

Public Health

Department of Entomology

BED BUGS: BIOLOGY AND PUBLIC HEALTH RISK

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Bed bugs are well known as annoying biting pests, and they are increasing in importance, including in hotels and other lodging establishments in the U. S. You are encouraged to learn more about the biology of bed bugs and their association with homes, apartments, hotels, and lodging establishments so that you can make more informed decisions about health risks, how to protect yourself when traveling, and whether bed bug control is warranted in a residence or lodging establishment.

Are Bed Bugs a Public Health Risk?

Bed bugs require blood in order to reproduce and complete their life cycle. The effect of bed bug bites varies among people, but they eventually produce red welts that itch. The bites themselves are not painful and typically are not felt. However, frequent feeding can disrupt people's sleep and make them irritable, and seeing bites may cause emotional distress in some people. Heavy rates of feeding can result in significant blood loss and eventually lead to anemia, especially in malnourished children.

At least 27 agents of human disease have been found in bed bugs, including viruses, bacteria, protozoa, and parasitic worms. None of these agents reproduce or multiply within bed bugs, and very few survive for any length of time inside a bed bug. There is no evidence that bed bugs are in-



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An adult bed bug, *Cimex lectularius* (Photo credit: Michael F. Potter, University of Kentucky)

involved in the transmission (via bite or infected feces) of any disease agent, including hepatitis B virus and HIV, the virus that causes AIDS.

Relatives of Bed Bugs

Bed bugs belong to the family Cimicidae of the insect order Hemiptera, the group of insects known as "true bugs." In addition to the three species that are associated with humans, there are at least 88 species of Cimicidae in the world that live with and feed on bats or birds. Approximately 10-12 species of these bugs occur in the continental U. S., including four species in Indiana. Two species are known as "bat bugs," one is known as a "swallow bug," and one is known as a "purple martin bug." Bat bugs and swallow bugs typically feed on their bat or bird hosts, but will feed on humans if their normal sources of blood are not available. The effects of their bites are similar to those associated with the bites of bed bugs. There is no evidence that bat bugs and swallow bugs transmit disease agents to humans.

There are two additional groups of Hemiptera that bite humans, the so-called "kissing bugs" and "assassin bugs," both of which belong to the family Reduviidae. Kissing bugs feed on the blood of mammals and birds, and transmit a protozoan parasite that causes a disease of humans known as "Chagas Disease." Chagas Disease is widespread in Central and South America, and an occasional case occurs in Texas. Assassin bugs, instead of being blood feeders, are predators on other insects, including crop pests. They are beneficial insects, but they will bite humans if mishandled, and the bites are very painful.

How Many Types of Bed Bugs Are There?

There is only one species of bed bug in Indiana, *Cimex lectularius*. This species is a pest of humans worldwide, including the entire U. S., and has over 50 common names, among them “mahogany flat,” “redcoat,” “wall louse,” and “bed louse.” A second species of bed bug, *Cimex hemipterus*, is limited to tropical regions of the world. A third species of bed bug, *Leptocimex boueti*, lives with and feeds on both humans and bats in West Africa.

How Can I Recognize a Bed Bug?

Adult bed bugs are about $\frac{1}{4}$ inch long, oval, reddish-brown, and wingless. Their body is very flat, and they possess long, slender legs and antennae. They have a long, segmented proboscis (beak) that extends forward when the bug takes a blood meal. At rest, the proboscis lies beneath the body and projects backwards between the legs. Immature bed bugs are known either as “larvae” or “nymphs.” They closely resemble adults, but are smaller and less deeply pigmented.

What Is the Life Cycle of Bed Bugs?

Bed bugs develop from egg to adult via a process called “gradual metamorphosis.” This means the last larval stage develops directly into an adult without passing through a non-feeding pupal stage. There are five larval stages, and each one requires a blood meal before molting into the next life cycle stage. Both adult male and female bed bugs feed on blood and take repeated blood meals during their lives. Females require blood for the development of eggs.

The five larval stages are completed in about a month under suitable conditions of temperature, humidity, and availability of hosts for blood meals. Larvae can survive

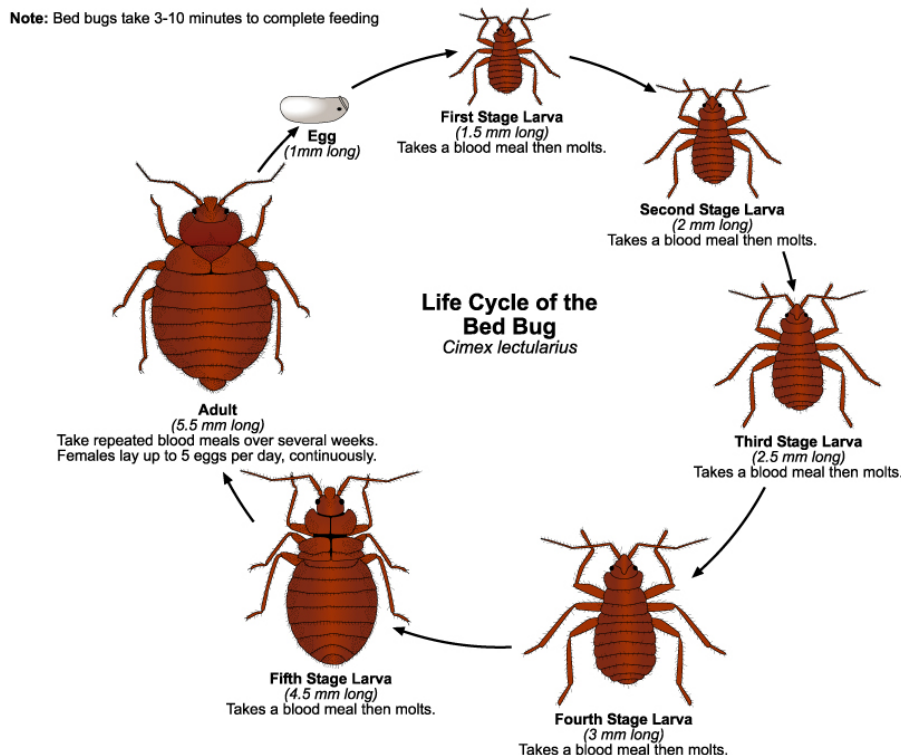
inside dwellings for several months without a blood meal, but they do not molt into the next life cycle stage until they engorge on blood. Adults can survive even longer under the same conditions, but do not develop eggs unless they feed on blood.

Where Are Bed Bugs Found Inside Dwellings?

Bed bugs typically are active at night and hide during the daytime. Being very flat, they are able to find a number of places in which to hide. Typical hiding places include beneath loose flooring, behind loose wallpaper, inside box springs, in mattresses, and in upholstered furniture. One common hiding place in hotel rooms is behind bed headboards that are fastened to the wall and another is behind moldings just above the floor. Bed bugs also hide behind electric switch plates and inside appliances. However, sites that have surfaces consisting of plaster, stone, and metal typically do not harbor bed bugs.

How Do Humans Influence Bed Bug Development and Dispersal?

Human dwellings provide bed bugs with a place to live and access to a source of blood meals. Bed bugs commonly infest larger buildings such as apartments, dorms, prisons, and theaters, but they also can occur in individual hotel rooms and in private homes. There is a common misconception that bed bug infestations occur only in poorly constructed and poorly maintained buildings with unsanitary conditions. However, this is not the case, as explained below. Modern construction has aided the spread of infestations by enabling bed bugs to move from room to room via central heating ducts.



Life cycle of the bed bug, *Cimex lectularius* (Illustration by: Scott Charlesworth, Purdue University, based in part on Usinger, R. L. 1966, *Monograph of the Cimicidae*)



Bed bug infestation of a mattress
(Photo credit: Michael F. Potter, University of Kentucky)



Bed bugs on a mattress seam
(Photo credit: Michael F. Potter, University of Kentucky)



Bed bug infestation of a carpet
(Photo credit: Michael F. Potter, University of Kentucky)

Humans can aid the dispersal of bed bugs from one structure to another via the movement of infested bedding, furniture, and packing materials. Even more widespread dispersal is associated with infested clothing, luggage, and perhaps lap top computers of travelers. International travelers from countries that have heavy bed bug infestations can be a source of bed bug infestations in hotel rooms, and there has been an increasing incidence of bed bugs in lodging establishments around the world, including in the U. S. Dependent only on a source of blood, bed bugs do not require unsanitary conditions characteristic of infestations of cockroaches. Bed bugs do not discriminate between economy or luxury hotel rooms, and they can exist in the cleanest hotels, motels, apartments, and homes.

How Far Do Bed Bugs Travel to Feed and Lay Eggs?

Bed bugs typically do not travel far to feed and lay eggs once they become established in a building. Females lay eggs more or less continuously as long as they have access to blood meals. A well-fed female is capable of laying about 500 eggs in her lifetime. The eggs are laid singly in the same sites that harbor larvae and adults. These sites often are marked by masses of bed bug feces, which appear as yellowish to reddish-black specks and contain the remnants of digested blood. Large concentrations of bed bugs may be accompanied by a characteristic sweetish odor caused in part by secretions from scent glands.

What Should I Know About the Feeding Habits of Bed Bugs?

Bed bugs feed on warm-blooded animals. They have a normal host with which they live and on which they feed, but they will feed on other species. For example, bed bug larvae and adults feed readily on humans, bats, and chickens, and they do so when the host is at rest. Thus bed bugs living with humans typically feed at night while a person sleeps, but they also will feed during the day in dark structures such as infested theaters with upholstered seats. Male and female adults usually feed every 3-4 days and become engorged with blood in about 10-15 minutes.

Bed bugs detect carbon dioxide emitted from warm-blooded animals and respond to warmth and moisture as they approach the potential host. On humans, they tend to feed on exposed surfaces such as the face, neck, arms, and hands. Again, the bites are painless, and the host typically is not disturbed while bed bugs feed.

How Can I Avoid Being Bitten by Bed Bugs?

Preventing bed bug infestations is the best approach. This involves thoroughly searching for bed bugs or signs of infestation in any suitable hiding place, such as bedding, upholstered furniture, or packing materials that might be introduced into your home or apartment. You should search for feces, eggs, and shed "skins" of larval bed bugs, as well as for active bed bugs.

Travelers are encouraged to inspect their room for signs of bed bug infestation upon arrival. Check the mattress, box springs, and behind the headboard before using the bed (see details in the section below). It is very important to report suspected bed bug infestations to the hotel

management immediately so that steps to control the infestation and prevent subsequent spread can be implemented as quickly as possible.

Hotel guests should place luggage and clothing on dressers or on luggage racks. Avoid placing bags and personal items on beds or upholstered furnishings because these types of fixtures may harbor bed bugs. Guests also should be vigilant and keep suitcases, brief cases, and computers and their cases closed when not in use. It is a good idea to search these items prior to vacating the room and again prior to bringing the items inside your home.

What Should Hotel Managers Do About Bed Bugs?

Training housekeeping and maintenance staff to check for bed bugs is strongly recommended in order to identify an infestation. A professional pest control company should be contacted immediately if an infestation is found.

Hotel staff should examine guest rooms closely, including sheets and bedding. In infested rooms, sheets and pillowcases used by guests who are bitten by bed bugs may have small bloodstains, which appear as small reddish brown spots. Mattress seams should be examined for brown spots that could be bed bug feces, for shed skins, and for active bed bugs. Cracks and crevices should be examined using a flashlight. Sites to be searched include behind bed headboards, furniture seams, draperies, floor moldings, areas where wallpaper is loose, and behind picture frames and baseboards, especially those located near the beds. If a centralized forced-air heating system exists, the heating ducts in guest rooms should be checked for signs of bed bugs.

What Should I Do About a Bed Bug Infestation in My Residence?

Control of an infestation of bed bugs is very difficult and is best left to professional pest control companies that have both the approved insecticides and the application equipment to effectively treat the places where bed bugs hide. The representative of the pest control company should examine the residence and describe any pre-treatment responsibilities of the homeowner. For example, eliminating or at least reducing clutter in rooms to be treated is a necessity, and infested bedding may have to be discarded before the infestation is treated.

Where Can I Find More Information on Bed Bugs?

The University of Kentucky Web site <<http://www.ca.uky.edu>> contains accurate and detailed information about bed bug biology and bed bug control.

A recent symposium devoted to the biology and control of bed bugs took place at a meeting of the Entomological Society of America. The symposium was published in the journal *American Entomologist*, Volume 52, number 2, Summer 2006.

An excellent reference book devoted to the biology of bed bugs and their relatives is: Usinger, R. L. 1966, *Mono-graph of the Cimicidae (Hemiptera: Heteroptera)*. Thomas Say Foundation, Vol. 7, Entomological Society of America, College Park, MD.

We greatly appreciate the information pertaining to bed bugs provided by Dr. Sheryl Kline, Department of Hospitality & Tourism Management, Purdue University.

READ AND FOLLOW ALL LABEL INSTRUCTIONS. THIS INCLUDES DIRECTIONS FOR USE, PRECAUTIONARY STATEMENTS (HAZARDS TO HUMANS, DOMESTIC ANIMALS, AND ENDANGERED SPECIES), ENVIRONMENTAL HAZARDS, RATES OF APPLICATION, NUMBER OF APPLICATIONS, REENTRY INTERVALS, HARVEST RESTRICTIONS, STORAGE AND DISPOSAL, AND ANY SPECIFIC WARNINGS AND/OR PRECAUTIONS FOR SAFE HANDLING OF THE PESTICIDE.

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