

~ Bed Bugs ~  
**Cimex lectularius (Cimicidae)**

**Biology and Management**

Bed bugs are increasingly becoming a problem within residences of all kinds, including homes, apartments, hotels, cruise ships, dormitories and shelters. We have drafted this document to provide basic information about the biology and health significance of these pests, and to offer guidance on how to safely and effectively manage an infested residence.

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**What are bed bugs?**

Bed bugs are small wingless insects that feed solely upon the blood of warm-blooded animals. Bed bugs and their relatives have evolved as nest parasites. Certain kinds inhabit bird nests and bat roosts and await the return of their hosts; others have adapted well to living in the 'nests' (homes) of people.

Hatchling bed bugs are about the size of a poppy seed, and adults are about 1/4 of an inch in length. From above they are oval in shape, but are flattened from top to bottom.



Their color ranges from nearly white (just after molting) or a light tan to a deep brown or burnt orange. The host's blood may appear as a dark red or black mass within the bug's body. Because they never develop wings, bed bugs cannot fly. When disturbed, bed bugs actively seek shelter in dark cracks and crevices. Cast skins of bed bugs are sometimes discovered. Although such a finding confirms that bed bugs had been present previously, it does not confirm that any continue to infest the residence. Thus, inspect carefully for live crawling bed bugs. Because many other kinds of small brown bugs may be discovered, it is critical to ensure that the bugs are correctly identified (more about this below).

**Do bed bugs cause harm or spread pathogens (disease-causing germs)?**

Bed bugs seek out people and animals, generally at night while these hosts are asleep, and painlessly sip a few drops of blood. While feeding, they inject a tiny amount of their saliva into the skin. Repeated exposures to bed bug bites during a period of several weeks or more causes people to become sensitized to the saliva of these bugs; additional bites may then result in mild to intense allergic responses. The skin lesion produced by the bite of a bed bug resembles those caused by many other kinds of blood feeding insects, such as mosquitoes and fleas. The offending insect, therefore, can rarely be identified by the appearance of the bites. A physician should be consulted to rule out other causes for the lesions and to offer treatment, as needed. The affected person should resist the urge to scratch the bites, as this may intensify the irritation and itching, and may lead to secondary infection. Physicians often treat patients with antihistamines and corticosteroids to reduce allergic reactions and inflammation. Despite what you may have heard or read elsewhere, bed bugs are not known to transmit any infectious agents.

**Where do bed bugs occur?**

Bed bugs and their relatives occur nearly worldwide. Bed bugs became relatively scarce during the latter part of the 20<sup>th</sup> century, but their populations have resurged in recent years, particularly throughout parts of North America, Europe, and Australia. They are most abundant in rooms where people sleep, and they generally hide nearest the bed or other furniture used for sleeping. Bed bugs are most active in the middle of the night, but when hungry, they will venture out during the day to seek a host. Their flattened bodies allow them to conceal themselves in cracks and crevices around the room and within furniture. Favored hiding sites include the bed frame, mattress and box spring. Clutter around the room offers additional sites for these bugs to hide, and increases the difficulty in eliminating bed bugs once they have become established.

**How do bed bugs invade a home?**

Because bed bugs readily hide in small crevices, they may accompany (as stowaways) luggage, furniture, clothing, pillows, boxes, and other such objects when these are moved between apartments, homes and hotels. Used furniture, particularly bed frames and mattresses, are of greatest risk of harboring bed bugs and their eggs. Thus, one should carefully scrutinize and consider the history of any used furniture, particularly 'street' items so plentiful at the beginning and end of each academic year. Because they readily survive for many months without feeding, bed bugs may already be present in apparently 'vacant' and 'clean' apartments. Bed bugs can wander between adjoining apartments through voids in walls and holes through which wires and pipes pass. In a few cases, bats and/or birds may introduce and maintain bed bugs and their close relatives (bat bugs and bird bugs). Pest control personnel should be mindful of the presence of blood feeding insects and mites that may be left behind after removing nests or roosts of birds and bats in and on the home.

**How can you tell if the residence is infested?**

Bed bugs infest only a small proportion of residences, but they should be suspected if residents complain of bites that occurred while sleeping. The bedroom and other sleeping areas should be carefully examined for bed bugs and signs of bed bug activity. Folds and creases in the bed linens, and seams and tufts of mattresses and box springs, in particular, may harbor bed bugs or their eggs. They may also be found within pleats of curtains, beneath loose areas of wallpaper near the bed, in corners of desks and dressers, within spaces of wicker furniture, behind cove molding, and in laundry or other items on the floor or around the room. Sometimes, characteristic dark brown or reddish fecal spots of bed bugs are apparent on the bed linens, mattress or walls near the bed. A peculiar coriander-like odor may be detected in some heavily infested residences. Adhesive-based traps used for sampling insects or rodents are not particularly effective for trapping bed bugs.

**What should you do if you find bed bugs?**

Because several different kinds of insects resemble bed bugs, specimens should be carefully compared with good reference images (such as those in this document) to confirm their identity. If any questions remain regarding the identity of your samples, then submit them to a competent

entomologist for evaluation (see information below).

Once their identity is confirmed, a careful plan should be devised to eliminate the bed bugs in a manner that promotes success while limiting unnecessary costs and exposure to insecticides. Don't discard furniture and don't treat until and unless you have a plan.

### **What can you do to manage bed bugs?**

Refer to the management scheme (flow chart) for more guidance.

<http://www.hsph.harvard.edu/bedbugs/management.html>

Before considering treatment, collect specimens and confirm their identity (<http://www.hsph.harvard.edu/bedbugs/specimen.pdf>). Managing bed bugs requires a multi-faceted approach that generally includes cleaning, room modifications, and insecticidal treatments to the residence.

**Search for signs of bed bugs.** Carefully inspect the bed frame, mattress, and other furniture for signs of bed bugs and their eggs. Although dead bed bugs, cast bug skins and blood spots may indicate an infestation occurred previously; they do not confirm that an infestation is still active. Search for live (crawling) bugs and ensure they are bed bugs before considering treating. To confirm the identity of the specimens, refer to our evaluation form

<http://www.hsph.harvard.edu/bedbugs/specimen.pdf>.

**Reduce clutter** to limit hiding places for bed bugs.

**Thoroughly clean** the infested rooms as well as others in the residence. Scrub infested surfaces with a stiff brush to dislodge eggs, and use a powerful vacuum to remove bed bugs from cracks and crevices. Dismantling bed frames will expose additional bug hiding sites. Remove drawers from desks and dressers and turn furniture over, if possible, to inspect and clean all hiding spots.

Mattresses and box springs can be permanently encased within special mattress bags. Once they are installed, inspect the bags to ensure they are undamaged; if any holes or tears are found, seal these completely with permanent tape. Any bugs trapped within these sealed bags will eventually die.

To prevent bed bugs from crawling onto a bed, pull the bed frame away from the wall, tuck sheets and blankets so they won't contact the floor, and place the frame legs into dishes or cups of mineral oil.

Caulk and seal all holes where pipes and wires penetrate walls and floor, and fill cracks around baseboards and cove moldings to further reduce harborages.

If you own your residence, we suggest you contact a licensed pest control operator who is knowledgeable and experienced in managing bed bug infestations. Ask the pest control company for references, and ask at least a few of their customers about their experiences before you agree to any contract.

If you are a tenant, contact your property manager or landlord to discuss your respective obligations, and to agree on a plan to manage the infestation. Generally, landlords are legally required to contract with a licensed pest control operator.

Request a written integrated pest management (IPM) plan from the pest control operator. This plan should detail the methods and insecticides to be used by the pest control operator, and describe the efforts expected by the building manager as well as by the tenants.

Because bed bugs and other pests may spread through cracks and holes in the walls, ceilings and floors, it is wise to inspect adjoining apartments on the same floor as well as those directly above and below.

### **What are your rights and obligations?**

Landlords and property owners have specific legal obligations to provide safe and habitable accommodations for tenants. Certain infestations, including bed bugs, may constitute an unacceptable condition. Tenants have an obligation to cooperate with owners and landlords. This includes preparing the apartment so that the pest control operator can easily inspect the rooms and treat if necessary. Contact your state or municipal health agency or housing authority for more guidance on these issues.

### **What shouldn't you do?**

Don't panic. Although bed bugs can be annoying, they can be battled safely and successfully if you adopt a well-considered strategy.

Do not apply pesticides unless you fully understand what you are applying and the risks involved. You are legally liable if you misapply a pesticide, or apply it without a license to the property of another (including common spaces in apartment buildings). Generally, landlords, owners and building managers cannot legally apply pesticides. They should, instead, hire a licensed pest control operator to confirm the infestation and to develop an integrated pest management plan.

Do not dispose of furniture that is useful. Infested furniture can be cleaned and treated. Placing infested furniture (particularly mattresses) into common areas or on the street may simply help spread bed bugs to the homes of other people. Infested furniture intended for disposal should be defaced to make it less attractive to other people. Officials in some municipalities affix to potentially infested furniture a label to warn of bed bugs. To reduce opportunities of infested furniture re-entering their building, building managers should ensure that any disposed furniture is locked within a dumpster or immediately carted away to a landfill or waste facility.

### **How can you have specimens examined?**

Specimens suspected of being bed bugs should be collected into small break-resistant containers (such as a plastic pill bottle or a zipper-lock plastic bag. They may also be secured to a sheet of white paper using clear packaging tape. These containers should be packaged carefully to prevent damage/crushing of the sample, and be sent to a knowledgeable expert for positive identification. We provide a form that may be downloaded and printed for this purpose:

<http://www.hsph.harvard.edu/bedbugs/specimen.pdf>

### **What should you know about insecticides and other methods for treating bed bugs?**

Property owners may purchase and apply certain pesticides to their own property, and tenants may do so (with certain exceptions) to their own apartments. Generally, owners and tenants may not, however, apply these products to common use areas or to the property of another person. A licensed pest control operator may perform these tasks more effectively, safely and legally. If one apartment or room is found infested, adjoining rooms and those immediately upstairs and downstairs should be inspected and managed, as appropriate.

**Carefully read the label before applying any pesticide. Apply the product only if you fully understand the instructions, and if you have the appropriate training/certification and equipment.**

**Do NOT apply any insecticide or pesticide to mattresses or to surfaces that would be in direct contact with a person, unless the label instructions specifically state that the product can be applied in that manner. Some products can be harmful to people and pets. READ and UNDERSTAND the label.**

Insecticide formulations used to treat bed bug infestations consist mainly of the following:

-**Insecticidal dusts** abrade the insect's outer waxy coat and cause the bugs to dry out quickly. Some consist of a finely ground glass or silica powder. These dry dusts may be applied in cracks and crevices, as well as within the hollow interior of a tubular bed frame. Some dust formulations include another kind of insecticide.

-**Contact insecticides** are those that kill the bugs shortly after they come into direct contact with the product or its residue. These mainly consist of one or more kinds of pyrethroids (synthetic analogs of the extract of chrysanthemum flowers). These products tend to rapidly 'knock down' bugs that wander over or otherwise contact the insecticide. Because pyrethroids can be irritating and repellent to many insects, bed bugs may avoid treated surfaces. A different kind of contact insecticide, chlorfenapyr, is now available in a product available to pest control operators. This product is non-repellent and effective for a longer period.

-**Insect Growth Regulators (IGR)** affect the development and reproduction of insects. Although these products can be quite effective in reducing the population of the pests, they do not kill bugs quickly. Thus, pest control operators often use these products as a supplement to other kinds of insecticides.

A pest control operator may consider and propose a variety of other methods to manage bed bugs. An infestation that affects most or all units in a building may be best managed by treating the entire building with insecticides. This requires close cooperation by managers and tenants, and may require the tenants to leave the building for a few hours or even several days. Only licensed and knowledgeable pest control operators should attempt such treatments.

Be aware that you may spread bed bugs from your own infested residence if you move to another apartment, home or hotel. Generally, it is best to leave your possessions in your home or apartment when it is treated. All food and eating utensils should be protected from insecticidal products.

Some building managers have allowed infested apartments to remain vacant of tenants for extended intervals in attempts to 'out wait' or 'starve' the bed bugs. This strategy would rarely make good sense, as bed bugs are well adapted to patiently wait for the return of their hosts. Each bed bug needs only one full blood meal to develop to the next developmental stage, and they can readily wait months between feeding opportunities. Under ideal conditions, adult bed bugs can survive for more than one year between meals. Thus, infested residences should be aggressively managed to eliminate bed bugs.

### **What might you do when returning from a visit to an infested residence?**

Travelers increasingly encounter bed bugs during their stays away from home. If signs of bed bugs were observed or suspected, consider the possibility that you may have unwittingly transported bed bugs or their eggs in your luggage and other personal effects. Clothing should be laundered in a manner to kill bugs and their eggs before or as soon as these items are brought back into the home. Suitcases should be carefully inspected, scrubbed with a stiff brush, and thoroughly vacuumed. Leaving such luggage for several hours in a closed vehicle in full summer sun may render the items bug free.

We hope this information will help you to more effectively identify and safely manage a suspected bed bug infestation. This document has been assembled to assist homeowners, property managers and tenants with information relevant to the identification and management of bed bugs. Brand names have not been mentioned, nor do we endorse any particular commercial product. This web site is intended for informational purposes and is not meant to substitute for the advice provided by a medical professional. Always consult a physician if you have personal health concerns.

Costs associated with assembling this information and responding to inquiries are borne by our general laboratory funds. Please feel free to contact us if you found this information useful and are inclined to assist with support of our work. We encourage inquiries regarding the support of further research and educational efforts.

For information about the biology and management of head lice, visit our site at:

<http://www.hsph.harvard.edu/headlice.html>

For information on identifying other kinds of pests, visit our site at:

<http://www.massinsects.com/default.htm>

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To contact the Harvard School of Public Health with suggestions, comments, or questions, please use our feedback form at: [www.hsph.harvard.edu/email.html](http://www.hsph.harvard.edu/email.html).

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