finding refuge.

Interestingly, researchers recently discovered that bed bugs are themselves hosts to the endosymbiotic bacterium,

Wolbachia.^{8,9} This genus is found in many invertebrates and appears to be essential for normal bed bug fertility and reproduction. Targeting the bacteria may inhibit the ability of bed bugs to breed—something we'll discuss a bit later.

Clinical assessment

Patients with bed bug bites complain about intensely pruritic lesions. These are typically erythematous and indurated and may be hemorrhagic. The pattern of bites is often linear, and 3 bites in a row are common, sometimes referred to as “breakfast, lunch, and dinner.” Patients typically have no recollection of being bitten, as bed bugs feed on sleeping hosts, and their bite is usually painless.

■ **Clues to bed bugs as the source.** Scabies mites also cause linear pruritic lesions, but bed bug lesions differ in appearance and distribution. Scabies lesions are subtle, appearing as burrows and excoriations, in contrast to the more prominent erythematous papule seen with bed bugs and other arthropod bites. Scabies tend to occur in skin folds, finger webbing, genitals, and areas where clothing is tight, such as beltlines. In contrast, bed bugs tend to attack easily accessible, exposed areas. Areas covered with loose clothing are less affected, and areas covered by tight clothing are essentially spared. Multiple members of the household are often affected.

■ **Flea bite?** Bed bug bites may be virtually indistinguishable from those of other arthropods such as fleas, spiders, or mosquitoes. While the linear 3-bite pattern may suggest bed bug exposure, it is not pathognomonic. Capturing the arthropod or finding evidence of infestation (discussed in a bit) is needed to confirm a bed bug as the source of the bite.

The etiology of pruritic papules is broad. Besides arthropod bites, include conditions such as papular eczema, papular pruritic eruption, and eosinophilic folliculitis in the differential diagnosis.

Potential for complications

As with any break in the skin, secondary infection is a risk, although it is rarely a complication of the bite. If infection occurs, it is

more likely due to scratching. Bed bug bites are allergenic, and they have also been implicated in asthma exacerbations and even anaphylaxis.^{10,11} In severe infestations, anemia from the extensive blood-meals can occur.¹²

Experimental studies have found that >45 human pathogens—ranging from viruses to methicillin-resistant *Staphylococcus aureus* to helminths—can survive ingestion by bed bugs, but none have shown pathogens to be transmitted to humans by bed bugs.¹¹ Fortunately, bed bugs do not appear to be competent as vectors, although prospective studies are ongoing.¹³ In addition to allergic manifestations, bed bug bites have been associated with significant, even incapacitating, psychiatric problems such as anxiety, obsession, and depression to the point of suicide.¹⁴

Treating symptoms and cause

Management of bed bugs consists of symptomatic treatment of the bites and elimination of the infestation—treating both patients and their environments.¹⁵

Treating patients

Treating bed bug bites mainly involves providing symptomatic relief with antipruritic agents (antihistamines, topical or oral corticosteroids, over-the-counter topical anesthetics).¹⁶ When, rarely, a bite becomes infected, antibiotics may be indicated. Address psychological distress associated with an infestation. Counseling with cognitive behavioral therapy is effective most of the time, although some cases may warrant short-term psychopharmacotherapy.

Symptomatic relief will be short-lived, however, without remediation of the underlying infestation. If the bugs remain, the biting will continue.

Treating the environment

Every object and location in which bed bugs may have taken refuge must be treated. The first step in eradicating an infestation is to find it. In light infestations, evidence may be limited. However, they are dirty bugs. Significant amounts of litter, including molted exoskeletons, dark feces, and eggs, are found wherever there is an infestation. These signs

➤ The CDC recommends an integrated approach to fighting infestation: removing clutter, sealing cracks and crevices, applying heat treatment, vacuuming, and using pesticides.



➤ **Bed bugs are good at hiding and can survive for up to a year without feeding.**

TABLE

Xenointoxication with ivermectin has proven effective against several ectoparasite infestations²⁴⁻²⁸

In vitro research has shown that bed bugs are also susceptible to this class of antiparasitic drugs.

Ectoparasite	Condition	Ivermectin dosing
<i>Sarcoptes scabiei</i>	Scabies	0.2 mg/kg, single dose
<i>Pediculus capitis</i>	Head lice	0.2 mg/kg every 10 days x 2 doses
<i>Pediculus corpora</i>	Body lice	0.2 mg/kg every 7 days x 3 doses

of infestation may be found on mattresses or box springs, or in the bottom of bureau drawers and the corners of rooms. Anywhere just out of reach of the vacuum cleaner can harbor their detritus. Some success has been reported using bed bug detectors/monitors.¹⁷ Bed bug-sniffing dogs have been trained and employed in both identifying infestations and monitoring the efficacy of eradication interventions.

A number of extermination methods have been used. The most commonly used chemicals are permethrins, the same agents that have proven effective in antimalarial bed net programs. This agent is applied to the environment, not to the patient. Generally, at least 2 applications are required. Although as recently as 1990 no bed bug resistance to permethrin had been reported,¹⁸ there is now widespread resistance.¹⁹ Efforts at developing new agents are progressing.

Besides resistance, toxicity to humans is a concern. The Centers for Disease Control and Prevention (CDC) has reported both morbidity and mortality from chemical pesticides used in bed bug extermination efforts.^{20,21}

Physical methods have also been applied.

■ **Thermal treatment** (heating or steaming to >48°C [120°F] for one hour or freezing to -20°C [-4°F] for one hour) has proven effective.²² Books, clothing, and other small items may be placed in an oven or freezer (as long as specified temperatures are met); steamers are useful for treating furniture and baseboards. If an oven is used, diligent attention must be paid to avoid too high a temperature, which could create a fire hazard. Let patients know that, even at 120°F, some book bindings and slipcovers could be damaged.

■ **Desiccant dusts** such as silica gel and diatomaceous earth, applied along the baseboards and the back of bookshelves, have also demonstrated efficacy.²³ As with chemical pesticides, it is important to follow directions when using desiccant dusts to minimize potential health hazards.

■ **The CDC recommends** a comprehensive, integrated pest management program to control bed bugs. This program includes a number of methods, such as removing clutter and sealing cracks and crevices where bed bugs take refuge, applying heat treatment, vacuuming, using nonchemical pesticides, and cautiously applying effective chemical pesticides.¹⁷ An approach such as this is labor- and time-intensive, and can be costly.

Given the inadequacies of current strategies in controlling infestations, new approaches are needed. One such approach may be xenointoxication, in which patients take an oral arthropodocidal agent, making the blood meal toxic to the parasite and decimating the population. Although there are no literature reports of its application to bed bugs, the technique, using ivermectin, has been successfully applied to other ectoparasites, including scabies,^{24,25} lice,^{25,26} and the medically important arthropod vectors *Triatoma*²⁷ and *Anopheles*.²⁸ The TABLE shows dosing recommendations for 3 of these indications.

In vitro studies demonstrate that *Cimex* is susceptible to this same class of agents,²⁹ so there is reason for optimism. Future studies will reveal the viability of this approach. Another potential approach to bed bug control is targeting the *Wolbachia* endosymbi-

onts. Elimination of these bacteria has been associated with a significant decrease in parasite reproduction⁹; this strategy has also been efficacious in treating human filarial infections.³⁰

Preventing infestation

Bed bugs depend largely on humans for their dissemination. They take refuge in or near their host's bed during the day, and when the bed or other object in which they are hiding is moved, they are transplanted to a new location. They also migrate directly to adjacent apartments, hotel rooms, etc, along plumbing and wiring or through cracks.¹⁶ Bed bugs are effective at hiding, and can survive for up to a year without feeding.³¹ This contributes to the frequent failure of elimination efforts and the presence of bed bugs in hotels, furnished apartments, theaters, shopping centers, airplanes, newly purchased houses, and other places.

Avoiding bites while in an infested facility is difficult, if not impossible. But people can take steps to decrease the likelihood of bringing them home. Although there are no strong evidence-based guidelines on preventing infestation, pest control experts make a number of recommendations,³² which you can pass on to your patients.

■ Protect luggage when traveling.

When staying in hotels, for instance, patients should keep suitcases tightly closed when not in use. Protection is further enhanced by placing suitcases in a sealed plastic bag; "contractor" trash bags available at hardware stores are large and durable. Keeping suitcases in the bathroom rather than the sleeping quarters also decreases the possibility of stowaways, as bed bugs typically shelter within a few feet of their host's sleeping place.

Immediate laundering of clothes upon returning home from a trip, and storing suitcases outside the living quarters can decrease risk, too.³³ There are commercially available suitcase heaters that raise the temperature of the suitcase and its contents to insecticidal levels, but they are fairly cost-prohibitive.

■ Screen items brought into the home.

Used items, especially furniture, may har-

bor bed bugs. Fumigating used furniture was once common; it is still a good idea before second-hand items are brought into the house. Cardboard boxes in which used items are commonly stored or transported can shelter bed bugs, too.³³

■ Deprive bed bugs of hiding places.

Decluttering one's sleeping quarters decreases the number of places bed bugs can hide. This tactic diminishes the likelihood of an infestation becoming firmly established before being discovered. Intervention early in the course of infestation, when it is limited to a single room, increases the likelihood of successful elimination.³³

Mattress and box-spring encasements can prevent bed bug infestations by blocking movement of the bugs into and out of their shelters. If encasements are placed during an infestation, it is important to keep them in place for an extended period, given that bed bugs can survive for up to a year without feeding. Also effective is caulking and sealing molding, joints, and cracks wider than the thickness of a credit card in the room and in furniture.³³

Vacuuming is part of the CDC's recommendation for household pest control. But vacuum cleaners can also transfer bed bugs from infested to uninfested rooms. During an infestation, it's important to empty vacuum bags immediately. And sharing vacuum cleaners between dwellings is best avoided.

A need for better solutions

Although bed bugs are not competent as vectors for the transmission of infectious diseases, they are responsible for significant dermatitis, allergic reactions, and psychological distress. Treatment of symptoms is effective in the short-term, but current methods of eliminating infestation are cumbersome, toxic, and are seldom completely successful. New strategies are desperately needed. The CDC Web page (<http://www.cdc.gov/nceh/ehs/topics/bedbugs.htm>) is regularly updated, and is a good source of information as new approaches are developed. **JFP**

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Tell patients that when they stay at hotels, it's advisable to keep their luggage in the bathroom. Bed bugs typically shelter within a few feet of their host's sleeping place.

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Covering mattresses and box-springs at home with encasements can prevent infestations by blocking movement of bugs in and out of shelters.

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