

Why Is the Control of Bed Bugs' (*Cimex spp.*) Infestations as an Urban Environmental Health Pest Difficult? Reasons & Control Strategies

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The bed bug (*Cimex spp.*; Hemiptera: Cimicidae) is a public health nuisance and urban pest that can cause significant economic loss. It is a cryptic, wingless, and nocturnal hematophagous ectoparasite insect that requires blood meal from humans, other mammals, or birds to survive¹⁻³.

There was a resurgence of bed bug, as an important public health pest in the past decade⁴. Bed bug infestation is a neglected and unreported health and medical concern in comparison with other vector-borne diseases such as Leishmaniasis, Malaria, and Crimean-Congo hemorrhagic fever, which is increasing worldwide².

Bed bugs infestation can produce psychological distress with nightmares, insomnia, anxiety, avoidance behaviors, anemia, and personal dysfunction. So far, bed bugs have not been able to vector human pathogens. Their bites are painless and cause itching skin in individuals, but different complications can arise in individuals. Bed bug bites are mainly on the arms, forearms, legs, neck, and face^{5,6,2}.

Bed bugs are a severe public health issues with difficult and costly eradication methods. They are ordinarily nocturnal and hide in protected places⁷ such as floor areas under beds and couches, mattresses, desks, walls, chairs, crevices and corners of wooden bed boards, sofas and wooden furniture, door and window frames, behind loose wallpaper, and behind pictures. Therefore, it is difficult to find and control the infestation⁸. Today, integrated pest management (IPM) approach is mainly used to control bed bugs, but the majority of bed bug infestation control methods are treated with conventional synthetic insecticides, such as Pyrethroids, Carbamates, Neonicotinoid, and other classes of insecticides^{9,10}.

Bed bug infestation has been reported dramatically from different countries all over the world¹¹, such as United States, Australia, United Kingdom, Italy, Switzerland, France, Spain, Denmark, Sweden, Norway, Scandinavia, Brazil, Nigeria, Iran, Singapore, Malaysia, Thailand, and Kuwait¹²⁻²¹. The reason of this recent reemergence

is unclear, but the following reasons are possible: I. High levels of bed bugs' resistance to domestic insecticides, II. Increased number of human travel (international travels and migrations), III. Decreased public awareness about bed bug biology, IV. Poor or lack of pest management practices, and V. Global warming^{2, 12-21}.

Bed bug resistant

In general, bed bugs' resistant to DDT has been determined since 1960s. The first case of bed bugs resistance to DDT was reported and confirmed in 1947s in Hawaii. Researchers reported bed bugs' resistant to other groups of insecticides such as organophosphates, carbamates, and pyrethroids all over the world^{10, 22, 23}. Bed bugs' populations can become resistant by biochemical resistance²⁴, molecular resistance²² and cuticular resistance²⁵. The findings of Doggett *et al.* demonstrated that cuticle thickness is present within a pyrethroid-resistant strain of *C. lectularius*²². Moreover, Moussian *et al.* demonstrated that the bed bug (*C. lectularius*) cuticle acted as a protective coat against the penetration of insecticides²⁵.

Lack of identification, knowledge, and awareness against bed bug

The general lack of public awareness about bed bug is one of the most important factors that increased its infestation. In addition, people are usually not aware about the existence of bed bugs. So, at the time of infestation, bed bugs are often quickly picked by other individuals and transported into other houses²⁶. Despite the increasing incidence of infestation, relatively few people can identify a bed bug. Hence, public awareness and knowledge are the key factors to reduce the bed bug infestation^{2, 27}.

Poor bed bug management practices

Implementation of controlling programs using just one strategy is rarely efficient and only causes immediate effects in eliminating the bed bugs' infestation. Most of the residents of houses, apartments, hotels, dormitories, and other human

dwelling have no effective technical knowledge to prevent and control the bed bug infestation²⁸.

Integrated pest management (IPM) methods to control bed bug

Recently, IPM method has been applied as the main tool to control bed bug. Research carried out in the recent eight years showed that IPM was the best approach to eliminate bed bug infestation in contaminated houses^{9, 28}. It refers to a logical combination of physical, environmental, mechanical, biological, and chemical controlling methods to minimize the risk of exposure to chemical insecticides and control the pests. According to the definition, IPM is a promising and safe strategy for humans and the environment and includes active surveillance and simultaneous use of both chemical and non-chemical control strategies, implementation of follow-ups and preventive measures²⁹.

In order to control bed bugs, IPM strategy includes survey for infestation, identification of its severity, cleaning all contaminated areas in order to eliminate the bed bug habitats (sanitation), physical removal (mechanical) of bed bugs, effective and careful use of insecticides according to the instructions, following the inspections daily, weekly, and monthly^{29, 30}.

Based on the latest research on the control of bed bugs by Wang *et al.*, IPM programs were more effective in reducing and exterminating the bed bugs' infestations than the traditional pest control services³¹. The findings of Wang *et al.* demonstrated two methods of pest control: (a) Non-chemical tools including steam, vacuuming, mattress encasement, de-cluttering, discarding severely infested items, and frequent laundering as well as (b) Chemical methods including insecticide sprays and dusts, which are named as IPM approach³¹. They indicated that these two methods were necessary for eliminating bed bug infestations rapidly from human's dwellings (Figure 1)³¹.

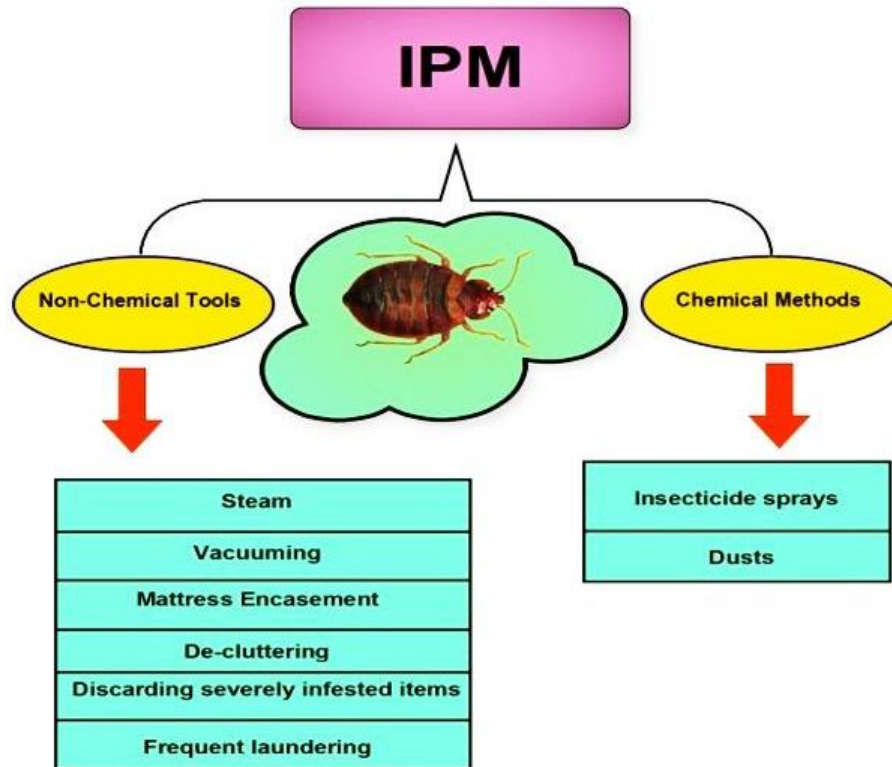


Figure 1: Methods to control integrated bed bug ³¹

References

1. Wang C, Saltzmann K, Chin E, et al. Characteristics of *Cimex lectularius* (Hemiptera: Cimicidae), infestation and dispersal in a high-rise apartment building. *J Econ Entomol.* 2010; 103(1): 172-7.
2. Alizadeh I, Sharififard M, Jahanifard E, et al. Identification, knowledge, and awareness of people regarding public health nuisance insect (*cimex lectularius*) in southwest of Iran. *Jundishapur Journal of Health Sciences.* 2018; 10(3): e81133.
3. Fountain T, Ravinet M, Naylor R, et al. A linkage map and QTL analysis for pyrethroid resistance in the bed bug *cimex lectularius*. *G3: Genes, Genomes, Genetics.* 2016; 6(12): 4059-66.
4. Singh N, Wang C, Zha C, et al. Testing a threshold-based bed bug management approach in apartment buildings. *Insects.* 2017; 8(3): 76.
5. Alizadeh I, Sharififard M, Jahanifard E. Allergic reactions and dermatitis to common bed bug bites: a case report from Ahvaz, southwest of Iran. *Iranian Journal of Dermatology.* 2017; 20: 65-7.
6. Alizadeh I, Sharififard M, Jahanifard E. *Cimex lectularius* and prevent and control methods on human settlements. Tehran: Khosravi Publisher; 2016.
7. Zhu F, Sams S, Moural T, et al. RNA interference of NADPH-cytochrome P450 reductase results in reduced insecticide resistance in the bed bug, *cimex lectularius*. *PLoS One.* 2012; 7(2): e31037.
8. Hottel BA, Pereira RM, Koehler PG. The influence of roughness and pyrethroid formulations on bed bug (*cimex lectularius* L.) resting preferences. *Insects.* 2015; 6(2): 455-63.
9. Cooper RA, Wang C, Singh N. Evaluation of a model community-wide bed bug management program in affordable housing. *Pest Management Science.* 2016; 72(1): 45-56.
10. Candy K, Akhoundi M, Bruel C, et al. Ineffectiveness of insecticide bendiocarb against a *cimex lectularius* (hemiptera: cimicidae) population in Paris, France. *J Med Entomol.* 2018; 55(6): 1648-50.
11. Balvín O, Booth W. Distribution and frequency of pyrethroid resistance-associated mutations in

- host lineages of the bed bug (hemiptera: cimicidae) across europe. *J Med Entomol.* 2018; 55(4): 1-6.
12. Tawatsin A, Thavara U, Chompoonsri J, et al. Insecticide resistance in bedbugs in thailand and laboratory evaluation of insecticides for the control of *cimex hemipterus* and *cimex lectularius* (hemiptera: cimicidae). *J Med Entomol.* 2011; 48(5): 1023-30.
 13. Politi FAS, Nascimento JD, da Silva AA, et al. Insecticidal activity of an essential oil of *tagetes patula* l.(asteraceae) on common bed bug *cimex lectularius* l. and molecular docking of major compounds at the catalytic site of clache1. *Parasitol Res.* 2016; 116(1): 415-24.
 14. Haghii SFM, Behbodi M, Hajati H, et al. Prevalence of bed bug (*cimex lectularius*) in human settlement area of bahnamir, Iran. *Asian Pac J Trop Med.* 2014; 4: S786-S9.
 15. Giorda F, Guardone L, Mancini M, et al. Cases of bed bug (*cimex lectularius*) infestations in northwest italy. *Vet Ital.* 2013; 49(4): 335-40.
 16. How YF, Lee CY. Survey of bed bugs in infested premises in Malaysia and Singapore. *J Vec Ecol.* 2010; 35(1): 89-94.
 17. Omudu E, Kuse C. Bed bug infestation and its control practices in gbajimba: a rural settlement in benue state, nigeria. *J Vector Borne Dis.* 2010; 47(4): 222.
 18. Levy Bencheton A, Berenger J, Del Giudice P, et al. Resurgence of bedbugs in southern france: a local problem or the tip of the iceberg?. *J Eur Acad Dermatol Venereol.* 2011; 25(5): 599-602.
 19. El-Azazy O, Al-Behbehani B, Abdou N. Increasing bedbug, *cimex lectularius*, infestations in kuwait. *J Egypt Soc Parasitol.* 2013; 43(2): 415-18.
 20. Doggett SL, Russell RC, editors. The resurgence of bed bugs, *cimex* spp. (hemiptera: cimicidae) in australia. Proceedings of the sixth international conference on urban pests; 2008: Veszprem: OOK-Press Kft.
 21. Kilpinen O, Jensen K-MV, Kristensen M, editors. Bed bug problems in denmark, with a european perspective. proceedings of the sixth international conference on urban pests; 2008: OOK-Press Veszprém.
 22. Lilly DG, Latham SL, Webb CE, et al. Cuticle thickening in a pyrethroid-resistant strain of the common bed bug, *cimex lectularius* l.(hemiptera: cimicidae). *PLoS One.* 2016; 11(4): e153302.
 23. Dang K, Lilly D, Doggett S. Bed bugs and insecticide resistance; implications for pest managers. *Pest.* 2013: 25-7.
 24. Karunaratne S, Damayanthi B, Fareena M, et al. Insecticide resistance in the tropical bedbug *cimex hemipterus*. *Physiology.* 2007; 88(1): 102-7.
 25. Wang Y, Carballo RG, Moussian B. Double cuticle barrier in two global pests, the whitefly *trialeurodes vaporariorum* and the bedbug *cimex lectularius*. *Journal of Experimental Biology.* 2017; 220: 1396-9
 26. Cooper R. Bed bugs-still more questions than answers: a need for research and public awareness. *American Entomologist.* 2006; 52(2): 111-2.
 27. Gerardo EM. Increasing awareness of and education about bed bugs (*cimex lectularius*) as a public health issue in hawaii: [MA degree] University of Hawaii at Manoa; 2014.
 28. Bennett GW, Gondhalekar AD, Wang C, et al. Using research and education to implement practical bed bug control programs in multifamily housing. *Pest Management Science.* 2016; 72(1): 8-14.
 29. Fong D, Bos C, Stuart T, et al. Prevention, identification, and treatment options for the management of bed bug infestations. *Environmental Health Review.* 2013; 55(04): 89-102.
 30. Wang C, Gibb T, Bennett GW. Evaluation of two least toxic integrated pest management programs for managing bed bugs (heteroptera: cimicidae) with discussion of a bed bug intercepting device. *J Med Entomol.* 2009; 46(3): 566-71.
 31. Wang C, Eiden A, Singh N, et al. Dynamics of bed bug infestations in three low-income housing communities with various bed bug management programs. *Pest Management Science.* 2018; 74(6): 1302-10.