

## BATTLING BED BUGS IN THE USA

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**Abstract** The bed bug, *Cimex lectularius* L., has made a rapid and unexpected comeback in the United States. In an online survey of 509 U.S. pest control firms, 91% encountered bed bugs in the past two years, whereas only 37% recalled seeing them five years ago. Perpetual movement of people, zero tolerance for bug bites, marginally effective management tools, and health concerns about pesticides have created the most difficult pest challenge in a generation. Infestations are occurring in homes, apartments, hotels, dormitories, health care facilities, schools, laundries, movie theaters, and public transportation. News media coverage has been intense, and several lawsuits have been filed with some plaintiffs requesting compensation in the millions of dollars. Unreliable insecticides and widespread pyrethroid resistance has necessitated the use of vacuums, steamers, bed encasements and other non-chemical methods. Consequently, companies are often finding elimination time consuming and tedious. Barring future availability of improved insecticides with safety margins permitting liberal application, the outlook for a simple solution is not encouraging.

**Key Words** *Cimex lectularius*, pest control, pesticides, litigation

### INTRODUCTION

The rapid resurgence of the bed bug, *Cimex lectularius*, in the United States has created the most difficult pest management challenge in a generation. Infestations have been likened to the proverbial “perfect storm” (Potter, 2006) because citizens are not accustomed to being bitten by blood-sucking parasites while they are sleeping. Moreover, since bed bugs tend to congregate in sensitive places (beds and bedrooms), pest management firms are concerned about applying pesticides for fear of reprisal. Curtailment of organophosphate and carbamate insecticide use indoors has depleted the arsenal of effective bed bug products, which has resulted in application of mainly pyrethroids to which resistance has been shown to be widespread (Romero et al., 2007ab). Tolerance for the presence of bed bugs in homes and businesses is essentially zero, and lawsuits in the U.S. have become increasingly common (Donaldson, 2006).

In this paper we discuss the growing challenge of bed bug infestation in the United States, its ramifications, and state of management. We also include some of our research findings with relevance to global bed bug management.

### INFESTATION SEVERITY AND STATUS

Bed bug infestation in the United States is increasing at an alarming rate. Some pest management firms have reported more than a 10-fold increase in bed bug treatments in recent years (Cooper, 2006). In a recent online survey of 509 U.S. pest control firms, 91% report encountering bed bugs in the past two years; 37% said they encountered them five years ago, and 21% recalled seeing them more than 10 years ago. Respondents who reported seeing bed bugs a several years ago indicated the frequency was very low, never more than one or two incidents per year. In a related survey question, 23% of companies indicated they treated more than 20 different bed bug infestations last year, while 6% battled more than 100 (Potter, 2008).

Various hypotheses have attempted to explain the rapid resurgence of bed bugs in this country which became noticeable in the late-1990s. They include: increased travel to and from areas of the world where the bugs remained common; increased exchange of second-hand furniture and a lack of vigilance by the public; a shift from premise-wide use of broad-spectrum insecticides to more selective control tactics for other urban pests; and insecticide resistance (Doggett et al., 2004; Potter, 2005). While the above factors presumably contributed to the resurgence, it remains a mystery why bed bug populations have increased so quickly after being so scarce for so long.

As in the past, bed bugs are appearing in diverse locations. Our recent survey of the pest management industry indicated infestations were most often found in single-family homes (mentioned by 80% of respondents), followed by apartments and condominiums (mentioned by 72%), and hotels/motels (58%). A number of firms also reported finding infestations in college dormitories (24%), nursing homes (18%), and shelters/hostels (17%). Other notable locations mentioned were hospitals (mentioned by 6%), primary/secondary schools (5%), public transportation (4%), laundries/dry cleaners (3%) and movie theaters (2%). Other unusual places where bed bugs were found included moving vans, motor homes, private automobiles, office buildings, overnight restaurants, and pet groomers (Potter, 2008).

The tendency of this insect to be transported from one location to another means they can materialize almost anywhere. Last year in New York City alone, the Department of Education reported finding bed bugs in 43 different schools during January and February. Similar incidents have occurred elsewhere, with an entire school district in Northern Kentucky canceling classes after a single bed bug was found on a child.

### **PUBLIC REACTION TO BED BUGS**

Bed bugs used to be called the bug that nobody knows because they were a societal embarrassment (Usinger, 1966). The same is true today, and most households and businesses in the U.S. that have them do not want to discuss them. The hospitality and housing industries are especially apprehensive, fearing adverse publicity and lawsuits. So are colleges and universities who are finding bed bugs in their dormitories. Today's bed bug infestations raise complex questions about society's right to know of potentially harmful conditions. Few establishments are willing to admit they have had bed bugs, yet failure to disclose may be used against them in a court of law. The hesitancy to report bed bugs and a lack of public awareness are helping to spread infestations. Notifying tenants or guests of a bed bug problem, however, can be a property manager's worst nightmare.

Ignorance and aversion to bed bugs also continues to be present among health care providers (Scarupa, 2006). A few years ago, we had a case where a child was sent home from school because the nurse said she had chicken pox. Two different dermatologists subsequently examined her, one believing she had flea bites and the other, scabies. Neither physician bothered to ask if the family had been traveling or had acquired used furnishings. The family had in fact received two donated beds (both infested with bed bugs) just before the welts started appearing. Another client informed us that two different caregiver agencies refused to visit her after learning she had bed bugs, fearing they would take bed bugs home with them. Another caregiver agency opted to call a hazardous materials (HAZMAT) unit to deal with a bed bug-bitten man because of concerns over blood-borne pathogens.

Although bed bugs are not known to transmit human pathogens, infection resulting from bites is a possibility. Health officials in the U.S. have become particularly concerned about methicillin-resistant *Staphylococcus aureus* (MRSA) outbreaks in healthcare settings, schools, fitness centers, and other communal facilities. At least one lawsuit has been filed claiming a connection between bed bugs and MRSA although a definitive connection was never proven.

Bed bugs have been a newsworthy topic in recent years, far outpacing media interest in such stories as the global decline in honeybees. They have been featured in most major news publications, including *The Wall Street Journal*, *The New York Times*, *Washington Post*, *USA Today*, *Business Week* and *U.S. News & World Report*. Many of these stories about bed bugs have focused on litigation with plaintiffs requesting compensation in the millions of dollars although most are settled for smaller undisclosed amounts. Besides the cost of litigation, establishments reported to have bed bugs may experience negative publicity, erosion in brand value, and a drop in business (Miller, 2007).

### **BED BUG MANAGEMENT**

Bed bug infestations in the U.S. are a challenge to eradicate. Attempts by amateurs usually are unsuccessful, and we have seen serious misuses of bed bug insecticides purchased online. Pest management professionals also are finding bed bugs difficult. In our online survey of companies, 58% of respondents considered bed bugs the hardest pests to control, followed by ants (24%), cockroaches (14%) and termites (6%).

## Inspection and Detection

Correct diagnosis of a bed bug problem is important. Older established infestations are fairly easy to detect; but in the early stages, they can be much more subtle. As people become more aware of this pest, all manner of welts and itches may be attributed to bed bugs though they are often caused by other factors. Because it is hard to diagnose a bed bug bite by merely examining the patient, the pest management industry must play a key role in confirming infestations.

One reason bed bug elimination is so challenging is that they can hide almost anywhere. Most aggregations reside near a sleeping host, but as infestations persist, others are found in various locations within several meters of the bed. Based on our industry survey, the most common areas for finding bed bugs were beds (mentioned by 85% of respondents), bedding (mentioned by 52%), baseboards/carpet edges (37%), furniture such as nightstands and dressers (26%), couches and chairs (25%), walls and ceilings (14%), and clothing (6%). Bed bug counts in 13 infested apartments in Ohio showed a similar distribution pattern, with 70% of all bugs associated with beds (Potter et al. 2006). When inspecting multi-occupancy dwellings such as hotels and apartments, most survey respondents (91%) said they routinely recommend inspecting surrounding units adjacent to infested units. This seems prudent considering other industry surveys have found adjoining units to be infested much of the time (J. Black, pers. comm).

No reliable and affordable detection device is presently available for monitoring bed bugs except keen eyes and a flashlight. Nonetheless, more than half of companies surveyed (53%) said they routinely use sticky traps to monitor bed bug activity (Potter, 2008). While bed bugs are occasionally captured in glue traps, reliability is poor relative to such pests as cockroaches and spiders. A few companies in the U.S. have begun using canines for bed bug detection. Reliability of the dogs has been impressive provided they are properly trained (Cooper, 2007). Unfortunately, scent detection dogs require a substantial financial commitment, making them impractical for most companies. Various groups are working to develop more affordable detection devices based on pheromones or other attractants, which could have great utility in managing bed bugs in the future.

## Customer Cooperation

Client involvement is important when battling bed bugs. Educational materials are available through the National Pest Management Association, industry trade journals, and university web sites (Potter, 2004; Doggett, 2005). Especially important are instructions pertaining to preparation before treatment. Providing access for inspection and treatment is essential and in some cases, infested items will need to be discarded. Clutter is a particular problem in homes and apartments, obstructing treatment and affording additional places for bed bugs to hide. In uncluttered situations, industry surveys indicate that two or three treatments are normally needed to get infestations under control, whereas in cluttered situations four or more treatments are often necessary (Potter, 2008). Items must be removed from floors, and furnishings moved away from walls. Some pest control firms request that beds be disassembled or disposed of before they arrive for treatment, while others prefer to dismantle beds themselves to minimize disturbance and possible spread of infestations.

Bedding and clothing will need to be bagged and laundered, although judgments should be made as to what is most vulnerable because it is impractical to ask householders to launder everything they own. Laundering experiments with bed bug-infested clothing indicate that a standard wash cycle using hot water effectively kills all life stages, including eggs. The same result was achieved by placing a load of unwashed infested clothing into a clothes dryer at high heat (80°C) for as little as five minutes, suggesting either regimen, alone or in combination, is effective (Potter et al. 2007). Further washing tests revealed that when items were laundered in cold water, about a third of bed bug adults survived as did most eggs (A. Romero, pers. comm.). In general we discourage the taking of bed bug-infested items to professional drycleaners to spare them the risk of also becoming infested. Provided they are dry, most dry cleanable garments can safely be placed in a clothes dryer at a low to medium heat setting (50-70° C) with negligible risk of harming the fabric (Drycleaning & Laundry Inst., pers. comm.).

### **Vacuums and Steamers**

Almost two-thirds (65%) of companies surveyed said they routinely use vacuums for managing bed bugs, while 25% indicated using steamers. Routine vacuuming by clients is seldom of much benefit because the bugs hide in places where normal housecleaning efforts do not reach. Targeted vacuuming of infested harborages, however, can be useful if performed properly and limits of the procedure are understood. Bed bugs are not so easily dislodged with vacuums. In comparison to cockroaches, the adults and nymphs cling more tightly to surfaces and the eggs are affixed with a cement-like substance. Better results are achieved by scraping the end of the suction wand repeatedly over the harborage area. Removal becomes difficult if not impossible when the bed bugs are located deep within crevices, and one should assume that some bugs and eggs will be left behind. After vacuuming, the collection bag should be discarded since observations indicate that some bugs and eggs survive the trip down the vacuum hose. Brush attachments further enhance the potential for spread by allowing bugs and eggs to adhere to the bristles (Potter et al., 2007).

Steamers are another tool being used in the U.S. to manage bed bugs. Commercial units employed by pest controllers emit small amounts of moisture to lessen the possibility of mold growth, and have a large enough tank to accommodate extended use between fill-ups. Larger brush heads usually work better than small diameter tips which are less efficient and often emit too much pressure, causing bugs and eggs to be blown off the substrate. When using steam, it is important that the bed bugs be exposed to lethal temperatures. The steamer head is moved slowly, and whenever possible, maintained in direct contact with the substrate being treated. A digital infrared thermometer pointed at the area just treated can be used to confirm lethal temperatures (65-85°C) are being achieved. Typical places where steamers are being used include beds, couches and upholstered furniture, baseboards and carpet edges. In combination with, or in lieu of vacuums, they are useful but afford no residual protection against bugs or eggs which may have been missed (Potter et al., 2007).

A small number of U.S. companies are using heaters to de-infest items placed in vans or other large storage containers, while other firms are experimenting with heating entire rooms or buildings (Quarles, 2006). Portable heaters and fans are used to gradually heat potentially infested items and areas to about 55°C while monitoring with strategically placed sensors. Such treatments require a substantial equipment purchase and sometimes a licensing and royalty fee to utilize the technology.

### **Bed Encasement**

An important issue in managing bed bugs is what to do with the bed. Beds offer perfect harborage in the immediate vicinity of the host. While frames and headboards are rather easy to service, mattresses and box springs are not and are often main reservoirs of infestation. If there are holes and tears in the fabric, bugs and eggs may be inside as well as outside. This is especially true of box springs, which have plenty of places for bed bugs to enter and hide. Some companies insist that all infested beds be discarded or fumigated, whereas others advise against getting rid of beds, rationalizing that a new one will also become infested if the infestation has not yet been eliminated. Such decisions are usually based on the condition of the bed, severity of infestation, and nature of the client. Hotels, for example, may want to discard anything that is potentially infested whereas renters on a budget may not.

A majority of U.S. pest control firms we surveyed (59%) mentioned they routinely recommend that infested beds be discarded, whereas 52% said they routinely utilize bed encasements. Encasing both the mattress and box spring denies bed bugs access to inner, hard-to-reach areas and entombs any bugs already inside. A tight-fitting smooth outer cover also makes it easier to detect and destroy any bed bugs reappearing on subsequent inspections (Cooper, 2007).

### **Insecticide Treatment**

Most U.S. pest control firms rely on insecticides to control bed bugs. Ninety-one percent of companies surveyed said they routinely use insecticide sprays and 64% mentioned using dusts (Potter 2008). The most widely used products are pyrethroids which is concerning given the high levels of resistance detected throughout the U.S. (Romero et al., 2007ab). Most indoor uses of organophosphate and carbamate insecticides which often controlled bed bugs with a single treatment are no longer permitted, and there are no highly effective alternatives.

In our recent industry survey, the most commonly used products were Suspend (deltamethrin), Gentrol (hydroprene), Bedlam (phenothrin plus synergist), Delta Dust (deltamethrin), and Demand (lambda cyhalothrin). Other products frequently mentioned included Sterifab (phenothrin plus alcohol), Tempo/Cy-Kick (cyfluthrin), Phantom (chlorfenapyr), and Drione/Tri-Die (silica gel plus pyrethrum). When spraying for bed bugs, 65% of companies surveyed said they typically incorporate an insect growth regulator (such as Gentrol), though relatively few studies have examined the effect of IGRs on bed bug populations.

Most pest managers treat wherever bed bugs are found and anywhere they are likely to crawl or hide. For this reason, treatment often takes hours and the amount of insecticide applied is substantial, often exceeding 3.8 liters for a typical apartment. Nearly three-fourths (74%) of companies surveyed said they typically spray beds, and of those that do, 76% spray both the mattress and box spring. Before the resurgence of bed bugs, most pest managers would have shunned treating beds with insecticides. Bed bugs have changed the dynamic and in doing so, increased the likelihood of pesticide-related claims and litigation.

Companies in the U.S. are generally finding bed bug treatment tedious and time consuming. Many have found it better to work in teams, or at least have someone available onsite to help dismantle beds and move heavy furniture. One treatment is seldom effective, and available insecticides seemingly have limited residual effect between services. Consequently, most firms schedule at least one follow-up service after the initial treatment.

### **The Future**

The bed bug problem in the United States is expected to worsen with no resolution in sight. Public awareness is improving, but businesses, municipalities and private citizens must become vigilant in regard to prevention. Hotels are beginning to implement in-house surveillance in order to detect infestations early, but this is more difficult in multi-unit housing, college dormitories, and other establishments where clutter and other constraints make it harder to inspect on a routine basis. Municipalities have begun debating the responsibilities of property managers and tenants relative to bed bug remediation. Some cities are also considering legislation banning the sale of used and recycled mattresses, and instituting a telephone 'hotline' that can be called for removal of infested items before they are scavenged by others.

The pest management industry will become more skilled at managing infestations, but people's intolerance of bed bugs and their bites will pose many challenges. So will the depleted arsenal of effective insecticides and apprehensions about applying pesticides in the very places they are needed. The future of bed bug management could well hinge upon having a residually potent product with a wide margin of safety and similarly permissive label. This was what changed the course of bed bug management more than a half century ago. Without a 21st century version of DDT we may be in for quite a struggle.

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