



This guide will help property managers prevent and manage bed bugs in multifamily housing. You will find information on best practices for bed bug management, how to hire a qualified pest management professional (PMP), selecting treatments, and eliminating bed bug infestations using an integrated pest management (IPM) approach. For information on the biology and life cycle of the common bed bug, please see the resource section at the end of this guide.

IPM of bed bugs includes educating residents and staff, preventing new infestations, proactively monitoring and inspecting, treating with various chemical and non-chemical control tools, and evaluating the success or failure of treatments. Use this guide to improve pest management treatments and existing bed bug policies.

## Best Practices for Bed Bug Management

### Educate all Staff and Residents on Key Points

- How to inspect for bed bugs and recognize the signs of an infestation.
- The precautions to take when working in—or visiting—infested units in order to prevent taking bed bugs into other units/apartments or your own home.

The education and involvement of residents and staff is a critical part of bed bug prevention and management.

Actively engage new tenants and staff in efforts to prevent new bed bug introductions, and encourage residents to report bed bugs if they find them. Promote cooperation within the community by conducting resident meetings, distributing brochures and posters, and holding one-on-one interventions when needed.

Encourage residents and staff to talk openly and supportively about bed bugs. This demonstrates that management is taking a proactive approach and residents are not risking eviction if they report bed bugs.

See [StopPests.org](http://StopPests.org) for materials and advice you can use to communicate with residents.

### Respond to Reports

Respond to a tenant report of suspected bed bugs within 24 hours or as soon as possible. During this initial contact, share information about how to avoid spreading bed bugs to other homes, discourage the use of over-the-counter (OTC) pesticides and home remedies, and schedule an inspection. Use a bed bug-specific work order to report, schedule, and track progress of bed bug treatments.

A physical inspection of the home by a trained staff member or qualified PMP should occur within three to four days of the of the initial contact. If bed bugs are confirmed, the surrounding units above, below, and on each side of the unit (including across the hall) should also be inspected. If no bed bugs are found, monitors or interceptors should be placed in the bedrooms and living room and rechecked in one to two weeks. The Department of Housing and Urban Development's notice on bed bugs advises that when an infestation is detected, treatments should be scheduled within five days of infestation confirmation. If a treatment cannot be scheduled within five days, retain proof of efforts to hire a qualified company<sup>1</sup>.



**Figure 1.** The bed bug life cycle includes egg, five immature stages, and adult life stages. Staff and residents should know how to identify bed bugs from egg to adult. (D-H. Choe, UC Riverside)



**Figure 2.** Educate staff and residents on how to inspect for and recognize the signs of a bed bug infestation. (A. Corbett)



**Figure 3.** Bed bugs shed their skins as they grow. These shed skins accumulate and if not removed, we don't know if it's an old or current infestation. This photo shows pesticide applied on top of shed skins. (S.Reese)



**Figure 4.** Fecal staining or droppings, the telltale sign of an infestation. (Shutterstock)

## DOCUMENT ALL OBSERVATIONS!

### A rapid response plan for residents:

- Save any insects found in a zip-top bag, piece of folded-over tape, or sealable container.
- Report the problem.
- Do not disturb the area.
- Do not apply pesticides.
- Do not discard furniture.
- Reduce the chances of carrying bed bugs to other homes by wearing freshly laundered clothing when departing from home to visit friends and family.

### Recordkeeping

Recordkeeping is important for several reasons. Keeping a close account of when, where, and how many treatments have been made in a unit/apartment will indicate if treatments are failing or successful.

If records show treatments continue beyond 3-6 months without successfully eliminating light-to-moderate infestations, reassess the treatment and tenant behavior and make adjustments as needed. When one unit/apartment is treated repeatedly with the same pesticide, bed bugs can develop resistance to that product, which makes it necessary to change the treatment protocol. Recordkeeping should be undertaken cooperatively with both the property management staff and the pest control team involved.

Records must be reviewed by both parties to discuss which units need special attention, how effective treatments have been, product rotation, and possible reasons for treatment failure, if that is determined to have occurred.

**Note:** While residents can and should be encouraged to report bed bugs, a recent study found that managers who relied on resident reporting rather than proactive inspections were missing 67% of active infestations<sup>2</sup>.

Additionally, in a 2015 study of 20 infested homes, it was discovered that 70% of residents were unaware of the presence of bed bugs<sup>3</sup>. Some people simply do not react to bed bug bites.

These studies highlight the importance of trained staff or a qualified PMP conducting regular, proactive inspections.

## FOCUS UNIT TRACKING LOG

Name/Address of Property: \_\_\_\_\_

*The IPM team identifies areas or units of focus and coordinates IPM efforts. This sheet unites pest control, housing, and maintenance record-keeping systems. Keep it in the front of the IPM log.*

Date	Unit / Location	Name of Staff Member / Technician	Pest Level	Repairs Needed		Recent or Current Focus Unit?	Housekeeping / Lease Compliance	
			Note any pests and circle the level of infestation. Involve your PMP.	Work order number or problem description	Check when completed	Yes or No	Housekeeping level* (circle one)	Action taken (e.g., met with tenant, sent violation notice)
			Type of Pest: Light Moderate Heavy				G F P	
			Type of Pest: Light Moderate Heavy				G F P	
			Type of Pest: Light Moderate Heavy				G F P	
			Type of Pest: Light Moderate Heavy				G F P	
			Type of Pest: Light Moderate Heavy				G F P	

**\* Housekeeping level:**

- G Good—little or no food or water accessible to pests, easy to move throughout the unit, and inspection in all areas is possible
- F Fair—dishes left undone for more than one day, or plenty of food or water accessible to pests, or PMP has to step over or move items to inspect
- P Poor—multiple days of dirty dishes, sloppy food storage methods, or PMP’s inspection and service limited by clutter

Figure 5. An example of the Focus Unit Tracking Log. (Available at <http://stoppests.org/go/IPMlog> )

If one technician servicing the building or site changes, good records will inform the new technician which units to focus on. Recordkeeping is also essential in the event a resident takes legal action for presumed neglect. Records showing regularly occurring treatments can be presented as evidence that building managers were actively addressing an infestation or infestations.

### Troubleshooting

Consider the following changes when troubleshooting treatment failures:

- Incorporate a non-chemical control tactic such as steam, heat, or vacuuming.
- Change pesticide products.
- Spend enough time per unit and return every two weeks to repeat treatments.
- Inspect surrounding units for active infestations.
- Treat wall voids and seal common wall cracks and crevices to minimize bed bug travel between units.
- Provide laundering, treatment-preparation assistance, and post-treatment vacuuming when needed.
- Investigate if residents could be picking up hitchhiking bed bugs from other infested units or building locations.

### Staff Inspection

Inspecting sleeping areas can:

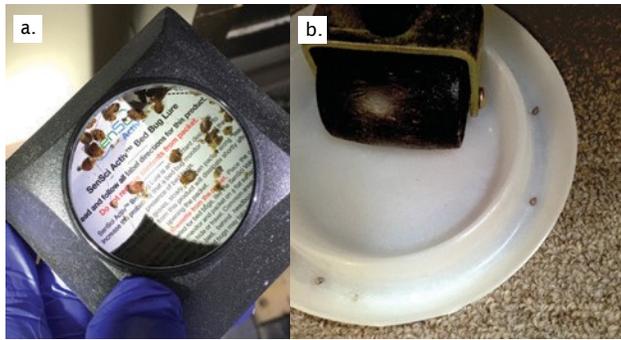
- Catch new infestations before they spread.
- Help determine if a treatment has resolved an infestation.
- Tell us if additional treatments need to be scheduled.

All units/apartments should be inspected at least once a year if they have no history of bed bugs and quarterly if they do. Housing staff can do a quick five-to-ten-minute inspection.

The goal is to find any signs of an active bed bug infestation. If signs are found, the PMPs can be asked to do a more thorough inspection to determine the level of infestation and whether other units/apartments are affected. Bed bugs can quickly spread to neighboring apartments in high-rise and multi-unit buildings<sup>4</sup>. All units/apartments surrounding an infested unit/apartment must be inspected.

**Note:** Sticky trap monitors like the ones used for cockroaches are not reliable monitors to use for bed bugs. While these sticky traps may catch some, adult bed bugs will avoid the sticky surfaces of the traps<sup>5</sup>.

## Monitors



**Figures 6.** Bed bug monitors can detect an infestation early and help determine if an infestation has been successfully resolved. Two examples here are the SenSci Activ Volcano with a lure (a.), and the ClimbUp Insect Interceptor trap (b.), which catches bed bugs as they climb up or down the bed legs. (S.Reese)

Inspections are far more reliable if monitors are used. Monitors under or next to sleeping areas can help staff and residents quickly confirm the presence of bed bugs. Early detection and treatment reduce the chance of infestations spreading through buildings, and ongoing monitoring is key to successful bed bug management.

In the early stage of an infestation, most bed bugs will be found on or near the bed or sleeping area. If an infestation is not treated, the bed bug population will increase and spread further away from sleeping areas.

Monitors can be installed in all units, or just units with previous or current infestations *and* the units surrounding them.

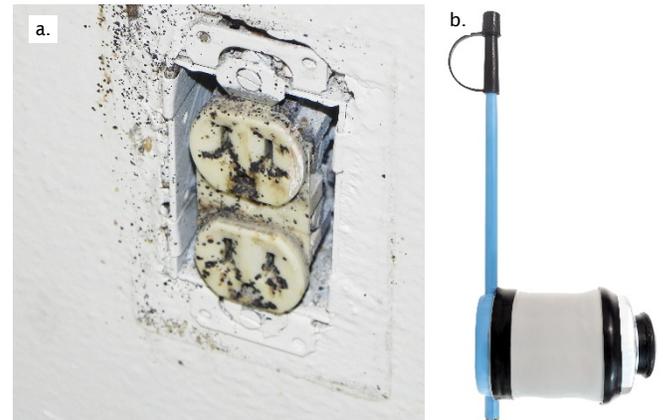
Studies have shown passive bed leg monitors with a pitfall trap design can detect 95 % of infestations<sup>6</sup>.

Consider hiring a pest control company that uses monitors for bed bugs. If your current contractor does not use them routinely, housing managers may ask them to purchase monitors in bulk through their supplier. This is often far cheaper than purchasing on your own.

## Unit Turnover

A thorough inspection and cleaning should be done at unit turnover. It is easier to detect a bed bug infestation in an occupied unit because bed bug signs can be seen on beds and furniture, so try to schedule an inspection before a tenant moves out. A vacant unit provides a good opportunity to apply desiccant dusts in hard-to-reach places, such as in wall voids and under flooring if it is replaced, and to caulk and seal crevices where bed bugs can hide and travel through.

**Tip:** Bed bugs will emerge from hiding locations only if they detect the presence of carbon dioxide. When we breathe we exhale carbon dioxide. Once they detect carbon dioxide, bed bugs will start to wander in search of heat and human scent<sup>7</sup>. Monitors with a lure including carbon dioxide should be used to detect bed bugs in vacant units and common areas. Commercially available active bed bug monitors vary in price, so shop around or ask your pest management service provider to help.



**Figure 7.** Unit turnover is the perfect time for a PMP to apply desiccant dusts to wall voids and other hard-to-reach places. The picture above shows an outlet removed for painting, which provides access to the wall void (a). PMPs can apply dusts with specialized equipment like the bellow duster shown here (b). Dusts are effective as long as they remain dry. (a. M. Kaltenbach & b. Shutterstock)

## The Role of Maintenance Staff

Maintenance staff can seal openings around pipes, utility conduits, and bathroom vents, and can install door sweeps to prevent bed bugs from traveling between apartments within a building.

If a vacuum cleaner is not part of your contractor's treatment protocol, consider equipping your maintenance staff with a HEPA vacuum cleaner to assist the residents who are unable to perform this task. A vacuum can remove a significant number of living and dead bed bugs. This will help in determining whether an infestation has been successfully treated (no new remains) or is ongoing.

There is new evidence that living and dead bed bugs and cast skins can be a source of allergens<sup>8</sup>, which is another reason to incorporate a vacuum in bed bug treatment plans.

Maintenance staff can also play a role in heat treatments. Although some training is needed, staff do not need a pesticide applicator license to use a steamer or a heat chamber to heat-treat difficult items like recliners, wheelchairs, cribs, etc.



**Figure 8.** Staff can take on some of the non-chemical control activities to save costs and facilitate faster treatment success. The staff shown in the picture above purchased a portable heat chamber to heat-treat non-washable items, such as recliners, wheelchairs, cribs, and car seats. (M. McGinty)

### Working with Residents

Encourage residents to feel comfortable reporting signs of bed bugs. Make it clear they will not be charged as long as they cooperate, as charging will discourage reporting and encourage dangerous or ineffective self-treatments.

Discourage the use of home remedies and retail products by residents. OTC and internet-purchased products, like sprays and foggers (bug bombs), can disperse bed bugs into surrounding areas and push them further into hiding, making treatment more difficult for PMPs. Foggers have also caused explosions in homes when fog mist comes into contact with a pilot flame or an outlet spark.



**Figure 9.** Discourage residents from using over-the-counter sprays and bug bombs. They are ineffective and can push bed bugs further into hiding, making them more difficult to treat. (S. Reese)

Housekeeping inspections are an opportunity to address OTC and illegal or off-label chemical use. Consider a chemical buy-back program where residents receive a cleaning kit or some other incentive for turning in their bug bombs, aerosol sprays, and other ineffective or illegal products.

Encourage residents to work with maintenance staff if they wish to discard heavily infested items<sup>9</sup>. Maintenance staff should wrap furniture in plastic, or use furniture bags to move infested furniture through a building to avoid dropping bed bugs in hallways<sup>9</sup>.

Throwing out mattresses and box springs may not be necessary. Let the professional and the resident decide. If residents are forced to discard their belongings, they will be less likely to report infestations.

Mattresses and box springs can be treated using steam, or vacuumed and covered in bed bug-specific mattress encasements.



**Figure 10.** Use this poster to warn residents to avoid picking up discarded furniture. (Available at [www.stoppests.org/stoppests/assets/File/furniture%20poster.pdf](http://www.stoppests.org/stoppests/assets/File/furniture%20poster.pdf))

Discourage residents from picking up discarded beds and furniture from dumpsters or curbside. Housing staff should mark or destroy all discarded infested furniture.

Share picture-based information like the *Clutter Image Rating Scale* and *Stop Bed Bugs!* (English and Spanish). Both of these resources can be found at [StopPests.org](http://StopPests.org).

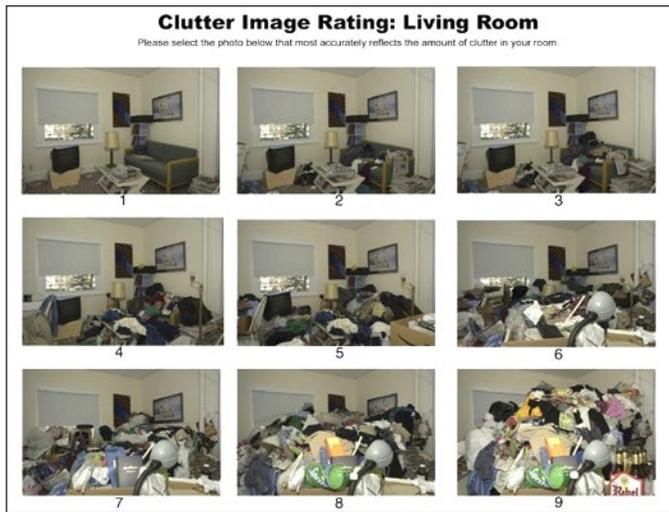


Figure 11. Clutter Image Rating Scale. (Available at <https://stoppests.typepad.com/files/clutter-image-rating-scale.pdf>)

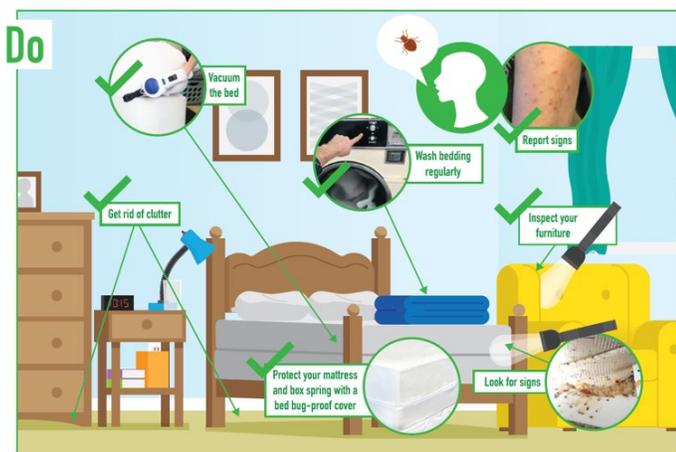


Figure 12. Stop Bed Bugs! (Available at [https://stoppests.org/stoppests/assets/File/2Stop\\_Pests\\_BedbugsF2.pdf](https://stoppests.org/stoppests/assets/File/2Stop_Pests_BedbugsF2.pdf))

## Preparation for Treatment

Staff should go over these instructions with the residents and make sure they fully understand the preparation instructions and can carry out the instructions. Placing a call or visiting with the residents a day or two before the scheduled treatment may be a helpful reminder. It will also save the time and cost of a visit from PMPs if they are unable to treat due to lack of preparedness.

Review your lease. Does it include a clause to encourage residents to cooperate with treatment preparation instructions? Consider enforcing a clause to require payment of a fine only if a capable resident is non-compliant more than once. This is a fair practice only if the resident is mentally capable and able-bodied. It is not helpful to anyone to fine residents who are unable to comply with extensive preparation instructions. Consider whether family, a charity,

or a government agency can help with treatment preparation.

## Hire a Qualified Pest Management Professional

Hire a dependable and experienced contractor or have well-trained, in-house staff do bed bug treatments. Know what the treatment options are and discuss options with your pest control provider.

The most effective management strategy is to use an IPM approach. Treatments should include a combination of chemical and non-chemical tools, partly because bed bugs may be resistant to some of the chemicals available today<sup>10,11</sup>. So a chemical-only approach is not likely to result in the successful elimination of an infestation, but not only that, it will also needlessly expose residents to pesticides and the hardships associated with an ongoing bed bug infestation.

When putting your pest control work out for bid, in the request for proposals, specify the treatment details you expect. If you have a contract in place, know what it says and hold the contractor accountable. If the contract says bed bugs will be eliminated, require proof that the infestation has been successfully eliminated. Only bed bug monitors that fail to catch bed bugs for several weeks in a row indicate successful extermination of bed bugs.

Treatments that go on for many months without eliminating an infestation often occur. Reasons for control failure include:

- Not enough time is spent on finding the hidden insects.
- Bed bugs are coming from an adjacent unit or visitors.
- Ineffective chemicals are being used.
- An IPM approach is not being practiced.

## Questions to ask new or current contractors:

- How many technicians will be servicing your communities each month? *Does the bidding company have enough labor to service your units?*
- Do they use *non-chemical* tools like a vacuum cleaner, steam, heat chamber, whole-unit heat, or mattress encasements?
- Do they monitor for bed bugs? How?
- Do they inspect every apartment *at least* once a year?
- What is their follow-up inspection/treatment schedule? *A follow-up inspection should be scheduled 10 to 14 days after treatment and continue until three to four consecutive monthly inspections reveal no new pest activity.*

- Do they say they will eliminate bed bugs? Can they provide proof and references supporting their claims?
- Do they blame residents' lack of sanitation? Good control is possible in most cases with little cooperation from residents. Do not accept this excuse, but organize the support the resident needs if they are unable to clean, launder, vacuum, etc.
- Who decides which units need to be serviced? Your records and theirs should indicate which units need the most attention. Focus time and effort on the worst infestations first.
- What kind of records are kept indicating infestation levels? Is anyone reviewing records to make sure the numbers of pests and infestations are going down?
- What does your contractor charge per treatment? How many visits does that include? *While heat treatments may be effective with just one treatment, conventional pesticide treatments always involve multiple treatments because the chemicals cannot kill the eggs. Many pest control companies include three treatments in the cost of service.*
- Is there a warranty or guarantee? If yes, hold them to it.

### Cost of Treatment

Treatment costs should be covered by building management. It is impossible to prove why an infestation or reoccurrence of an infestation occurs. It could be due to treatment failure, a reintroduction or invasion from an undetected local infestation. Charging residents for the cost of treatments could discourage them from reporting infestations to building managers and encourage them to resort to often unsafe and ineffective do-it-yourself treatments.

Be wary of companies who say they can do it in one visit (unless they are conducting whole-unit heat or fumigation) and/or their treatment takes under 30 minutes. The typical cost of bed bug management in one-bedroom apartment ranges from \$300 to \$500 for conventional chemical treatments or \$1,500 to \$2,000 for heat treatments (these are estimates; costs vary across the country).

Ask what the contractor's bed bug price includes. Most companies will include three pesticide treatments, which is considered minimal. You must be prepared to pay more for heavy infestations. Consider the costs for chemically treating a heavy infestation several times, versus the cost of a heat-plus-chemical treatment, which will be fast and effective if done well.

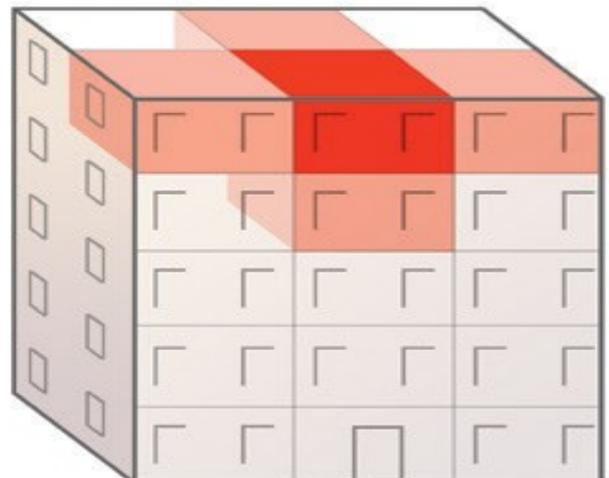
Be wary of deals that seem too good to be true. Bed bug management demands very detailed and time-consuming work. Be prepared to get what you pay for. Inexpensive service may end up costing more in the end if you have to repeat treatments and bed bugs spread to surrounding units/apartments. It is *always* cost-effective to pay for an *effective* IPM service.



**Figure 13.** While staff can do a quick inspection to confirm the presence of bed bugs, professionals must do a very thorough inspection to find and treat *all* harborage (hiding places). (J. Obermeyer)

### Inspection Schedule

Clearly state inspection expectations in the scope of work in your request for proposals or bids. Require your pest control company to have a plan for regular inspection (visual or canine—see below) and monitoring. Units with active infestations should be inspected every two weeks and re-treated until the unit/apartment is free of bed bugs.



**Figure 15.** Inspect above, below, on all sides of the unit, *and* across the corridor from units with a confirmed infestation.

Three to four consecutive monthly visual inspections revealing no new signs and no new bites are needed to confirm a unit/apartment is cleared of an infestation. The unit/apartment should be inspected quarterly (every three months) thereafter.

Adjacent units, including the one across the hall, should be inspected, monitored, and treated if bed bugs are found. Treatment of adjacent units/apartments is unnecessary if no bed bugs are found. An experienced PMP is the best person to determine this. If the infestation level is high, the PMP may recommend a barrier treatment in the neighboring units.

### Canine Scent Detection

Dogs can be trained to detect bed bugs. Properly trained dogs can be extremely effective and practical, but effectiveness varies considerably among different dogs and handlers<sup>12</sup>.

Canine detection teams may operate independently from the pest management contractor used for treatment, but some companies provide both detection and treatment services. Certifications by an independent agency such as NESDCA (National Entomology Scent Detection Canine Association) may be helpful indicators of reliable canine service. Dog training methods vary and not all dogs and handlers are well trained.

Some companies use multiple dogs to confirm bed bug alerts. Irrespective of the number of dogs used, a live bed bug or viable egg should always be found to verify alerts.

### Preparation Instructions for Bed Bug Treatments

Carefully read through the preparation instructions provided by your pest control company. Consider how the preparation instructions will be fulfilled in units/apartments housing elderly and/or disabled residents. If the pest management company requires extensive preparations before treating a unit/home and the resident cannot comply, ensure that there is a plan in place to have either the PMP, a family member *or* housing staff prepare for treatment, *and* undertake the post-treatment instructions, which can be significant.

An initial inspection should be done by the PMP, and the residents should be advised on the next steps. Be aware that the more that residents move things around, the more likely that bed bugs will scatter, and the more challenging it will be to control them. Any furniture moving that is necessary should be done at the time of treatment.

Reasonable preparation instructions may include asking the residents to wash, dry, and bag clothing and bedding, and to clean out under the bed. Consider requiring less preparation for low-level infestations. If a resident is not prepared and the PMP refuses to treat, this can waste valuable time. If your PMP refuses to treat, ask them—at a minimum—to apply a barrier treatment to prevent the spread to neighboring units.

On occasion, preparation instructions contain some questionable directions. Consider all aspects of the bed bug management process, ensuring that all parts are reasonable and can be practically fulfilled.



**Figure 16.** Everything is bagged, but what if there are bed bugs in those bags? Make sure all bagged items have been washed and dried before bagging. (Shutterstock)

### Treatment Options

There are many ways to kill bed bugs. The most effective treatments include a range of tools, including the use of chemicals and heat, not a reliance on just one tool.

While property managers don't have to be experts on every treatment option out there, they do need to provide oversight when records indicate the same unit is being treated over and over without making progress toward elimination. That would indicate a need to re-evaluate the treatment protocol and meet with the PMPs to discuss changes to their treatment. Read the following so you can make sure your treatment options include effective tools.

#### *Vacuum*

Irrespective of what killing agents are to be used to control bed bugs (pesticides, heat, cold, etc.), vacuuming to remove live and dead bed bugs is an important part of the control plan. It is especially important that either PMPs or

housing staff undertake vacuuming in cases where residents are unable to vacuum. Vacuuming removes allergens, live bugs, and some but not all eggs, and it helps determine whether the infestation is ongoing.

### ***Mattress Encasements***

Mattress encasements should always be included in your bed bug management plan. If your contractor does not provide mattress encasement services, building managers can make bed bug mattress encasements available free or at cost to residents. Encasements make bed bug inspection easier and eliminate the need to discard mattresses and box springs.

Even inexpensive vinyl mattress covers can be used, but they tend to rip easily. Bed bugs prefer fabric and will congregate less on vinyl and plastic covers<sup>9</sup>. Bed bugs trapped inside encasements will be unable to feed and will eventually die. Encasements should be kept on for a full year and resealed with duct tape if torn.



**Figure 17.** A contractor covering a mattress with an encasement. Not only does this avoid the need to discard mattresses and box springs, but the white color makes inspections easier. (S. Reese)

### ***Heat Treatments***

Heat treatments include using clothes dryers, steam, containerized heat treatments or heat chambers, and whole-unit heat treatments.

When using heat chambers or whole-unit/apartment heat treatments, require your contractor to provide a temperature readout that indicates the thermal death point was reached in well-insulated areas (such as between couch

cushions, in clothing, and inside drawers), and that lethal temperatures were held for an appropriate length of time.

Live bed bugs and eggs die within 90 minutes at 118°F (48°C) or immediately at 122°F (50°C). During a heat treatment, the air temperature in the room is held between 135°F (57°C) and 145°F (63°C)<sup>13</sup>. Expect heat treatments to take at least several hours and up to 24 hours.

During the heat treatment, the resident will be asked to remove pets, plants, and any heat-sensitive items from the unit/apartment. Medications can usually be placed in a refrigerator during the treatment period, or removed from the home. Notify PMPs about items that have been removed (e.g., wheelchairs, walkers, oxygen generators, etc.), as these items will need to be treated or cleaned before being moved back into the unit/apartment.

Residents may need to be provided with alternative accommodations overnight and receive assistance with laundering and cleaning of possessions before moving back into their unit/apartment. Keep an eye on what the residents remove during treatment. They may be bringing the infestation back with them when they return, if those items contain bed bugs.

When a whole-unit heat treatment is conducted, remember heat cannot penetrate walls very well, so an insecticidal dust should be used by the PMPs in wall voids. Often, a pesticide barrier around a room is used during heat treatment to prevent bed bugs from escaping as the room heats up. Heat treatments should be used only when live bed bugs are found. Whole unit heat treatments with a pesticide application can be used effectively for high-level infestations or in homes with clutter where chemical treatments alone are less effective. Clutter makes pesticide and heat treatment more challenging because it provides bed bugs numerous hiding places<sup>9</sup>, which limits their exposure to pesticide and heat.

Whole-unit heat treatment plans are variable, and often combine vacuuming, laundering, and pesticide applications as part of the protocol. If more than one heat treatment is needed, a re-evaluation of treatment and resident behaviors should be made to determine possible causes for treatment failure. Heat treatment failure is most often due to:

- Units/apartments being held at a high heat for an insufficient amount of time.
- Temperatures not rising high enough in all parts of the unit/apartment.
- Bed bugs being reintroduced on resident's belongings.
- Bed bugs reinvading from surrounding wall voids and units/apartments.

## Pesticides

Pesticide treatments that are conducted thoroughly and correctly by a licensed PMP are an effective tool for managing bed bugs. Although we advise you to leave the pesticide treatments to the professionals, you should still be aware of what products your PMP is using. The occupants or property manager may request a copy of pesticide labels if the PMP does not supply them.



**Figure 18.** A technician applying a residual chemical pesticide to the underside of a chair. (S. Reese)

It is important to note that bed bugs have become resistant to some commonly used pesticides<sup>10, 11</sup> and an IPM program cannot rely on pesticides alone for elimination. Ask your service provider how they combat insecticide resistance. Do they use a dual-action (two chemicals in one product) pesticide and rotate their products? These practices are highly recommended<sup>11</sup>. A dust-formulated insecticide or desiccant dust application into wall voids and other hard-to-reach places should be considered as well<sup>14</sup>. Be careful of “green” product claims, as not all are effective<sup>11, 15, 16</sup>.

There is a biopesticide product that uses a fatal fungus to kill bed bugs and is showing promise in certain conditions. Unfortunately, some of the essential oil-based pesticides work only as a direct contact spray, if at all, and worse, might end up working as a repellent, pushing the bugs further into hiding and making the infestation harder to treat.

Make sure your PMP is choosing products that have been proven effective by objective research. See resources section for more information, call your local Extension

entomologist, or contact [StopPests.org](http://StopPests.org) for more information on specific products. It is important to note that, regardless of the products used, the applicator must inspect thoroughly and apply the products where bed bugs are. Even the most effective chemical products will not be effective if the bugs never come in contact with them.

**Find more guidance on managing bed bugs using an IPM approach.**  
Visit [StopPests.org](http://StopPests.org) or email [stoppests@cornell.edu](mailto:stoppests@cornell.edu).

## References

1. HUD Notice H 2012-5. Guidelines on Addressing Infestations in HUD-insured and Assisted Multifamily Housing. [https://www.hud.gov/sites/documents/BEDBUG\\_H2012\\_5.PDF](https://www.hud.gov/sites/documents/BEDBUG_H2012_5.PDF)
2. Wang, C., N. Singh, C. Zha, and R. Cooper. 2016. Bed bugs: prevalence in low-income communities, resident’s reactions, and implementation of a low-cost inspection protocol. *Journal of Medical Entomology*. 53(3): 639-646. DOI: 10.1093/jme/tjw018.
3. Cooper, R., C. Wang, and N. Singh. 2015. Evaluation of a model community-wide bed bug management program in affordable housing. *Pest Management Science*. 72(1): 45-56. DOI: 10.1002/ps.3982.
4. Cooper, R., C. Wang, and N. Singh. 2015. Mark-release-recapture reveals extensive movement of bed bugs (*Cimex lectularius* L.) within and between apartments. *PLOS One*. 10(9): e0136462. DOI: 10.1371/journal.pone.0136462.
5. Cooper, R. 2006. Bed bugs – still more questions than answers: a need for research and public awareness. *American Entomologist*. 52(2): 111-112. DOI: 10.1093/ae/52.2.111.
6. Wang, C., W. Tsai, R. Cooper, and J. White. 2011. Effectiveness of bed bug monitors for detecting and trapping bed bugs in apartments. *Journal of Economic Entomology*. 104(1): 274-278. DOI: 10.1603/EC10141.
7. Wang, C., T. Gibb, G.W. Bennett, and S. McKnight. 2009. Bed bug attraction to pitfall traps baited with carbon dioxide, heat, and chemical lure. *Journal of Economic Entomology*. 102(4): 1580-1585. DOI: 10.1603/029.102.0423.

8. DeVries Z.C, R.G. Santangelo, A.M. Barbarin, and C. Schal. 2018. Histamine as an emergent indoor contaminant: Accumulation and persistence in bed bug infested homes. *PLoS ONE*. 13(2): e0192462. DOI: 10.1371/journal.pone.0192462.
9. Wang, C., N. Singh, and R. Cooper. 2014. What Causes Bed Bug Control Failure: The Resident Factor. *PCT Bed Bug Supplement*. 86-93.
10. Zhu, F., H. Gujar, J.R. Gordon, K.F. Haynes, M.F. Potter, and S.R. Palli. 2013. Bed bugs evolved unique adaptive strategy to resist pyrethroid insecticides. *Scientific Reports*. 3: 1456. DOI: 10.1038/srep01456.
11. Doggett, S.L., D.M. Miller, and C-Y. Lee. (Eds). 2018. *Advances in the Biology and Management of Modern Bed Bugs*. John Wiley & Sons. DOI: 10.1002/9781119171539.
12. Pfiester, M., P.G. Koehler, and R. M. Pereira. 2008. Ability of bed bug-detecting canines to locate live bed bugs and viable bed bug eggs. *Journal of Economic Entomology*. 101(4): 1389-1396. DOI: 10.1093/jee/101.4.1389.
13. Shindelar, A. and S. Kells. 2014. Understanding Bed Bug Treatments. University of Minnesota Extension.
14. Singh, N., C. Wang, D. Wang, R. Cooper, and C. Zha. 2016. Comparative efficacy of selected dust insecticides for controlling *Cimex lectularius* (Hemiptera: Cimicidae). *Journal of Economic Entomology*. 109(4): 1819-1826. DOI: 10.1093/jee/tow129.
15. Zha, C., C. Wang, and A. Li. 2017. Toxicities of selected essential oils, silicone oils, and paraffin oil against the common bed bug. *Journal of Economic Entomology*. 111(1): 170-177. DOI: 10.1093/jee/tox285.
16. Aprehend Field Trial in a Severely Infested, Single-family Home.  
<http://sencionline.com/aprehend-field-study/>

## Additional Resources

- Bed Bug Action Plan for Apartments.** Dini M. Miller, Ph.D., Department of Entomology, Virginia Tech.  
<http://stoppests.org/go/BBG1>
- Bed Bug Biology and Behavior.** Dini M. Miller and Andrea Polanco, Department of Entomology, Virginia Tech.  
<http://www.vdacs.virginia.gov/pdf/bb-biology1.pdf>
- How to Get Bed Bugs Out of Your Belongings.** Jody Gangloff-Kaufmann and Matt Frye, NYS IPM Program, Cornell University.  
<https://ecommons.cornell.edu/handle/1813/55760>
- How to Select a Bed Bug Control Provider.** Mike Merchant and Wizzie Brown, Texas A&M AgriLife Extension. Ento-033. <http://stoppests.org/go/BBG3>
- What Property Owners and Managers Need to Know about Bed Bugs.** Amelia Shindelar and Stephen Kells, University of Minnesota Extension.  
<https://www.bedbugs.umn.edu/property-owners-managers>
- Cost-Effective and Money-Wasting Bed Bug Control Methods.** Changlu Wang, Richard Cooper, Department of Entomology. Rutgers Cooperative Extension.  
<https://njaes.rutgers.edu/fs1251/>
- Bed Bug Handbook: The Complete Guide to Bed Bugs and Their Control.** Pinto, Lawrence J., et al. Pinto & Associates, Inc., 2007.

## Acknowledgments

This guide was written by Susannah Reese, MS, StopPests in Housing; Shujuan Li, PhD, University of AZ; and Dawn Gouge, PhD, University of AZ, and was reviewed by Jody Gangloff-Kaufmann, PhD, NYS IPM Program, Cornell University, and Dan Wixted, PMEP, Cornell University. Edited and typeset by Shaku Nair, PhD, University of AZ.

**Updated: November 2020**

Northeastern  
IPM  
Center



THE UNIVERSITY OF ARIZONA

Agriculture, Life &  
Veterinary Sciences &  
Cooperative Extension

The Northeastern IPM Center receives support from the U.S. Department of Housing and Urban Development's Office of Lead Hazard Control and Healthy Homes through the U.S. Department of Agriculture, NIFA agreement #2016-4866825905. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the U.S. Department of Agriculture or those of other funders.

THE UNIVERSITY OF ARIZONA  
COLLEGE OF AGRICULTURE AND LIFE SCIENCES  
TUCSON, ARIZONA 85721

Any products, services, or organizations that are mentioned, shown, or indirectly implied in this publication are for illustrative purposes and do not imply endorsement by The University of Arizona, StopPests in Housing, or the Northeastern IPM Center

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Jeffrey C. Silvertooth, Associate Dean & Director, Extension & Economic Development, College of Agriculture Life Sciences, The University of Arizona.

The University of Arizona is an equal opportunity, affirmative action institution. The University does not discriminate on the basis of race, color, religion, sex, national origin, age, disability, veteran status, or sexual orientation in its programs and activities.