

Examination of Bed Bug (*Cimex lectularius* Linnaeus) Infestations on the Island of Oahu, Hawai'i

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Abstract

Bed bug (Cimex lectularius Linnaeus) infestations have been increasing over the past several years in the continental United States. This study identified a similar rise in bed bug infestations on the island of Oahu, Hawai'i and followed up to characterize the local situation. The amount of calls and complaints regarding bed bugs to the Hawai'i State Department of Health, Oahu Vector Control Branch (DOHVCB) and Pest Control Companies (PCCs) increased in 2007 as compared to 2006. Eighteen pest management professionals (PMPs) were interviewed by phone in follow up. The number of sites treated for a company ranged from 2 to 650 in 2007, with a mean of 95.31 sites treated. Residential facilities were most commonly serviced by PMPs, shelters much less often. Eighteen employees from 16 shelters were then also interviewed using a different, in-person survey form. Eleven of these shelters had experienced a bed bug infestation, two of which were still affected at the time of the interview. Sixty-four percent of shelters' infestations were limited to one incident, 87.50% of these were able to quickly eliminate infestations. To be able to contain an infestation in shelters such as these, training staff on prevention measures is critical. With the overall rise in infestations, updated public information is essential.

Introduction

One of the most popular topics in pest control today is the resurgence of bed bugs². Pest management professionals (PMPs) and public health officials are receiving an increasing amount of questions about bed bugs across North America, and Hawai'i should be no exception². People of all social and economic classes are affected by bed bugs, and even people who have not had an infestation find themselves worrying about getting one and what they can do to prevent such a situation. Across North America, a plethora of institutions have been directly affected by bed bugs, from motels to four-star hotels, from houses to apartments, and even homeless shelters, movie theaters, cruise ships and public transportation^{2,3}. The species of bed bug that accounts for the vast majority of infestation in the United States, as well as the only species found on O'ahu, is the common bed bug, *Cimex lectularius* Linnaeus.

Like many blood-sucking insects, bed bugs' saliva has anticoagulant properties, which causes the itchy sensations many people experience after a bite⁴. A

typical bed bug bite results in an itchy welt. However, responses to bites have been reported ranging from no reaction at all to severe discomfort, possibly to the point of giant urticaria and hemorrhagic bullous eruptions². Anaphylaxis has occurred in very sensitive allergy patients⁵. Bed bugs have been suspected of transmitting over 40 human diseases, but attempts to prove that they are vectors of disease have been unsuccessful^{6,7}. They do, however, present a severe nuisance and cause residents to call to Pest Control Companies (PCCs) and the Hawai'i State Department of Health, Vector Control Branch (DOHVCB) about their sleepless nights and mental anguish. The purpose of this study was to get a sense of the scope of bed bug infestations on the island of Oahu and further characterize the problem, particularly in homeless, transitional, and emergency housing shelters, so that we can more effectively increase public awareness about bed bugs.

Methods

The record of calls in 2006 and 2007 to the DOHVCB was reviewed for bed bug inquiries. This included, but was not limited to, calls requesting information, assistance with control and prevention, inspections for bed bugs and bed bug identifications.

In a survey, interviews were conducted with PMPs as well as employees and volunteers working for O'ahu's homeless, transitional, and emergency shelters. The survey forms in this study were the same survey forms written for "Bed bug infestations in an urban environment"² and used in this study with permission from the lead researcher and author of that paper. Participants were assured complete anonymity for themselves and their PCC/shelter.

The survey was conducted by telephone with the PMPs on O'ahu. All pest control companies (PCCs) listed in the 2007 phone book were contacted (n=42) and of these, 18 PMPs (each from a different company) participated in this phone survey. The remaining 24 PCCs were either unavailable for comment or declined to interview. Interviewed parties were asked if the number of calls and/or treatments had increased in 2007 as compared to 2006. They were also asked a series of questions which included how many facilities and of what type they treated, how many treatments were needed per site, and the methodology which they used for bed bug infestations.

Twenty-four shelters on O'ahu were then contacted for this study, of which 18 individuals from 16 different

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shelters participated in an in-person survey different from the one given to PMPs. Shelter interviewees included management staff from all participating shelters, and non-management staff from 2 of the shelters. The survey included information about previous and current infestations, action items taken, and the effects of these items on residents.

Results

Department of Health

The O'ahu DOHVCB recorded more than twice as many bed bugs in 2007 (n=69) as the branch did in 2006 (n=30). In both years, more than half of these calls were residential complaints. Shelter complaints went down from 10.0% in 2006 to 4.57% in 2007.

Pest Control Companies

Of the eighteen PMPs interviewed, 72.0 % reported a strong increase in the number of calls and treatments pertaining to bed bugs they received in 2007 versus 2006, while the other 28.0% responded that they will not treat for bed bugs and therefore did not have any record of how many calls were made. One of the PMPs reported stopping bed bug treatments in 2006 because demand was too high and profits were unpredictable, while another PMP reported only treating for bed bugs from long-time customers.

Of the companies that did treat for bed bugs, the number of sites treated ranged from 2 to 650 in 2007 (n=1203), with a mean of 95.30 sites treated. No specific data was able to be collected from 2006. Number of treatments per site ranged from 1 to 9, with a mean of 2.89, though this varied depending on the type of site (table 1). While all PMPs reported

inspecting thoroughly for bed bugs before treatment, less than one-third reported monitoring for bed bugs between services.

Table 1. The mean and range of treatments used by pest management professionals (PMPs) to treat different types of facilities for bed bugs.

Facility	Mean	Min	Max
Apt. buildings	3.95	1	9
Commercial	2.0	2	2
Health care fac.	3.87	3	4
Hotels	3.03	1	4
Private dwellings	2.81	1	4
Shelters	2.0	2	2
Other	4.0	4	4
Overall	2.89	1	

Residential facilities (houses, condos and apartments) were the type of facility most commonly serviced by PMPs (74%), followed by hotels (15%). Shelters comprised 0.42% of facilities serviced by PMPs in 2007 (figure 1). Other facilities infested included health care facilities such as nursing homes and assisted care living (7% in 2006, 9% in 2007) and less commonly affected places: cruise ships, businesses and even a fire station (figure 1).

Heat and cold treatments were recommended by one PMP, but no PMPs reported using these methods themselves. Steam and fumigation were reported in 23.08% and 38.46%, respectively, of the surveys, while contact pesticides were universally used by all PCCs. The Suspend SC (Deltamethrin) was more commonly reported (n=5) than other non-fumigant pesticides (figure 2).

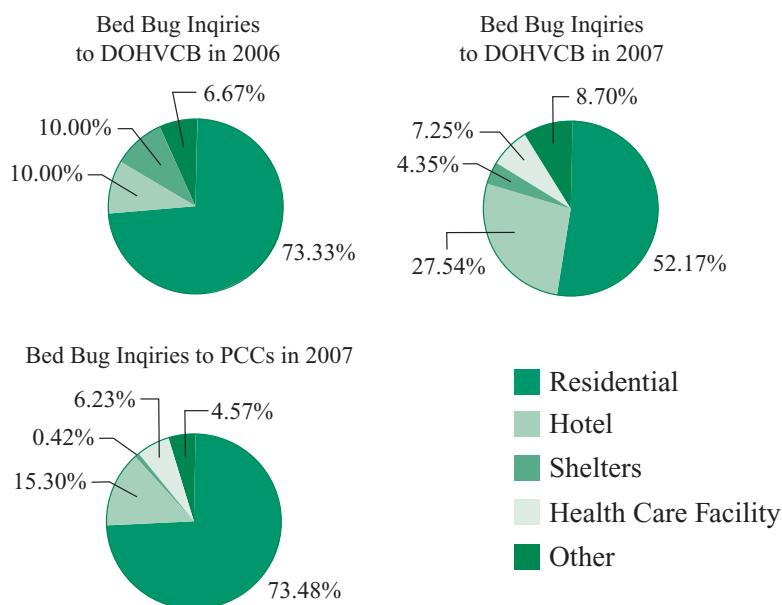


Figure 1. Summary of bed-bug related inquiries to the Hawai'i State Department of Health, Oahu Vector Control Branch in 2006 (n=30) and 2007 (n=69) and to Oahu pest control companies (PCCs) in 2007 (n=1203).

Shelters

Although shelters were such a small focus of attention for PMPs, they are a critical public health concern. DOHVCB personnel conducted an additional survey to get a sense of the scope of bed bug infestations in emergency, transitional, and homeless shelters. Of the 16 shelters that participated in this study, 68.75% had been affected by bed bugs in the past 2 years. Forty percent of shelters were infested in 2007. Twelve and a half percent were infested at the time of the interview. Two shelters had infestations on and off since the time the shelter opened (one of these was currently infested). Of the infested shelters (n=11), 64% had only one infestation of bed bugs. All shelters examined had mattresses and sheets that were infested, while only 69.23% had bed frames infested and 61.53% had other furniture infested. Bed bugs were sighted on 61.53% of the shelters' walls and floors.

The interviewees were asked how much knowledge they thought they had about bed bugs. Twenty-five percent claimed to have a large amount, 37.50% had a moderate amount, 25.0% had a small amount and 12.50% had no knowledge of bed bugs (this excludes 2 interviewees who declined to comment on this question). More interviewees used the Internet to gain knowledge about bed bugs than any other method (figure 3). Two-thirds of interviewees could correctly identify a bed bug from a series of pictures shown to them. When faced with the first sign of an infestation, 100% of interviewees reported that it was first suspected when residents complained of bites. Follow up inspections allowed 45.50% of the shelter personnel to recognize bed bugs from previous experience, while 54.50% called in PMPs and referred to books.

Of all the shelters that experienced infestations, 75.0% consulted a PCC for the treatment of bed bugs. Of these, 77.78% were satisfied with their first company, while the other 22.22% contacted a second.

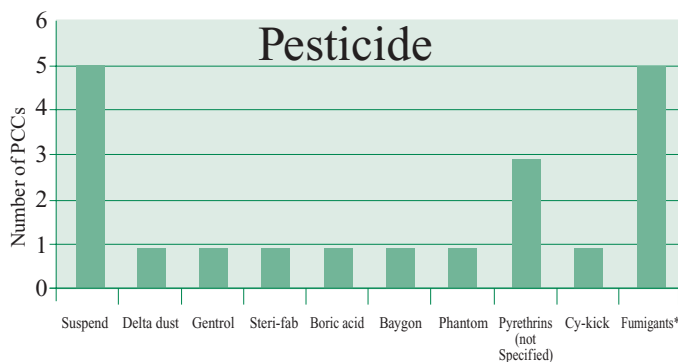


Figure 2. Types of pesticides used from bed bug control by pest control companies (PCCs) on Oahu.

*Fumigants used were either Vikane or its generic form Zythor, both of which have sulfuranyl fluoride as the active ingredient.

All PCCs sprayed affected rooms, two of which also sprayed adjacent rooms as a precautionary measure. Mattresses and other infested furniture at 90.90% of shelter were disposed of after each infestation. Traditional mattresses were banned from one shelter and replaced by air mattresses in an attempt to suppress the infestation. This action did not eliminate the infestation, although many of the residents reported a decrease in the number of bites following the enforcement of this rule. Almost 31% of affected shelters kept written records of their infestation and 38.46% kept educational materials about bed bugs.

About 64% of shelters had the bed bugs spread from the room originally containing the infestation. They were seen traveling on people, laundry bags, along hallways, across walls and through vents. The vast majority of shelters (93.31%) had only a handful of rooms affected by bed bugs, averaging only 2.1 rooms per shelter. One shelter, however, had every room and every bed infested with bed bugs. The spread of the infestation in this shelter may have been due to the short walls separating units. Whereas all other shelters examined had separate rooms for every family, this shelter used cubicles with 4ft walls to separate families. Only three shelters, including the one previously mentioned, had common rooms affected by the bed bugs. Forty-five percent of infested shelters had staff that were bitten by bed bugs and three of these shelters had staff whose homes were subsequently infested.

Of the shelters surveyed, 25.0% had hygiene requirements and 41.67% had mandatory room inspections prior to the bed bug infestations. Room inspections consisted of making sure that rooms were kept clean; they were not inspections for bed bugs. Only one shelter had rules regarding the washing of sheets and no shelters had any policy about cleaning mattresses. No shelters made changes in the rules regarding residents' personal hygiene or washing of their clothing due to the bed bug issue. However, one shelter increased the frequency in which they did room inspections, while a different shelter limited the amount of personal items residents could keep and installed new washers and dryers.

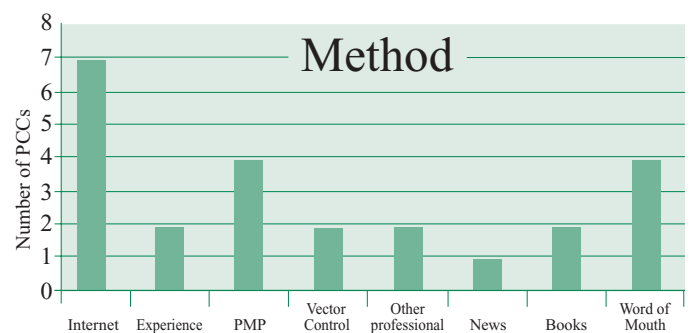


Figure 3. How different shelter interviewees obtained their knowledge of bed bugs.

Discussion

This study indicates that bed bug infestations are increasing on the island of O'ahu, Hawai'i, echoing the national trend. The relative amount of types of facilities that suffered bed bug infestations reported to Oahu pest control companies in 2007 was similar to those reports from the DOHVCB in 2006, although these reports differed substantially from DOHVCB's data from 2007, (figure 1).

Infestations of bed bugs in shelters are high. However, because the vast majority were able to quickly eradicate the infestation (87.50%), this study suggests that bed bug infestations in these shelters can be eliminated if proper procedures are followed. This study also suggests that "cube-farm" style shelters may have a difficult time maintaining control due to low walls and an inability to quarantine an infested room. This same shelter was also not able to receive professional pest control help until nearly two months after the initial infestation was discovered. Reasons for this slow response and control include the need to get several quotes and the lack of available funds for the purpose of pest control. Since the shelter in question was the only shelter of its kind surveyed, it cannot be concluded that cubicles are a problem. However, due to the fact bed bugs were seen crawling over the 4ft walls, this is likely the case.

Preventing bed bug infestations is critical in public health-sensitive environments like shelters and education is key to gaining quick control when an infestation does occur. Shelter staff and residents must learn to notice and quickly respond to bed bug infestations. It is important that staff learn the signs and symptoms of bed bugs, including spots on sheets and mattresses, complaints of bites from residents and the actual recognition of a bed bug.

Even though bed bugs can infest nearly any facility, they do thrive in cluttered areas and therefore maintaining a clean living space is critical (Pinto et al., 2007). Room inspections may be necessary to encourage residents to not provide harborage for bed bugs and other pests. Providing laundry facilities may also encourage resident to wash their items more frequently.

It would also be wise to thoroughly inspect all donations that are given to the shelter, and any furniture that enters the facility. The seams and crevasses should be carefully inspected for evidence of bed bugs. If the means are available, it would also be preferable for all personal items to be briefly inspected. Any items showing signs of bed bug infestation should be treated and quarantined or discarded. If items are disposed of, they should be treated to prevent the spread of the insects and they should be defaced or destroyed to prevent other people from picking up the infested items. One shelter on the Big Island of Hawai'i was given a large walk-in freezer and pre-freezes all items for several days before they enter the facility.

Shelters should have a protocol to treat for bed bugs should an infestation occur. This protocol should include the names of pest control companies or companies to contact and it should be assured that funds are available for bed bug and other pest control needs.

The DOHVCB intends to increase public awareness about bed bugs, including biology, behavior, prevention and control. The branch is currently updating bed bug brochures and factsheets with the goal of having these items translated into the languages most commonly spoken in Hawai'i. The DOHVCB also offers advice and talks about bed bugs to interested parties.

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