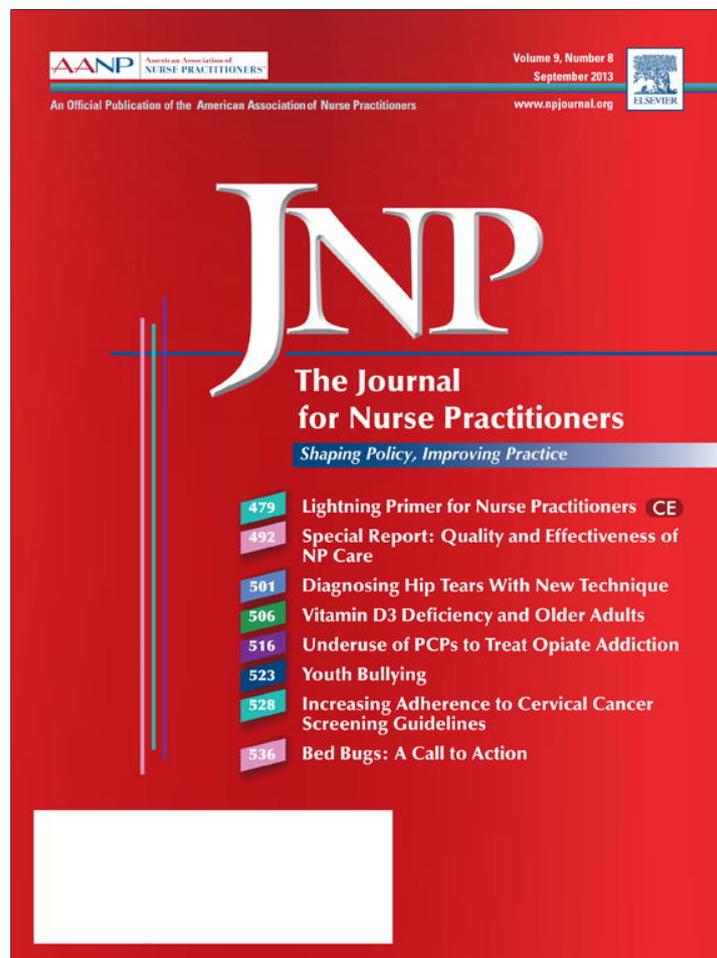


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# Bed Bugs and Beyond: A Call to Action for Advanced Practice Registered Nurses

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## ABSTRACT

Bed bugs, once considered well controlled and even eradicated in many parts of the developed world, have made a comeback and are an increasing public health concern. Coordinated actions on the part of public health entities, such as the Centers for Disease Control and Prevention and the Environmental Protection Agency, have focused on the use of integrated pest management strategies to combat the recent resurgence. Advanced practice registered nurses, especially as clinicians, educators, and policy makers, need to be aware of this public health issue and their integral role in management and containment efforts.

**Keywords:** bed bug re-emergence, complication and treatment of bites, identification, prevention of transmission, public health concerns, role of advanced practice registered nurse

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The re-emergence of bed bugs (*Cimex lectularius*) as a public health threat requires an urgent call to action by all primary care providers, including advanced practice registered nurses (APRNs). These pests were once a universal problem and plagued humans, but with increased awareness and use of pesticides, they were relatively controlled in the past century. Bed bugs, almost forgotten but not eradicated, have made a comeback globally, nationally, and locally.<sup>1</sup> They are increasingly found in any facility with high occupant turnover, such as health care settings, transportation venues, movie theaters, and hotels.<sup>2</sup>

## HISTORY OF BED BUG INFESTATIONS

Bed bugs have cohabitated with humans for thousands of years, as evidenced by the discovery of 3500-year-old fossilized bed bugs from an Egyptian village.<sup>3</sup> These “blood-sucking” insects were prevalent until World War 2, with an estimated 30% of homes in the United States infested.<sup>4</sup> After World War 2, with the discovery and accepted use of potent pesticides such as dichlorodiphenyltrichloroethane (DDT), bed bug infestations were greatly reduced.<sup>5</sup>

This reduction was also related to an awareness of the need to check environments for bed bugs, especially when traveling<sup>6</sup>; the changes in home furniture,

from wooden headboards to sleek metal designs; and the introduction of vacuum cleaners, making cleaning the home environment easier.<sup>3</sup> Berg<sup>6</sup> also noted that previous generations were more vigilant and aware of bed-bug infestations. Travelers knew to inspect lodgings for signs of bed bug activity and routinely checked children and clothing upon return from summer camps.

Even though the bed bug population dropped remarkably during the mid-20th century, bed bugs have returned in significant numbers. In 1972, the Environmental Protection Agency (EPA) banned the use of DDT, citing its potential as a human carcinogen and deleterious effects on wildlife.<sup>7</sup> Other reasons for the pest resurgence include an increased amount of domestic and international travel, increased immigration, reduced knowledge of treatment methods, and an increased resistance to legal pesticides.<sup>1</sup>

Since the late 1990s, reports of bed bugs have increased in residential areas, educational institutions, and shelters.<sup>4</sup> Today, increased outbreaks have been reported in college dorms, hotels, nursing homes, office buildings, schools, hospitals, and movie theaters.<sup>8</sup> Although there are no peer-reviewed data on the prevalence of bedbugs in the US, 2 of the larger pest control companies have released data based on the increase of needed treatments. Some of the major

cities dealing with the problem of bed bug infestation are Chicago, New York, Detroit, Cincinnati, and Philadelphia. In New York City, complaints to the city council have risen from 537 in 2004 to 10,985 in 2009.<sup>9</sup> Additionally, other countries have reported increased outbreaks.<sup>10</sup>

## IDENTIFICATION

Identification of these pests and their bites can be problematic. A bed bug bite is difficult to discern without the actual presence of a bed bug or its egg. Bed bugs do not have wings, are reddish-brown and parasitic, and consume blood. They prefer human blood but will also feed on pets, rodents, and birds when no human is available.<sup>3</sup> Adult bed bugs are oval shaped and approximately the length of an apple seed, 1/4 to 3/8 inches. After feeding, their length can increase by 30%–50% and their weight by 150%–200%.

Adult bed bugs live for 6 to 12 months and are able to survive a year without feeding.<sup>13</sup> They have 3 main life stages: egg, nymph, and adult. The egg stage is characterized by a white egg that is the size of a poppy seed, 1 mm long. In the nymph stage, the larva ranges from 1–4.5 mm long and transitions through 5 phases of molting.<sup>4</sup> During this process, the nymph grows into an adult bed bug that is approximately 5–6 mm long and will consume several blood meals over many weeks. Once reaching adulthood, females can lay between 200–500 eggs within 2 months.<sup>12</sup> An EPA Web site (<http://www.epa.gov/pesticides/bedbugs/#identify>) offers an excellent illustration of each stage.

Bed bugs prefer a warm, dark environment, with an availability of warm-blooded hosts. They feed at night when their host is asleep and thus stationary for long periods. Headboards and box springs are frequent hiding places for the bugs, which rarely travel more than 8 feet to feed.<sup>11</sup> Once a host is located, the bed bug pierces the skin of the victim and injects a chemical that numbs the area before the bite, allowing uninterrupted feeding for up to 5 minutes.<sup>12</sup>

People who report bed bug bites may be unaware that they have been bitten.<sup>12</sup> Bed bug bites vary from person to person but typically consist of 2–3 bites in a line or circle, sometimes called the “breakfast, lunch, and dinner pattern”<sup>12</sup> (go to <http://www.cdc.gov/>

[nceh/ehs/Publications/Bed\\_Bugs\\_CDC-EPA\\_Statement.htm](http://www.cdc.gov/nczod/dpdx/bedbugs/PDF/nczh/ehs/Publications/Bed_Bugs_CDC-EPA_Statement.htm) for an example). This pattern can be seen along the path of blood vessels under the skin.<sup>3</sup> Blood spots from the bites or brownish fecal stains may also be detected on bedding (go to <http://www.epa.gov/bedbugs/#prevent> for an example).<sup>4</sup> The anesthetic chemical injected by the bed bug during feeding may cause an atopic reaction, such as a rash or other irritation that may become raised and infected. Anaphylaxis has also been reported in rare cases.<sup>14</sup> Mental health effects from bed bug infestations include insomnia and anxiety and may exacerbate pre-existing mental health illnesses.<sup>15</sup>

As bed bugs prefer to feed on human blood, they are the suspected vector in the transmission of more than 40 human diseases. However, research has not substantiated this link, and no single instance of transmission of blood-borne disease from bed bug to human has been documented. Recent studies have focused on the potential of bed bugs as vectors for the transmission of human immunodeficiency virus (HIV) and hepatitis B virus (HBV). Though research shows these viruses can be detected in bed bugs after feeding on highly concentrated viral meals, neither of these viruses is able to replicate within the bed bug, nor were they detected in its waste. Therefore, bed bugs are not considered a competent vector as they are not able to acquire, replicate, sustain, or transmit a disease.<sup>13</sup>

## TREATMENT

Treatment of bed bug bites is not necessary unless the patient is symptomatic. Bites may cause an allergic reaction with the subsequent release of histamine. Over-the-counter antihistamines may be used to block these histamines and relieve itching and discomfort.<sup>12</sup> In addition topical steroids may be used to relieve severe pruritis. If a bite becomes infected, a systemic antibiotic may be prescribed.<sup>13</sup>

Though rare, bite-induced asthma or anaphylaxis may require emergency treatment, including intramuscular or intravenous epinephrine, antihistamines, and corticosteroids.<sup>13</sup> While most people will not suffer severe consequences, many will suffer anxiety, sleeplessness, and discomfort that may require professional treatment.<sup>5</sup> A pest infestation must be eliminated by treating the environment before the

patient begins to experience reduced quality of life, either physiologically or psychologically.<sup>10</sup>

### CONTAINMENT AND MANAGEMENT

All levels of socioeconomic status are vulnerable to bed bug infestation—even hotels with the highest standards have reported outbreaks. Bed bugs are extraordinarily difficult to treat and even more difficult to eradicate. Several steps may be necessary to control and eliminate bed bugs: proper identification of the species, education of those involved, complete inspection of the infested areas, use of chemical and non-chemical control measures, and effective follow-up.<sup>13</sup> The most effective approach is a defensive one, as pesticides have sometimes proven ineffective or even detrimental to the health of those exposed. Cities such as New York have strongly discouraged the use of “bug bombs” and foggers because of the possible harm of the pesticide and the potential of bed bugs developing resistance.<sup>4</sup>

The Integrated Pest Management (IPM) approach is the most comprehensive program for control and elimination of bed bugs. This program incorporates knowledge of insect life-cycle, environmental control, and pest control methods.<sup>14</sup> It generally includes:

- Inspection of suspected areas of infestation
- Correct identification
- Accurate record keeping, noting times and locations where *bugs* were found
- Cleaning of all infested areas (ie, linens, bedclothes, curtains, mattresses)
- Reduction of all clutter
- Elimination of all bed bug habitats (contaminated mattresses)
- Physical removal of bed bugs through cleaning
- Judicious use of pesticides by a licensed exterminator
- Follow-up inspection for possible further treatment
- Raising awareness through education on prevention of the spread of bed bugs<sup>4</sup>

The environmental control portion of the IPM includes inspection and control of bed bugs. When inspecting the bed and bedroom of a suspected infestation, carefully remove all linens, including mattress pads. Avoid cross-contamination and place all items in a sealed plastic bag. Wash all

contaminated materials in very hot water and dry on the highest heat setting for 30 minutes because bed bugs are eradicated at high temperatures. Barriers, such as mattress encasements, should be used to avoid spreading bed bugs to new locations.<sup>11</sup> Contaminated mattresses should not be donated because of the risk of cross contamination and must be tagged as contaminated and disposed of properly.<sup>4</sup>

Inspection of suspected areas needs to include all furniture, not just the bed and mattress. Baseboards, electrical outlets, cracks in the wall, loose wallpaper, carpeting, the underside of all furniture, the interior of drawers, the bottoms of dressers, and even wall hangings should be carefully checked. Clutter should be eliminated because it provides an excellent hiding place for bed bugs.<sup>11</sup> General cleaning may involve the use of a vacuum dedicated to pest control. This specified vacuum should be inspected for bed bug contamination before use and washed with hot water and soap after use. The contents may be disposed of in a sealed plastic bag and the vacuum stored in a larger plastic bag.<sup>4</sup>

Steam cleaning or the use of freezing temperatures will also help eliminate bed bugs.<sup>4</sup> Additionally, items found on the street should not be brought into the home as they may already be infested. Purchased or donated secondhand clothing should be washed and dried on high heat settings.<sup>4</sup>

Minimizing risk of contact, whether at home or traveling, is the best protection against these pests. When traveling or in any unfamiliar environment, check for evidence of bed bugs, eggs, and droppings, and never place luggage on the floor of potentially contaminated areas. Evidence of bed bugs may appear along the mattress seams and crevices. Droppings may be determined by applying alcohol, which will cause bed bug fecal matter to dissolve into a reddish brown color.<sup>4</sup> Specially designed bed and pillow encasements or shields are available for purchase and may help prevent contact and possible transmission.<sup>13</sup>

Pesticides are an important aid in the management of bed bugs. If used incorrectly the toxic effects of pesticides may be deleterious, especially to children and pets, and may actually spread the bugs to unaffected areas.<sup>4,10</sup> Therefore, a pest management professional specializing in bed bug eradication should be employed.<sup>4</sup> Unfortunately, bed bugs have developed

resistance to pesticides meant to eradicate them.<sup>6</sup> Clinical trials have shown that repellants such as lemon eucalyptus oil and 70% isopropyl alcohol also have demonstrated limited effectiveness.<sup>13</sup>

Another tool employed in the fight against these insects is the use of bed bug sniffing dogs, most often beagles. Dogs used for bed bug detection must be recognized by the National Entomology Scent Detection Canine Association. When they are brought into suspected contaminated areas, these small dogs are easily carried and concealed, thus reducing potential anxiety and stigma associated with infestations. Some companies using dogs to detect the presence of bed bugs may use a pair of dogs to help reduce the number of false-positive signals.<sup>4</sup>

### **PUBLIC HEALTH CONCERNS**

With the rising incidence of bed bug infestations and increased awareness comes a need for health officials and authorities to contain the spread and clarify treatment options and standards. Although bed bugs have not been proven to transmit zoonotic diseases, they are still considered a public health threat.<sup>13</sup> Infestations can negatively impact individuals through treatment costs, anxiety, displacement, and economic hardships, such as decreased productivity, lost wages, and time off from work.<sup>15</sup>

The cost of eradicating an infestation is expensive and time consuming, and conflicts often arise between tenants and landlords over responsibility for treatment.<sup>15</sup> Many municipalities have attempted to clarify responsibilities through legislation, but policy varies between jurisdictions, leading to variable approaches to bed bug control.<sup>1</sup>

Public health authorities serve as the frontline safeguard against diseases, including bed bug exposure and the health and economic threats they pose.<sup>1</sup> US government agencies recognize that bed bugs are a re-emerging public health threat and have taken steps to address the growing concern. In an attempt to foster cooperation among varied public health jurisdictions, private industry representatives, and academia, the EPA and the Centers for Disease Control and Prevention (CDC) convened a National Bed Bug Summit in 2009, with a follow-up summit in February 2011. The Summit strives to increase networking, collaboration, and research

with the goal to improve efficiency in combating the rising incidence of bed bug infestations.<sup>15</sup>

The CDC accepted the responsibility for developing national strategies to reduce bed bug populations and providing timely information on emerging trends in bed bug control. This includes encouraging ongoing research into bed bugs and dissemination of this information to the public. The 2011 summit identified several main areas of needed research, including bed bugs as potential disease vectors, potential biological control agents, and population biology.

The EPA assumed a 2-fold responsibility for ensuring that pesticides used to combat bed bugs are safe and effective against the labeled pest.<sup>14</sup> Local government agencies are also directly responsible for programs to combat infestations as their responsibility is to assess risk, develop policy, and ensure health in their community.<sup>1</sup> This approach shows variability between jurisdictions, depending on local policy and procedures, legislation, and budget constraints. For example, Eddy and Jones<sup>1</sup> point out that some local jurisdictions do not have housing or hotel regulations, restricting the ability to police bed bug infestations and prevent outbreaks.

### **ROLE OF APRNs**

As the frontline practitioner in many communities, nurses may be the first to recognize the signs of bed bug exposure. Nurses serving in areas with potential or known bed bug exposure should be familiar with public health summits, findings, policies of local public health jurisdictions, and emerging research.

Goddard and deShazo<sup>13</sup> include proper identification as a necessary step for bed bug eradication. Therefore, distinguishing the signs of bed bug bite reactions and the ability to identify bed bugs are important steps for clinical practitioners. Krause-Parello and Sciscione<sup>3</sup> point out the need for nurses to also educate the community and to increase awareness and knowledge about bed bugs. APRNs are uniquely suited for this educational role because of nursing's emphasis on teaching and empowering patients. Nurses in public health settings may even use media coverage as a tool to disperse educational material to inform the public on treatment and prevention techniques. Various media, such as newspapers or local television news, may also serve to

prevent panic that often accompanies the anxiety associated with bed bug infestations.<sup>5</sup>

Rising awareness causes a reciprocal decrease in prejudice, an increase in reporting, and a more accurate accounting of the spread and prevalence of bed bugs. This media coverage is also advantageous to public health officials to expose the extent of infestations and to inform the general population of treatment and control options through targeted educational materials.<sup>5</sup>

APRNs are partners in an effective use of the IPM approach. APRNs should know how to make referrals to a reputable and licensed pest management professional and to serve in the role of educator and prescriber of medical treatment and nonchemical bed bug management. In institutional settings, such as shelters, schools, and nursing homes, nurses are responsible for helping to quickly identify and contain any bed bug infestation. APRNs are an integral part of any institutional management strategy through the development of an aggressive bed bug control protocol, including education of the resident population on appropriate containment and prevention techniques.<sup>4</sup> Krause-Parello and Sciscione<sup>3</sup> specify that the responsibility of nurses in an institutional school setting is to educate the community about bed bug bites, including identification and transmission reduction. Similarly, APRNs in occupational health care may protect employees through education on techniques to prevent infestation and contagion while traveling.<sup>2</sup>

## CONCLUSION

As populations become more mobile, the possibility of bed bug contamination increases, necessitating vigilance and knowledge of bed bugs by practitioners, health care entities, and public health agencies. The American Nursing Association specifies that nurses are “individually responsible and accountable for maintaining professional competence,” including continuing education and knowledge of treatment standards.<sup>16</sup> Current research, prevention methods, and treatment trends are necessary areas of expertise for APRNs serving in areas at risk of infestation. In their unique

role as primary health care providers, educators, and public health officials, APRNs may serve on the frontline for guarding individuals from the increasing public health threat posed by bed bugs. **JNP**

## References

- Eddy C, Jones SC. Bed bugs, public health, and social justice: part 1, a call to action. *J Environ Health*. 2011;73(8):8-14.
- Chalupka S. Preventing bedbug infestation. *AAOHN J*. 2010;58(11):500.
- Krause-Parello C, Sciscione P. Bedbugs: an equal opportunist and cosmopolitan creature. *J School Nurs*. 2009;25(2):126-132.
- Gangloff-Kaufmann JL, Pichler C. Guidelines for prevention and management of bed bugs in shelter and group living facilities. [http://healthvermont.gov/prevent/bedbugs/documents/BedBugs\\_Guidelines\\_for\\_Shelters\\_Group\\_Living\\_Facilities.pdf](http://healthvermont.gov/prevent/bedbugs/documents/BedBugs_Guidelines_for_Shelters_Group_Living_Facilities.pdf). Accessed December 10, 2012.
- Anderson A, Leffler K. Bedbug infestations in the news: a picture of an emerging public health problem in the united states. *J Environ Health*. 2008;70(9):24-27.
- Berg R. Bed bugs: the pesticide dilemma. *J Environ Health*. 2010;72(10):32-35.
- Environmental Protection Agency. DDT—A Brief History and Status. <http://www.epa.gov/opp00001/factsheets/chemicals/ddt-brief-history-status.htm>. Accessed December 13, 2012.
- National Pest Management Association. 2011 bugs without borders survey. New data shows bed bug pandemic is growing. <http://www.pestworld.org/news-and-views/press-releases/press-releases/2011-bugs-without-borders-survey-new-data-shows-bed-bug-pandemic-is-growing/>. Accessed April 24, 2013.
- Doggett S, Dwyer D, Penas P, et al. Bed bugs: clinical relevance and control options. *Clin Microbiol Rev*. 2012;25(1):164-192.
- Jacobson JB, Wheeler K, Hoffman R, et al. Acute illnesses associated with insecticides used to control bed bugs— seven states, 2003-2010. *JAMA*. 2011;306(18):1974-1977.
- Central Ohio Bed Bugs Task Force Web Site. <http://centralohiobedbugs.org/>. Accessed December 13, 2012.
- Nozarko L. Bed bug bites: identification, treatment and prevention. *BJHCA*. 2011;5(1):12-14.
- Goddard J, deShazo R. Bed bugs (*Cimex lectularius*) and clinical consequences of their bites. *JAMA*. 2009;301(13):1358-1366.
- Centers for Disease Control and Prevention. Joint Statement on Bed Bug Control in the United States from the U.S. Centers for Disease Control and Prevention (CDC) and the U.S. Environmental Protection Agency (EPA). [http://www.cdc.gov/nceh/ehs/Publications/Bed\\_Bugs\\_CDC-EPA\\_Statement.htm](http://www.cdc.gov/nceh/ehs/Publications/Bed_Bugs_CDC-EPA_Statement.htm). Accessed December 13, 2012.
- Rossi L, Jennings S. Bed bugs: a public health problem in need of a collaborative solution. *J Environ Health*. 2009;72(8):34-35.
- American Nurses Association: Position Statement on Role Competence. <http://ana.nursingworld.org/MainMenuCategories/ThePracticeofProfessionalNursing/NursingStandards.aspx>. Accessed December 13, 2012.

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