



BED BUGS

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Until fairly recently, most people (and even pest control professionals) had never seen a bed bug. Bed bug infestations actually used to be very common in the United States before World War II. But with improvements in hygiene, and especially the widespread use of DDT during the 1940s and '50s, the bed bugs all but vanished. The pests persisted, however, in some areas of the world including parts of Africa, Asia, and Eastern Europe. Over roughly the past decade, bed bugs have made a dramatic comeback in the U.S. They're appearing increasingly in homes, apartments, hotels, health care facilities, dormitories, shelters, schools and public transportation. Other places where bed bugs sometimes occur include movie theaters, laundries, rental furniture, and office buildings. Immigration and international travel have contributed to the resurgence of bed bugs in the U.S. Changes in modern pest control practice, less effective insecticides and a decrease in societal vigilance are other factors suspected for the recurrence.

Description and Habits

Bed bugs are small, brownish, flattened insects that feed solely on the blood of animals. Although the common bed bug (*Cimex lectularius*) prefers feeding on humans, it will also bite other warm-blooded animals, including dogs, cats, birds and rodents. It has done so since ancient times; bed bugs are mentioned in medieval European texts and classical Greek writings back to the time of Aristotle. Adult bed bugs are about 3/16" long and reddish brown, with oval-shaped, flattened bodies. They are sometimes mistaken for ticks, cockroaches, carpet beetles or other household insects. The immature bed bugs (nymphs) resemble the adults, but are smaller and lighter in color. Bed bugs do not fly, and they don't jump like fleas do but they can crawl rapidly over floors, walls, ceilings and other surfaces. Adult females lay their eggs in secluded places, depositing 1, 2 or more eggs per day, potentially hundreds during their lifetime. The eggs are tiny (about the size of a dust spec), whitish and hard to see without magnification, especially on light-colored surfaces. When first laid, the eggs are sticky, causing them to adhere to surfaces. At room temperatures, bed bug eggs hatch in about a week. Newly emerged nymphs are straw-colored and no bigger than a pinhead. As bed bugs grow they molt, shedding their skin five times before reaching maturity. A blood meal is needed between each successive molt. Adult females also must feed in order to lay eggs. Under favorable conditions (70-80°F), the bugs can mature fully in as little as a month, producing multiple generations per year. Cooler temperatures or limited access to blood prolong the development time. Bed bugs are very resilient. Nymphs and adults can persist months without feeding which is unusual for most

insects. The ability to survive without a blood meal is longer at cooler temperatures, potentially up to a year or longer at 55°F or less. In temperature-controlled buildings, a more typical duration is about 2 to 6 months. Consequently, it is usually impractical to leave buildings unoccupied in hopes of 'starving out' an infestation. When infested dwellings such as apartments are vacated, bed bugs often disperse to nearby units, or reduce their activity until the unit is reoccupied. Bed bugs are active mainly at night. During the daytime, they prefer to hide close to where people sleep. Their flattened bodies enable them to fit into tiny crevices--especially those associated with mattresses, box springs, bed frames and headboards. Bed bugs do not have nests like ants or bees, but do tend to congregate in habitual hiding places. Characteristically, these areas are marked by dark spotting and staining, which is the dried excrement of the bugs. Also present will be hatched and unhatched eggs, the tannish shed skins of maturing nymphs, and the bugs themselves. Another possible sign are rusty or reddish smears on bed sheets or mattresses from crushed engorged bed bugs. Although it's often stated that bed bugs have a telltale "buggy" odor, the smell is seldom evident except in extreme infestations and should not be relied upon for detection. Bed bugs prefer to hide close to where they feed, but if necessary will crawl several feet to obtain a meal. Initially the bugs tend to be situated around sleeping areas, i.e., beds, couches and recliners. If infestations are allowed to persist, they also may disperse to other locations within the dwelling making elimination more difficult.

Bites and Health Concerns

Bed bugs usually bite people at night while they are sleeping. Hungry bed bugs may also feed during the daytime, especially if this is when the occupant normally sleeps. They feed by piercing the skin with an elongated beak through which they withdraw blood. Engorgement of the bed bug takes roughly three to 10 minutes, but because the bite is painless, the person seldom realizes they are being bitten. Bed bugs normally do not reside on people like head or body lice do; instead, immediately after feeding, bed bugs crawl to a secluded location to digest their meal. Symptoms after being bitten by bed bugs vary from person to person. Many develop an itchy red welt within a day or so of the bite. Others have little or no reaction. Sometimes the reaction is delayed days or even weeks after the actual bite occurs, which can make it difficult to determine where or when bites actually occurred. Studies conducted in bed bug-infested apartments suggest about 30 percent of people do not react even when bitten repeatedly over time, and there is still higher incidence of non-reactivity among the elderly. Unlike flea bites, which occur mainly around the lower legs and ankles, bed bugs feed on any skin exposed while sleeping (face, neck, shoulders, back, arms, legs, etc.). The welts and itching are often wrongly attributed to other causes, such as mosquitoes. For these reasons, infestations may go a long time unnoticed, and can become quite large before being detected. The likelihood of bed bugs increases if the affected individual has been traveling, or if they have acquired used beds or furnishings before symptoms started to appear. Bed bugs also are suspect if you wake up with itchy welts you did not have when you went to sleep. It's important to recognize, however, that

not all bite-like reactions are due to bed bugs. Confirmation requires finding and identifying the bed bugs, shed skins, fecal spots, etc., which often requires the help of a professional.

A common concern with bed bugs is whether or not they transmit diseases. Although bed bugs can harbor various pathogens, transmission to humans has not been proven and is considered unlikely. Their medical significance is most commonly attributed to itching and inflammation from their bites. Antihistamines and corticosteroids may be prescribed to reduce allergic reactions, and antiseptic or antibiotic ointments to prevent infection. Though not known to carry diseases, bed bugs can substantially reduce quality of life by causing discomfort, sleeplessness, anxiety, and embarrassment. According to some health experts, the added stress from living with bed bugs can have a significant impact on the emotional health and well-being of certain individuals.

Conventional insect repellents, like those used to deter ticks and mosquitoes, do not appear to be as effective against bed bugs. Therefore, attempting to avoid being bitten by applying insect repellent at bedtime is not recommended. Sleeping with the lights on is also not likely to deter hungry bed bugs, as they will adjust their feeding cycle to the host's sleeping patterns.

How Infestations Originate

It often seems that bed bugs arise from nowhere. The bugs are efficient hitchhikers and are usually transported into dwellings on luggage, clothing, beds, furniture, and other items. This is a particular risk for hotels and apartments, where turnover of occupants is constant. Bed bugs are small and agile, escaping detection after crawling into suitcases, backpacks and belongings. Acquiring secondhand beds, couches and furniture is another way that the bugs are transported into buildings. Bed bugs also can be carried in on one's clothing, shoes or wheelchair. Once bed bugs are introduced, they can crawl from room to room or floor to floor. They can also be transported throughout buildings on people and their belongings. Unlike cockroaches and flies that feed on filth, there is often no relationship between bed bugs and cleanliness. Since the bugs feed solely on blood, pristine dwellings can be as vulnerable to infestation as are places of squalor. That said, poverty and privation can lead to increased risk of bed bug problems, as can the inability to hire a professional exterminator.

Some bed bug species are parasites of bats or birds, and may bite people if the wild hosts are no longer available. Although similar in overall appearance, the species of bed bugs that normally feed on bats, swallows, chimney swifts, pigeons or other wild hosts can be differentiated from those that prefer humans. Entomologists and knowledgeable pest managers can make this determination. If bat bugs or bird bugs are present, roosting and nesting sites

should be the primary focus, and the animals should be removed and excluded from the building.

Controlling Infestations

Bed bugs are challenging to eradicate. Since they can hide in so many places, inspections must be thorough and elimination is not always a certainty. Whenever resources allow, it's prudent to enlist the services of a professional. Experienced pest controllers know where to look for bed bugs, and have an assortment of tools at their disposal. Nonetheless, owners and occupants can assist the professional in several important ways. Affording access to all living areas is crucial, and excess clutter will need to be removed. Belongings strewn about rooms offer many places for the bugs to hide, and impede inspection and treatment. Since bed bugs can disperse throughout a building, it often will be necessary to inspect adjoining rooms and apartments as well.

Where They Hide

Bed bugs can live in almost any crevice or protected location. The most common place to find them is the bed or where people sleep. This is especially true during the early stages of a problem. As infestations grow larger, the bugs tend to move beyond beds into other locations making control more difficult. Bed bugs often hide in seams, folds and crevices of mattresses, box springs, bed frames and headboards. A thorough inspection requires dismantling the bed so that upper and lower seams and surfaces can be examined. Things to look for are the bugs themselves, shed skins of the nymphs (immature bed bugs), and the blackish fecal spots. The dark spots of dried bed bug excrement are often present along mattress seams or wherever the bugs have resided. Box springs afford many places for bed bugs to hide, especially along the upper seams and underneath, where the bottom edge of the box rests on the frame. If an underlying dust cover is present, it may have to be removed to gain access for inspection and possible treatment. Successful treatment of mattresses and box springs can be difficult, however, and infested ones may need to be discarded or encased in a protective cover. Cracks and crevices of bed frames should also be examined, especially if the frame is wood. (Bed bugs have an affinity for wood and fabric more so than metal or plastic.) Wooden support slats, if present, should be removed and examined since bed bugs often congregate where the ends rest on the frame. Screw holes, knots and other recesses are also common hiding places. Headboards secured to walls should be removed and inspected. In hotels, the area behind the headboard is often the first place that bed bugs become established. Bed bugs also frequently hide within items stored under beds. Upholstered chairs, recliners and sofas are typically the next most likely area for bed bugs, and should be examined carefully along seams, skirts and folds of fabric. Sofas and recliners can be major bed bug hotspots, especially when used for sleeping. Like beds, they can be difficult to treat and sometimes may need to be discarded. Nightstands and dressers may need to be emptied and examined inside and out, and tipped over to inspect the woodwork underneath. Oftentimes the bugs will be hiding in cracks, corners,

and recesses. Other common bed bug hiding places include: along and under the edge of wall-to-wall carpeting, especially behind beds and sofas; cracks in wood molding; ceiling-wall junctures; behind wall mounted pictures, mirrors, outlets and switch plates; under loose wallpaper; clothing and clutter within closets; and inside clocks, phones, televisions and smoke detectors. Bed bugs tend to congregate, but it's also common to find a single bug or some eggs here and there. A thorough inspection and treatment may take up to several hours. Some companies use specially trained dogs to assist in finding small dispersed infestations, especially in such places as hotels, schools, libraries and office buildings. When properly trained, bed bug detection dogs can be quite effective. Relatively few companies are routinely using them, however, due to the expense of training. Bed bugs most often congregate along seams and edges of mattresses and box springs. Blackish spots are excrement. Bed bugs also congregate along seams of sofas and recliners.

Preparing for Treatment

Preparing for bed bug treatment is tedious yet important. Very comprehensive preparation is necessary when infestations are heavy and the bugs are widely dispersed. More limited prep may be adequate for light infestations since at these levels the bed bugs typically are more confined to sleeping areas (beds, sofas, and recliners). Pest control firms have their own policies, however, regarding preparation requirements which may also depend on the

manner of treatment. Some firms want beds stripped and furniture moved before they arrive, while other firms prefer to inspect first and perform these tasks themselves. Clutter and belongings on floors (especially beneath beds) must be removed since they impede treatment and afford additional places for bugs to hide. Bedding and garments normally will need to be laundered and/or hot dried (120°F minimum) since they cannot be treated with insecticides. An effective and efficient alternative to laundering is to simply place bedding, clothing, toys, shoes, backpacks, etc., in a clothes dryer set at medium-to-high heat for 10 to 20 minutes. This can be done in lieu of washing and will kill all bed bug life stages. According to textile experts, most garments designated as 'dry-clean only' (e.g., cotton, wool, silk, linen, rayon, nylon) will not be harmed provided they are dry before being placed in a clothes dryer at a moderate temperature setting. Dry cleaning procedures also kill bed bugs, but there is a risk of infesting the establishment when buggy items are tagged and sorted. Items that cannot be placed in a washer or dryer can sometimes be de-infested by wrapping them in plastic and placing them outdoors in a hot, sunny location for at least a day (for example, on pavement or in a closed vehicle parked in the sun). Packing items loosely in garbage bags and elevating objects off the ground helps the heat permeate further, and will make it harder for bugs to find a cool place to hide. Monitoring with a thermometer is prudent to ensure that a temperature of at least 120°F is achieved wherever the bugs may be. Bed bugs will also succumb to cold temperatures below 32°F, but the freezing temperatures must be maintained for a longer period (e.g., one to two weeks). Consequently, heating tends to be a better option throughout much of the country. Efforts to rid entire dwellings of bed bugs by raising or lowering the thermostat will be

unsuccessful, although pest control firms are able to achieve lethal temperatures with supplemental heaters

Discarding or Encasement

Although most furnishings need not be discarded, in some cases this may be necessary. This is especially true of heavily infested beds, sofas and recliners where bugs and eggs often reside in hard-to-reach places. Consequently, pest control firms may recommend such items be discarded, especially when in poor condition. When infested items are discarded, bagging or wrapping them prevents dislodgement of bugs en route to the trash. In the case of beds, a more economical option is to encase both the mattress and box spring in a protective cover like those used for allergy relief. Encasements specifically designed to help protect against bed bugs are available through retail or pest control firms. Higher quality ones tend to be more durable and comfortable to sleep on. Once the encasement is installed and zipped shut, any bugs which happen to be inside are entombed and eventually will die. Encasements also help protect newly purchased beds, and make it easier to spot and destroy any bugs residing on the outer surface during subsequent examination. Encasements will not, however, keep bed bugs from crawling onto a bed and biting a sleeping person.

Vacuumping, Steaming, Freezing

General housecleaning measures, (e.g. vacuuming floors and surfaces), seldom reach where bed bugs hide. For this reason, repetitive vacuuming by occupants may not be worth the effort, especially compared to other important preparatory activities. Targeted vacuuming of bed bugs and infested harborages, however, can help remove some of the bugs before other treatment measures are undertaken. Bed bugs and especially the eggs can be difficult to dislodge. Optimum results will be achieved by moving and scraping the end of the suction wand along infested areas such as seams and fabric folds of beds and sofas, and the perimeter edge of wall-to-wall carpet. Bed bugs can survive the high speed trip down a vacuum, so it's important to carefully dispose of the vacuum contents in a sealed trash bag

Afterwards, one trick to make this disposal easier involves using the cut-off end of a nylon stocking (or a kneehigh nylon stocking) and a rubber band. Insert the stocking (toe first) into the end of the vacuum suction wand/tube, leaving the opening of the stocking protruding out of the end of the suction wand. Then fold the stocking opening back over the end of the wand and use the rubber band to secure it there. When the vacuum is turned on and the bed bugs are sucked into the tube, they will be trapped in the stocking. Afterwards, carefully remove the rubber band and retrieve the bug-filled stocking. Then secure the end of the stocking with the rubber band and dispose of it. Some pest control firms also employ commercial steamers or spot-freezing equipment to treat areas where bed bugs are found or suspected. Used correctly, they kill bugs and eggs on contact. Neither method, however, affords residual protection against bed bugs

which may have been missed. Steaming and spot-freezing equipment also have limited ability to penetrate fabric, wood, and other materials where bed bugs often reside.

Heat Treatments

Some pest control firms utilize specialized heating equipment to de-infest furnishings, rooms, and entire dwellings. The procedure involves heating up the infested item or area to temperatures lethal to bed bugs. Portable heaters and fans are used to gradually heat the air to about 120 - 130°F while monitoring with strategically placed sensors. By carefully controlling the temperature, bugs and eggs are killed wherever they may be without damaging household items. Some preparation is still required (e.g. removal of heat-sensitive items such as aerosol cans, indoor plants and medications), but it is seldom necessary to bag, launder and/or hot dry bedding and clothing since these items will be heated along with other furnishings. Another advantage of heat treatment is that infestations can often be eliminated in one day, rather than over multiple days or weeks. Conversely, heat treatment alone has no lasting (residual) effect should bed bugs be reintroduced into the dwelling. Consequently, some companies recommend concurrently applying residual insecticides. To further minimize reintroduction, occupants are advised to take as few belongings as possible with them while the heat treatment is in progress. Heat treatments require specialized training and equipment, and may be more costly than conventional approaches relying principally on insecticides.

Insecticides

While the former methods are helpful, insecticides are widely used by most pest control companies. A variety of EPA-registered materials are available formulated as liquids, dusts and aerosols. Baits used to control ants and cockroaches are ineffective in this case since bed bugs must bite and feed on blood. Professional-use insecticides such as Temprid®, Transport® and Phantom® tend to be more effective than bed bug sprays sold by retailers. Steaming (left) and spot-freezing (right) kill bugs and eggs on contact but afford no lasting protection. Application entails treating all areas where the bugs are found or tend to hide or crawl. This takes considerable effort and follow-ups are usually needed. Companies typically treat seams, folds and crevices of bed components, chairs and sofas, but usually will not spray the entire sleeping surface or seating area. They also do not spray bed sheets, blankets or clothing, which instead should be hot washed or heated in a dryer. Fumigation using a penetrating gas is another way to de-infest dwellings or furnishings, but the procedure is only offered by certain companies. True fumigation is not the same as setting off a total release fogger or 'bug bomb.' (It should be noted that bug bombs are considered ineffective in the treatment of bed bugs, and can be quite dangerous if misused.) The fumigation process is technically complex and requires vacating the building for a period of days. The building is then sealed and injected with a lethal gas, usually sulfuryl fluoride. Because the entire building must be vacated, structural fumigation is logistically

more challenging with multi-unit buildings such as apartments, than for single family homes. Bed bug fumigations tend to be more common in southern and western states, where the procedure is also used to control certain types of wood-dwelling termites.

Preventing Infestations

Considering how time-consuming and costly it can be to eradicate bed bugs, it's prudent to take precautions and avoid infestations in the first place. Householders should be vigilant when acquiring used furnishings, especially beds and couches. Discarded items should be avoided, and secondhand articles should be examined closely before being brought into the home. Look carefully in the folds and seams of furniture for signs of bed bugs. There is no reason to stop shopping in consignment stores, yard sales, etc., but it would be prudent to run clothing and fabric items through the washer or dryer before storing them in the home. The risk of acquiring bed bugs from items purchased in antique stores would generally be insignificant. Avoiding bed bugs is most challenging in hotels, apartment buildings, and other places where there are many people, high turnover and ongoing opportunities for introduction of the pests. Periodic, preventive inspection by tenants, housekeeping/maintenance staff, or pest control firms is the best way to detect infestations in their initial stages when they are easiest to control.

Additional Tips for At-Risk Groups

Business and Leisure Travelers

Checking beds for bed bugs was a common practice long ago, especially while traveling. Travelers today should consider doing the same, preferably before unpacking. This would entail examining the bed sheets and seams of the mattress and perhaps box spring for signs of bed bugs, especially along the head (pillow end) of the bed. Experts also remove and check behind headboards since this is a frequent hiding place for bed bugs in hotels. Headboards are heavy and cumbersome, however, and untrained persons should not attempt removal themselves. Vigilant travelers may also want to elevate suitcases off the floor on a stand, tabletop or other hard surface rather than storing them on the floor or another bed. Hyper-vigilant travelers may further opt to keep belongings in sealed plastic pouches and their suitcase in a zippered tote — however each traveler must decide how cautious they wish to be. While encountering bed bugs in hotels is possible, typically only a small number of rooms have problems. If bed bugs are discovered, guests can request another room, preferably in another area of the hotel. To help guard against bed bugs while traveling, take a moment to inspect beds. A small flashlight is useful for dimly-lit areas. . Should you experience itchy welts suggestive of bed bug bites during your stay, it would be prudent upon returning home to place all clothing directly into the washer and/or dryer. Inspecting or vacuuming luggage upon arrival home is less useful since it's hard to spot bed bugs inside a suitcase. The suitcase itself can either be treated or discarded.

Those Who Cannot Afford a Professional

Bed bug eradication is challenging and it's prudent to hire a professional when resources allow. However treatment can be expensive, often costing hundreds or thousands of dollars. Those who cannot afford this often must cope with the problem themselves. A useful step that anyone can take to combat bed bugs is to install bed encasements. Covering the mattress and box spring can help eliminate a substantial portion of the bed bug population -- especially if discovered early while most of the bugs are still confined to the bed area. Extra care should be taken when installing budget encasements since these can tear easily, especially on metal bed

frames. Ideally both the mattress and box spring should be encased. If only one encasement is possible it's often best to cover the box spring which is harder to subsequently inspect. With practice and a flashlight, nonprofessionals can become proficient in finding and destroying bed bugs. The process is made easier by reducing clutter, especially in bedrooms and sleeping areas. Bugs that are spotted can be removed with a vacuum (see previous discussion), or killed with over-the-counter insecticides labeled for such use. Most bed bug sprays intended for householders have little remaining effect after the spray has dried. Therefore it's important to initially contact as many of the insects as possible with the spray droplets. Insecticide labels should be read carefully as some bed bug products should not be used on mattresses and seating areas. Some insecticides applied as powders or dusts (e.g., diatomaceous earth) will kill bed bugs although boric acid powder will not. However powders can be messy and difficult to apply, especially by nonprofessionals. Total release foggers (otherwise known as 'bug bombs') are ineffective against bed bugs and potentially dangerous when used incorrectly. Monitoring devices such as ClimbUp® are useful for confirming the presence of bed bugs when a visual inspection cannot. When installed under bed legs, they also provide a barrier between floor and bed which can potentially reduce bites, especially when beds are pulled slightly away walls and encased.

The incidence of bed bugs in the United States and in many countries of the world has increased to the point where vigilance is a prudent practice. Some common sense tactics and taking modest precautions may be wise.