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Bed Bug Infestations Impact Quality of Life

Hello and welcome to the presentation, Bed Bug Infestations Impact Quality of Life. To ask questions about this presentation, join the presenter for a Chat Hour in the Networking Lounge.

I would now like to introduce our presenter, Lucy Li, Assistant in Extension, Public Health IPM, at the University of Arizona.

Thanks for the great introduction, Marissa.

Hi, everyone. Welcome to the EEK Vectors and Public Health Pests Virtual Conference. Today I'd like to share with you some results from qualitative research that we have been conducting regarding how bed bug infestations impact our life quality. And this presentation will cover bed bugs' basic biology and the behavior, the results from our nationwide bed bug impact survey, and the problems or challenges that we have identified from the survey.

First of all, I would like to mention that this project is a comprehensive and nationwide cooperative effort. The University of Arizona and the partnering research institutions are working to battle the bed bug resurgence in the United States. Current real-world data on the impact of bed bugs on society, application risk factors, and pesticide use are needed to determine appropriate bed bug management approaches and reduce chemical exposure risk.

I would like to thank all our partners and collaborators that contributed to the development of the Bed Bug Impact Survey and that distributed that survey to a broad range of target audiences. And of course, I should thank all the participants that completed the survey questionnaires.

One fact about bed bugs is that they don't distinguish between people. So no matter the gender, age, society or ethnic group that you are, anyone can acquire bed bugs; and most times, they can get it by accident.

Bed bugs are true bugs, and they belong to the family Cimicidae, order Hemiptera. Like all other members of this family, they feed solely on blood, requiring a blood meal from vertebrate hosts in order to develop and to reproduce. And they are small and flattened insects. Adult bed bugs are about the size of an apple seed, and they look really the same from the side view. This is what they look like from the side view. And this makes them really easy to hide in crevices, such as seams, joints, cracks, and the folds of the bed, furniture, walls, clothing, and the floor close to beds.

They are insects, so they have six legs and two antennae. They don't have wings, so they can't fly. Their piercing-sucking mouthparts can help them to get blood from the hosts. When they feed, their mouth parts can pierce the skin of the host and suck out the blood. And they go through incomplete metamorphosis. This is a group photo for each life stage. As you can see, they look alike except the sizes are getting bigger as they age.

Bed bugs go through an egg stage and five nymph stages before they become reproductive adults. Each nymph or immature stage looks like a small version of the adult, but getting slightly bigger with age. At the final nymph stage, the insect then molts into adult form, including male and female. And they need to feed on blood at least once during each life stage.

So this is kind of a biography of a bed bug. They start with an egg; the egg hatches into the first instar; and then the first instar needs to take a blood meal, and then it molts and goes to the second instar. The second instar takes a meal and then molts and goes to the third instar. As you can see, this whole circle starts over and over if they are not treated.

Here are some real images you might see when you go visit friends or family or some people who have bed bug infestations. This is a bed bug egg; it's pure white. It's shaped like a grain of rice; and they have a sticky texture that kind of makes them stick on the bedding or furniture. And they're about the size of the letters on a penny.

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The newly-hatched bed bugs are the size of a poppy seed, and they're nearly see-through. And they can be bright red if they've just had a blood meal. See those red bright red little instars? They are really pretty though. And their bodies get longer and rounder as they get full. So this is a picture of all life stages of bed bugs after they are well fed, and you can see how plump they are.

Also, here is a picture of the molts of bed bugs, and they were being deposited right next to where bed bugs live. And when they are getting blood meals, then their body will be getting rounder and longer; and they have this elongated body. And this is a bed bug prior to feeding. And 5 to 10 minutes later, that's how big they are.

Generally, young bed bugs are smaller and lighter in color. If they haven't fed for several days, they appear yellow or tan with a dark spot – see the dark spot – at the end of the body. So when they're fully grown, they're reddish brown and about the size of an apple seed. And here is a passport photo for bed bugs. This is male; this is female – and their eggs.

However, bed bugs usually feed at night; so you cannot really see them. They come out of their hiding place at night, and they feed on the sleeping human host. So they can go back into hiding in a remote location after feeding. So you generally won't see them.

In addition to the bed bugs themselves and their shed skin, there are also some signs that you can use to detect if you have any bed bugs at your place.

The first one is fecal spots or poop of bed bugs. See here -- those are the fecal spots of bed bugs. Those are real bed bugs, well fed. And then you can see those are fecal spots of poop. And they were deposited, those poops, after they feed, after they've digested the blood. And sometimes you can see if there is a lot of activity in a place; those are the fecal spots on the electrical outlets. And these are the fecal spots on a couch.

Another sign of bed bug presence is blood smear, like this one, or smashed on the bed. This is a little toddler bed, and with the blood there of course you can see pieces of bed bugs there too. And that's because when the bed bugs feed, they can become very round – you saw the pictures earlier. And then when you accidentally roll over, you may smash them – kind of like here. So the blood will pop out, but they are still alive for a few seconds. And that's what is called (inaudible).

So look for the bed bugs signs at the mattress seams or the pad and the wood frame of the box springs, behind the headboard, along the tops of baseboards, or the edge of the carpeting. That's where you can generally see some activity.

But sometimes, they are not that obvious. Here, this is a corner; and you can tell these are just some dots. People would think those are moths. But actually, when you take a closer look, you can see the bed bugs here – and they have some eggs, bodies, shed skin – and they are hiding really well. And this picture is when you open your bedframe; you can see there is some activity there. And also, when you open the carpet, with a very heavy infestation, these are the ones you will see. They are really hiding well. So that's why sometimes you don't see them. It doesn't mean they're not there.

Bed bugs are not known to transmit disease organisms. But they can be forced to carry some disease-causing pathogens in the (inaudible), such as the parasite that causes Chagas disease. In 2014, there's some research study that showed that bed bugs can spread this parasite to and from mice in a series of three experiments and with auto transmission, such as mice eat the bed bugs, and through the bed bug feces.

This picture proves that they can poop while they feed. Generally, we don't think they poop and feed; but we've got proof. So they poop while they're feeding. And after they digest the blood, they excreted black or brown feces or poop on the bedding or furniture.

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Bed bugs feed on exposed skin and often prefer not to climb onto the host as they feed. And they probe the skin to find a capillary space that allows the blood to flow rapidly. And they may probe the skin several times before feeding. And this can cause bites to occur in a row as they move along the edge of exposed skin searching for a suitable feeding site.

Saliva that bed bugs inject into the host can cause a person to itch and cause sweating. And extreme scratching can often lead to secondary infections, and those are the symptoms that people react to the bed bug bites.

Reactions to bed bug bites are highly variable between people. Some have no reaction at all, while others have strong blistering reactions – like blisters over here. This is one of our colleagues who really sacrificed herself to get those blisters.

And more serious systemic reactions are rare, but have been reported. And the bites should never be considered a clue of a bed bug infestation because they can be caused by a range of other insects, including midges, mosquitoes, fleas and lice. And similar reactions can also be caused by scabies mites and a wide variety of allergens. And because people (inaudible) and some people see this guy, although he didn't really use his cellphone, take some selfie photos and then post it online.

So in Arizona we started working on bed bug cases in 2001; and some communities encountered bed bug problems, and they heavily relied on chemicals to deal with bed bugs and they remain unaware of chemical risks on people, especially for little kids. For example, there's one school – they have beds in the school dorm. Because of the bed bug problem, they were sprayed with dioxathion every week. And sometimes, the mattress was still damp when the kids came back to school. And the kids therefore got chemical burns or pesticide poisoning that way.

And we all know dioxathion is an insecticide belonging to the organophosphates. It affects the nervous system and has been banned from residential use in 2004.

And in 2007, there has been a dramatic increase of bed bug cases in Arizona; and the Phoenix Metro areas had a 300% increase between 2008 and 2010. In 2010, most pest management agencies in the United States reported bed bugs as the No. 1 pest concern. And multiple incidents of pesticide abuse and overuse associated with bed bug infestations have been reported from the residents in Arizona. And we have regular reports of pesticide abuse, house fires due to residents applying flammable substances to mattresses, and incidents of resident-generated explosions due to the overuse of total release of total release over the counter products which contain chemical propellants.

During 2007 to 2011, UA Extension scientists monitored the residents, seeking bed bug information to gather data essential to pest management efforts and the related needs assessment. The initial findings gathered during telephone conversations and onsite residential training events revealed very shocking discoveries. And this is why the bed bug impact survey was being developed. And I will share some results with you later in detail.

Based on the preliminary data, a group of scientists compiled and reviewed relevant questions for residents to methodically determine bed bug impact, acquisition risk, and residents' pesticide or chemical use patterns. And this is a list of the researchers and scientists that have worked to develop the Bed Bug Impact Survey.

The team members are from a number of universities or institutions, representatives from industry and government agencies. And the researchers hope to determine the real impact and the social cause of bed bugs, the risks to individuals and to society, as well as the significant causes of infestation.

In 2014, we launched an online survey to identify the three objectives that I mentioned earlier and the risk factors associated with the bed bug infestations to examine the pesticide patterns and document the social impact risk factors.

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The survey was anonymous. It was implemented on Survey Monkey, following institutional Review Board approval of the survey instrument and methods. The survey asked a few questions about how bed bugs affect life, how bed bugs cause people stress, and what people do when trying to get rid of them. This survey is available in both English and Spanish. And some of our researchers are bilingual, so we translated the English version into the Spanish version and hope to capture more audience that way.

Also, anyone who completes the survey will be contributing to information that will help us (inaudible) these parasites. I have to mention this project was funded by the USDA-NIFA. And also, this survey is still open and is still ongoing. So some of you who are really interested or would like to contribute to control of bed bugs, we would really appreciate your help. This is about a 5- to 10-minute survey, so it would really help if you can spare some time to answer the questions here. And for that, I will thank you so much.

The target audience is adults living in the United States that access information about bed bugs online. Data are collected from people who have experienced, are currently with infestations, and who have never experienced bed bug infestations –and that means everyone.

We'll provide the survey links to our target audience using many methods, such as via Internet, phone, brochures, educational materials, fact sheets, face-to-face conversations, on-site resident training events, and the EEK training events like this.

Our nationwide collaborators have also distributed this survey to their respective networks, such as the Midwest Pesticide Action Center. This is their website. As you can see, this is our survey on their website. When you click it, you can go to both the English and the Spanish version. If you click here, you will go to the Spanish version.

And this is the National Pesticide Information Center, and they posted the survey too. They also posted some basic information about bed bugs. So our survey is there. If you would like to, go ahead and answer the survey.

And this is the Northwest Center for Alternatives to Pesticides. Here, the highlighted part, you can go to the English survey or Spanish survey, as you like.

This survey has three tracks. Here we talk about the survey design. This survey has three tracks; how you respond to the first page will determine the questions throughout the remainder of the survey.

And the question on the first page is: Are you currently living in a place with bed bugs? And based on your answer, you will go to three different tracks with similar questions throughout. Check: Yes; No, but have a history; No, I have never experienced a bed bug.

For example, if you answer yes, you would go to the Yes track. And the questions would include identification, behaviors, impacts and the management that you have being done. For example, how bed bugs affect your life – so did you detect the bites, how long have you noticed the bed bug presence, and how often you move or host guests or live in a hotel room and all the behaviors that affect that, and also how bed bugs impact people's lives.

It would cover social and health costs, such as, do you sleep; do you have financial loss or anxiety or depression? And also questions like this: What have you done to get rid of bed bugs, as to the management part? Did you have a pest management company do it? Did you apply pesticides yourself?

Also, for each survey, demographic information about each respondent is also surveyed, such as, we will ask people's age, gender, number of people in the household, the yearly or annual household income, and the living situation -- are you renting a home or are you buying a home? And all kinds of disabilities will be covered, and also we would like to know where people live or where they come from. We capture all the information from the survey.

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As of December 1, 2015, we received 540 responses to the survey in English and 21 responses to the Spanish survey. So no data is included here from the survey in Spanish due to the low response rate.

The 540 respondents are widespread throughout the United States, since it is a nationwide survey. And we also found that 63% of the respondents are female and 37% are males.

So when asked, are you currently living in a place with bed bugs, over 51% of the respondents are currently living with bed bugs or have a history with bed bugs. So they belong to this group. For the people who currently are still living with bed bugs, it becomes about 35%. And people with a history, it's about 17%. So that says over half of the respondents have had or are dealing with bed bugs.

We have reached people of all ages; and you can see that our target audiences range from 18 years old to over 70 years old, and the majority of the respondents are between 31% to 60%. And we have about 22% are between 18 to 30 years old, and 3% are over 70 years old. So this is a pretty wide-range target audience we have reached.

Here is a table between the bed bug infestations cited and the annual income. For the first category with income less than \$11,000, 96% of the people in this category reported bed bug infestations. And between \$11,000 to \$20,000, 87% of the people reported bed bug infestations. And in this category, between \$20,000 to \$30,000, it's about 77%, compared to the high-income end, such as the people with annual income between \$80,000 to \$90,000, 30% of the people reported bed bug infestations. And in this category, it's about 30% too.

So we combined the data into groups; and with a household income of less than \$20,000, which are these two groups, 91% of the respondents reported either current bed bug infestations or a history with bed bug infestations, compared to 30% of respondents reporting infestations with a yearly income of more than \$80,000 here.

So what does this slide see? People with lower annual income reported more bed bug infestations.

People renting as opposed to buying homes are more likely to report infestations. So 64% of people renting have reported a bed bug infestation compared to 36% of people owning or buying a home reported bed bug infestations. And also, people currently living with bed bugs reported the highest number of people per household.

And based on our survey, the highest number of people per household is about 19 including 5 adults, 7 children that are younger than 5 years old, and 7 children between 5 to 18 years old. Also, people reporting disabilities may have a higher incidence of bed bugs. And based on our survey, 80% of people with disabilities reported either current bed bug infestation or a history with bed bug infestation.

We asked how they identified the pests as bed bugs; 35% of residents had pest control experts identify the insects, and 41% used Internet or literature resources. And 16% relied on landlords, friends or family; and they think their landlords, friends, or family are experts on bed bugs. And only a small number of people used the entomologists or Extension agents to identify the pests that are bed bugs. So they may pose a potential problem about how accurate the identification would be.

Think about that and look at this picture. Do a little quiz. Which one do you think is a bed bug if you don't see the numbers here? So correctly identifying bed bugs is really important because there are so many bed bug-like insects that look very similar, but adapted to feed on other animals, such as bed bugs. Bed bugs only feed on (inaudible).

We have a swallow bug; they really look alike. Sometimes cat fleas look like bed bugs. We got a phone call from a school IPM Coordinator. And he said one of the teachers said they had bed bugs in the classroom. She was panicked; she kicked all the kids out of the classroom, and then she called the IPM Coordinator. So he went in, he collected the samples, and he brought it into our facility to do the facility to do the identification.

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Guess what he brought in? Apple seed! So the teacher was panicked only because she found an apple seed in the classroom. So that's why correctly identifying if you have bed bugs is really important, and it's first on the pest management strategies.

Like we said earlier, reactions to bed bug bites are highly variable between people. Based on our survey, about 50% report swollen, itchy bumps of sorts. An additional 8% of the people with bite reactions required medical treatment, and it's pretty severe if you need medical treatment. An average of 14% report that they have no reactions to the bites at all.

People living with bed bugs have used the following methods to combat bed bugs. Thirty percent applied two to three retail pesticides inside their home, and 19% used total release foggers that are known to be completely ineffective against bed bugs. And 35% of people had personally applied chemicals of some kind two to three times; and 20% had applied chemicals more than eight times a year, eight times. And 25% of people reported using non-pesticide product chemicals, such as gasoline, alcohol, or cleaning agents to kill bed bugs.

This is a picture; firefighters are trying to kill the fire on that mattress. Guess what? That guy soaked that mattress with gasoline and then tried to kill the bed bugs. It killed bed bugs, but it also caused more problems.

So we have seen so many news videos that people will do anything to deal with bed bugs, and sometimes they even put themselves in danger. This was news from last year that a Long Island resident torched off that car in that parking lot when he tried to get rid of the bed bugs in his rental car because he found bed bugs in the car and he heard from his friend that alcohol can kill bed bugs. So he went to the store; he bought alcohol; and then he soaked the car with alcohol; and then he sat in the car, and he lit a cigarette. That's what happened after he lit a cigarette.

So people really need a better way to deal with bed bugs. When asked what had been done to get rid of the bed bugs, here are the answers that we received from people with bed bugs. And 37% contracted with a pest management company to apply pesticides only, and 9% contracted with a company that used heat or cold treatment. Eight percent used canine detection. Nine percent had multiple companies involved in remediation; and seven percent received pro bono, free treatment from the company.

Canine detection – they used dogs. Dogs are humans' best friend, and they're excellent detectors because they can distinguish between live and dead bed bugs. However, they are a little bit expensive; and they require constant training. They also have to work as a team with their handlers. And the dogs can be as good as their handlers, which means if their handlers don't have the professional training of identifying bed bugs, imagine the results for the dogs.

So while the professional pest management industry is able to eliminate infestations, treatments can be time-consuming and disruptive to consumers. About 76% of people resolved their infestations within six months of confirming a problem and of those, 13% within a week. And this must be the owner found one or two bed bugs in their place; and then they called the company and they contracted it out and they did the treatment.

And 10% of the responses never resolved the problem, and so they moved out. And based on our survey, we found out that many of them took the bed bugs with them; and they moved to another location. So 7% of the people with bed bugs have had infestations for over a year.

This is – we call that fecal crust. It's not a fecal spot anymore because there's so much, so it's a fecal crust on a person's mattress cover. And this is all covered with bed bug poop.

And this is a person's baseboard. When you open it, this is what you find. Look at all those white dots here. Those are all the bed bug eggs that we showed earlier. It's not one; it's millions of them. And we

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also found live bed bugs, shed skin, everything associated with bed bugs. And also for places like this, you also found German cockroaches along with bed bugs.

So who has a pest management service that applies pesticide? So 37% of people living with bed bugs had the service; 63% of people with a history of bed bugs used a pesticide service. For people with no bed bug history, among them only 3% used a pest management service every month. But among those people, 70% have a contract that includes application of pesticides only when needed. That means, if they think they have pests, they're going to hire a PMP, and they're going to do a pesticide treatment.

So almost 51% of people with bed bugs had to move at least once in the last five years, and 19% had moved two to three times in the same period. So it seems that people with bed bug infestations move more often. And 21.4% of people with no bed bug infestations stayed with friends or relatives more than six times per year compared to 36% of people who had a history of bed bugs in their past. And also, 20.7% of people with no bed bug infestations hosted visitors to stay more than six times per year compared to 32% of people who had experienced bed bugs in the past.

So the conclusion here is people with no bed bug history stay with friends or family less often and host visitors less often compared to those with a history of bed bugs infestations. So when you go to friends or family, make sure you check the bed. Make sure they don't have any bed bug problems.

Also, people with infestations are more likely to have acquired second-hand articles, like used furniture, second-hand clothes, two or more times per year compared to a resident with no history of bed bugs. And when we talk about bed bugs, we always mention second-hand items or used items because they are always assumed to be the source of a bed bug introduction.

I have a colleague who came to my office one day asking me about bed bugs because his friend had a bed bug infestation. And after he talked with me, he went back to talk with his friend and found out his friend got used furniture, a used couch, from the sidewalk. And somebody threw that beautiful couch by the roadside, and he picked it up. And guess what? He got a free couch; he also got some bed bugs with it.

So we can say for sure living with bed bugs can cause economic, social, and human health costs. I would like you to remember this. Living with bed bugs causes economic, social, and human health costs.

From our preliminary data we collected, based on five years of preliminary research, for the social costs we found out people feel they have troubled personal relationships; and they felt isolation and also sometimes lost friends and family connections. And people felt if they have bed bugs, they wouldn't feel confident, so loss of self-esteem. And most times, people were afraid they would transmit the bed bugs to another home or location.

I don't know if any of you have seen this; I saw it. There is one guy who was walking around in a building, and I did see a few bed bugs on his jeans and on his jacket. He was carrying that everywhere with him.

We also put this list in our survey, and we wanted to see exactly how people reacted to this. And economic impact – people need to spend a lot of money to control bed bugs. And if the infestation is really heavy, they will spend thousands of dollars on it. And they cannot really parent their kids because they are depressed or have anxiety, and they will lose a job because of that; and some of the people say they even lose a home, a house, because of the bed bugs. And probably you cannot really fulfill your work duties as well because of the bed bug problems.

There are also health impacts or there are emotional impacts. People cannot sleep; they cannot eat; and they cannot really relax; and they will increase smoking, alcohol consumption, drug use and also there are mental health problems. And some people can easily gain weight or lose weight, and also they have a decline in health or an increase in health problems. And most of the time, people will feel depression or desperation to get rid of the bed bugs.

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So we have compiled all these lists into our survey, and we asked our respondents to answer it. Here are the results.

For the people with current infestations, we found the top five impacts: suffer sleep loss and they cannot relax; and the third one is depression and/or desperation; and the concern that they transferred bed bugs to other locations; and financial losses. Those just are the major five. There are still many more on our list. And if you would like to know more information, you can contact me later; and I will answer it.

And for the people with previous infestations, we identified the top five impacts; and they are similar to the results of people with current infestations except the order is a little bit different. They still suffer sleep loss, and they cannot relax. And they also worry that they transfer the bed bugs to other locations. And all costs, financial losses, are really major; and people are depressed or feel desperation.

This is just a reference of bed bug costs. While the professional pest management industry is able to eliminate infestations, treatments can be costly. So treating for bed bugs represents unique challenges and significant costs. In Arizona, \$400 to \$10,000 being an appropriate range for in-home remediation costs.

Here you can see all the costs. If you want to use a mattress encasement, you have to spend \$100 to \$300 per bed. And the laundering -- laundering costs about \$100 per person. And bed bug interceptors cost about \$25 to \$75 per room. You can have the vacuum. And the thing is, you have to constantly think about you have bed bug infestations. And your sanity and peace of mind, that's priceless

Also, there are other costs along with bed bug remediation including fumigation, heat treatments, pesticides, and also some companies will give you a bed bug warranty. All this will cost you money; it's really costly.

So we found an overwhelming need for community education. The need for continued education and community awareness among the American public regarding bed bugs is overwhelming. Bed bugs appear to be here to stay, and they don't want to leave. But their spread can be stemmed by a vigilant public who take steps to prevent infestations wherever they go.

And there are many materials available about what you can do to prevent bed bugs, such as you have CDC website and we have the University Extension website and also your state's Department of Health Services. There is lots of information there, and you just need to find them and learn how you can prevent bed bugs – prevent bringing them to your house. So education is very important.

Also, with extremely high infestation rates among the low-income people, like we mentioned earlier, 90%, the poorest are at greatest risk. And knowledge gap among the target audience of non-English speakers and low income residents has been identified from this survey. And the increasing number of people reporting long-term bed bug infestations, such as beyond a year, is very common. So they have less income, and they still have to battle against the bed bugs; that's really exasperating for low-income people. So we have to do something to help those people, to educate them to try not to bring any bed bugs into their homes.

And people living with bed bugs and with a history of bed bugs are exposed to a much higher pesticide load compared to those with no experience. So this makes bed bug management an environmental justice issue. How you can correctly control bed bugs is very important.

At this point, we want to know how to control them. So I will briefly introduce some methods that we're using. I won't go into detail because I think the pest management professionals can do better. So integrated pest management is a way to go. It's short for IPM. IPM is a sustainable approach to managing pests by combining biological, physical, and chemical methods in order to minimize economic health and environmental risks.

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So IPM is the most likely strategy to result in successful elimination of bed bugs and the safeguard of the people and the environment. When you choose a treatment method, there are also lots of basic facts you have to know, such as the level of infestation. If you only have 5 bed bugs or 20 bed bugs, your treatment method will be different from the people with 1,000 or 2,000 bed bugs in their place.

Also, the level of clutter is very important. Is your cluttered or is your room clean? It's based on how big your room is, the square footage of the room. And also, it's based on people's needs. If you have a little child or little infant around your home or place, you may want to consider less pesticide use and less risky methods you can use, such as heat or steam.

Also, the structure type of the building is very important. What is the structure between you and your neighbor? Sometimes we saw two apartments, and they literally had no (inaudible). So basically, the bed bugs can crawl from the drywall from one room to another room, from your home to a neighbor's home. So structure of the building is very important.

Prevention is a very cost-effective tool for managing bed bugs. Avoid used and second-hand items; and even though you want to use them, make sure you inspect them before you bring them in the house. Also, avoid moving bedding in and out of other homes because they may have some bed bug infestation in their place. Also, try to avoid sitting on the furniture when you visit friends of family if you know they have bed bug infestation.

Also, dryers – if you get used clothes, your home dryer is your best friend. The dryer can kill all life stages of bed bugs.

There are also non-chemical methods you can use, and they also become the primary method used in combination with chemical methods, such as heat. If the temperature is over 122 degrees, it kills all live stages of bed bugs. Like I mentioned earlier, the home dryer, we tested the temperature; the temperature in your home drier can go to 150 degrees. So if you can dry anything – put them in your dryer for an extra 40 minutes after the items are dry, and it will kill all bed bugs. This is also a very good prevention method. If you're not sure when you come back from a trip, put all your stuff in the dryer; it will work.

Also some fragile clothing items that cannot be heated in the drier and also some delicate clothing, you can seal them in plastic and place them in your freezer for four days. And even electronics that have been near a bed can be cold treated.

Vacuuming removes bed bugs. For people with very heavy bed bug infestations, vacuuming is a good way to go. It can get rid of live bed bugs, dead bed bugs, molted skin, hatched egg shells, and feces. A mattress encasement is very important. It can be used as a prevention method; it can also be used after the treatment. You install the mattress encasement so that the ones already treated can't get out and also prevents the outsiders to go in.

Also, there are some desiccant dusts you can use. It's all non-chemical methods.

There are also chemical methods. For chemical methods, you have to remember when you have a bed bug infestation, it will required multiple applications of insecticide and also require cracks and crevice applications. Remember, bed bugs come out when they need to feed; and after they feed, they go hiding. So you want to control the cracks and the crevices as well. And also another thing you have to be aware of is the resistance to the pyrethroid product is really high.

Also on the market there are lots of products available. They're also effective to control bed bugs, and they have to be applied properly. That's a worry. You have to apply those products properly and at the right time. So read the labels and ask the pest management professionals to do that.

Also, due to the increasing resistance problems, non-chemical treatment options are emerging as industry standards. So heat treatment is a really good way to go – steam, dryer, and sometimes whole building heat can kill bed bugs when they have very high infestations.

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Also we found out – we collected some field samples from 2014, and we did the testing and we found out they're resistant to the pyrethroids. And those data are not published yet but, yes, we did find resistance.

Based on our online survey and our onsite treatment experience, we found out that the knowledge gap among the low-income residents is the big problem – how to reach out to low-income residents, how to reach out to non-English speakers is very important.

So in our bed bug survey team, many of us are bilingual. So if necessary, we can translate all our materials into other languages, such as Chinese, Spanish, Indian, Hindu, and other languages when necessary. Also, due to extreme pesticide and chemical abuse at higher-than-expected levels, and the quantification of the pesticide residues and associated human health risks related to bed bug-related practices is really important.

Also, education – a critical need for bed bug education and the training for pest management professionals – that's another thing we have to address because based on experience, we've found out some pest management professionals don't really correctly use the products or they don't really use them properly. So training for them is another important step.

Pesticide-resistant bed bugs have been found from coast to coast, and they are posing increasing management challenges for bed bug control. So resistant bed bug management is another important factor that we have to address, and we're considering IPM strategies to control bed bugs.

There are many resources out there, like I said. CDC is good; EPA is good; and also Dr. Changlu Wang's website is good. Also an example is the University of Arizona website; we've posted all the bed bug-related information there, so you can check.

I also would like to thank Dr. Dini Miller, Dr. Changlu Wang, and Dr. Fang Zhu for providing some valuable information in this presentation. Also I'd like to thank my founding agencies, USDA and the EPA and Arizona Pest Management Center for financial support.

This is my contact information. If you have any questions, please feel free to drop me an e-mail; or if you have questions, please come to the Presenter Chat Hours and shoot me a short message and I will answer that. I am looking forward to hearing from you. Thank you.

Thank you to our presenter.

And thank you, everyone, for attending the presentation, Bed Bug Infestations Impact Quality of Life. On behalf of the National Environmental Health Association, thank you for joining us today.