



In a home, where do bed bugs hide?
(Choose the top 3)

- ➔ a.) box springs
- b.) couches / chairs
- ➔ c.) mattresses
- d.) night stand / dresser
- e.) baseboards and moldings
- ➔ f.) head boards and bed frames
- g.) walls / ceilings
- h.) TV remotes
- i.) curtains / drapes
- j.) toilets

History

- 1910 -1940 bed bugs became a community-wide problem in US
- Infestations were worse in poorer, **overcrowded** communities, although wealthy households had problems as well

1941. Three years before World War II, a fumigation crew in a New York City tenement building is shown fumigating a room. The crew members wear protective suits and masks to avoid inhaling the gas. They are using a special device to pump the gas into the room.

Fumigation with hydrogen cyanide

- Common pest in the US at the turn of the century
- Almost eradicated in 1940-50 due to DDT
- Resistance documented to DDT, malathion, carbamates and pyrethroids

Spraying springs of bed with 5% DDT in kerosene for bed bugs. USDA photograph by M. Schuler, October 1943.

- Pull beds away from walls
- Place bed legs in pans of oil
- Application of pyrethrum powder (dried chrysanthemum flowers) dusted between the sheets of a bed
- Vigorous housecleaning, washing bedding/beds
- Dousing slats, springs, and crevices with boiling water or grease from salt pork or bacon

People resorted to extremely dangerous practices


Mercury chloride applied to the mattress using a feather

“Sometimes it is possible to destroy a light infestation by thorough soaking of the bed and other places with high-test gasoline”
Doner and Thomssen 1943

Management relied upon

- Labor intensive
- Detailed work
- Constant monitoring

This is just as true today as it was then, despite technological advances




Resurgence
2001 Arizona

Some communities remain unaware of chemical exposure risks

Beds in school dorms were sprayed with diazinon weekly

Diazinon registration for in-home use withdrawn by manufacturer in 2004




Why have bed bug infestations re-emerged in the developed world?

- Reduction in pesticide use indoors
- Increase in global travel
- Insecticide resistance
- Transient homeless
- Loss of DDT? •— No way!



- Bed bugs feed on the blood of humans, birds and mice
- Saliva can cause a person to itch and cause swelling
- Scratching can lead to infected sores




- Bites may occur in lines - usually on exposed skin




Saliva causes a "sensitivity" to bites


- 5 stages: no reaction; delayed reaction; both immediate & delayed; immediate reaction only; & finally, no visible reaction.
- True hypersensitivity can develop
- Asthma
- Anemia
- Skin lesions (multiple bites)



- Aggregate in cracks and crevices all day
- If hungry they become active between midnight and 5:00 am
- Stimulated by the increase of CO₂ in the room
- Travel many yards to get to host
- Bed bugs detect temperature, CO₂, other chemicals




- Probe the skin to find a capillary space that allows the blood to flow rapidly
- May probe the skin several times before feeding
- Feed for 5-10 min
- After feeding, move to aggregations
- Bed bugs usually feed every 3-7 days



- After feeding adults become interested in mating
- They engage in traumatic insemination
- Females may be mated by many different males
- Females leave aggregations after being mated several times



- Females that mate only once will produce 25% more eggs than multi-mated females
- A single mated female can cause an infestation
- After taking a blood meal females produce 5-20 eggs over ~12 days
- Females produce ~143 eggs in a lifetime



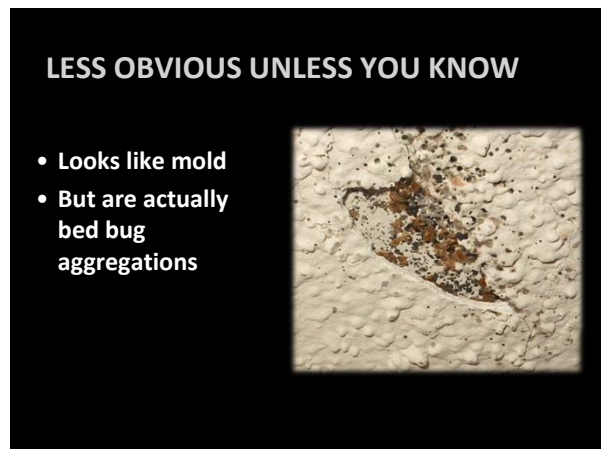
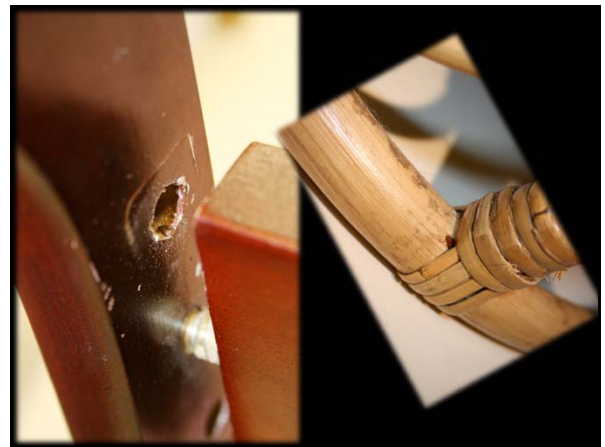
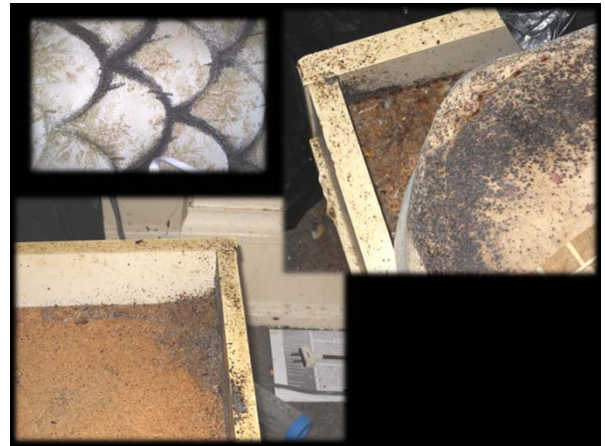
SIGNS

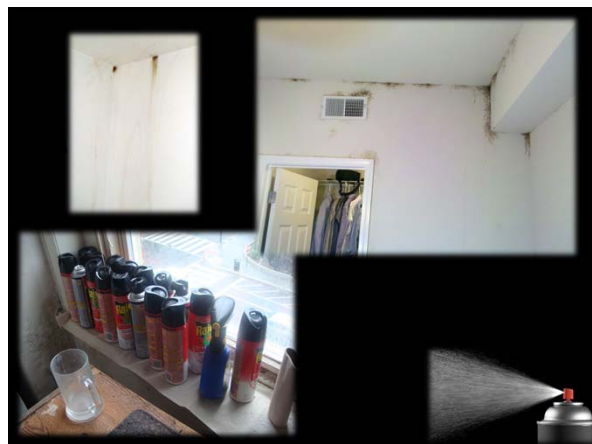
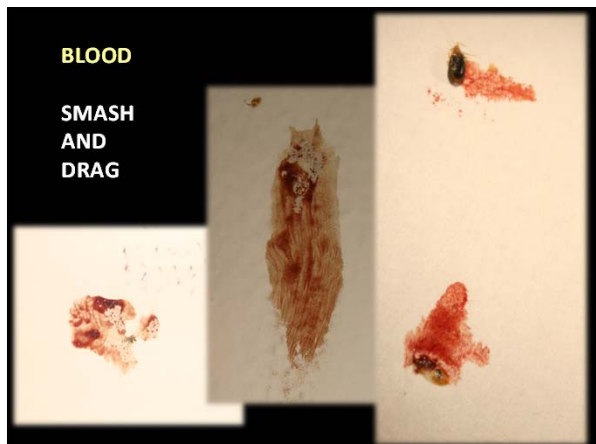
- Excreted digested blood
- Looks like cockroach feces but *feels* flat or smooth




- Frass spots (bed bug poop)
 - Mattress seams and on the tag
 - Wood frame of the box springs
 - Behind the head board
 - Along the tops of baseboards / the edge of carpeting
 - Ceiling / wall junctions behind pictures
 - Electrical outlets
 - In curtain seams










CONTROL

- Multiple applications of insecticides
- Crack and crevice applications
- Resistance to pyrethroid products is very high
- Not all populations are resistant to the same products
- Three general types of resistance occurring

RESISTANCE

- Metabolic enzyme cytochrome p450, helps to break down toxins – one gene variant that confers resistance enables the bed bug to produce large quantities of the enzyme



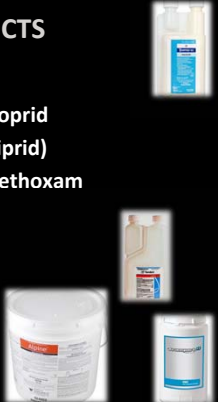
RESISTANCE

- Reduced cuticular penetration – thickening or remodeling of the bed bug cuticle may contribute to decreased insecticide penetration



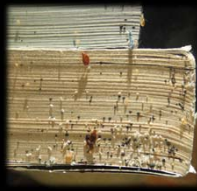
MANY LEGITIMATE PRODUCTS

- Novel pesticide formulations
 - Temprid (β -cyfluthrin & imidacloprid)
 - Transport (bifenthrin & acetamiprid)
 - Tandam (λ -cyhalothrin & thiomethoxam)
- Chlorfenapyr
 - pyrrole; “pro-insecticide”
- Alpine Dust
 - Dinotefuran and DE
- CimeXa
 - Amorphous silica gel





NON CHEMICAL METHODS

- **Becoming the primary methods used in combination with chemical methods**
 - Heat/Cold
 - Vacuuming
 - Mattress encasements
 - Desiccant dusts
 - Other




CANINE DETECTION

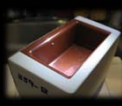
- Excellent detectors
- Can distinguish between live and dead bugs
- Good for lawsuit defense
- Expensive and require constant training
- Are only as good as their handler

ACTIVE MONITORS




NightWatch




Verifi



CDC 3000



2 Bed Bug First Response



BuggyBed



Bed Bug Beacon

PASSIVE MONITORS/TRAPS



4 Climb Up Interceptors



4 Bed Moat



BB Alert




4 CVT BB Trap



6 BB Detection System

VACUUMING

- The value of vacuuming is it makes inspections easier
- Large infestations, harborage areas are filled with live bed bugs, dead bed bugs, molted skins, hatched egg shells, and feces




HEAT KILLS BED BUGS BEST OF ALL!

- Items can be placed in a hot dryer dry for 40 minutes after items are dry
- Washing only, does not kill bed bugs
- Heat box




STEAM CLEANING

- Steam temperature (at the bed bug) **must be 130° F (54° C) or greater**
- The steam head must be large
- Steam power will kill bed bugs and their eggs
- Steaming is slow and labor intensive






HEAT CHAMBERS






WHOLE HOME HEAT

- Propane or electric
- Temperature ~140°F
- Time 4 hours


Cold

- Fragile non-clothing items that cannot be heat-treated in the dryer, and delicate clothing can be sealed in plastic and placed in a freezer for 4 days. Even electronics that have been near or on a bed can be cold-treated.




Cold: Cryonite®

- Bed bugs exposed to CO₂ snow at -42° C. Not widely used in US.
- The snow is pressurized through a nozzle that forms vapors.
- Snow freezes the cells of the bugs.
- This system will not eliminate a bed bug infestation if used alone.




FUMIGATION WITH VIKANE

- Fumigation is generally considered a last resort due to price
- Effective for multi-unit housing
- Residents moving to and from different units
- Sharing of belongings
- Large communal areas

MATTRESS COVERS

- Encasements for both mattress and **box springs!**
- Improved version has a zipper protector sewn in
- Traps bed bugs and eggs, bite proof and escape proof




DESICCANT DUSTS

- Desiccant dusts are ultimately more effective than sprays
- Resistant strains died in ~36 hours
- Diatomaceous Earth – insecticide grade 2-3 days
- Silica dust – 2-3 days
- Lasts unchanged in wall voids for years in low humidity



Desiccant dusts

Best So far



48 hours

Treatment	27% RH	49% RH
DE Insect grade	~50%	~55%
Premix-Quat D-20	~25%	~25%
Alumina Dust	~55%	~75%
Control	0%	0%

DIY stores are not helping

72 hours

Treatment	Adults	Nymphs
DE Insect grade	~80%	~70%
Premix-Quat D-20	~65%	~65%
Alumina Dust	~70%	~40%
Diatom	~70%	~60%
CimexPro	~85%	~95%
Insect killing soap	~75%	~75%
Slingsight	~60%	~45%
Castle Basher	~40%	~35%
Edge-Stamp D	~85%	~85%
Endomethrin and touch fiber	~85%	~85%
Ex-Ex-Stamp D	~55%	~40%
Cyfluthrin Diatomaceous earth fiber	~30%	~15%
Hot Shit bed bug glue filter	~10%	~5%
D1 water	~5%	~5%

TREATMENT PREPARATIONS

- Most PMPs provide preparation instructions
- Instructions make treatments easier for PMP
- Difficult for the resident: laundry bill
- Top complaint is lack of tenant cooperation

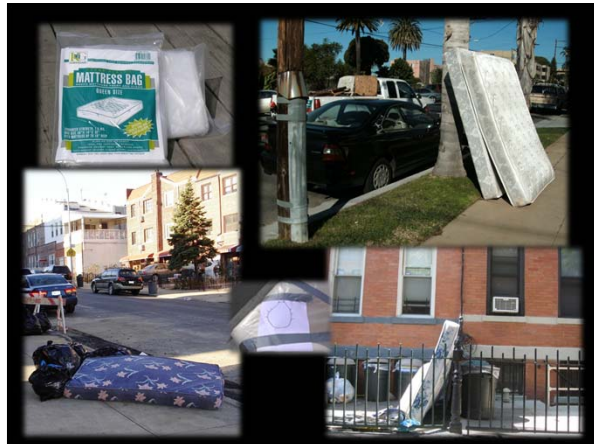


New way of thinking!
Leave the infestation in place

DISPOSAL

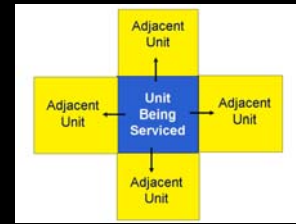
- Wrap and mark items for disposal
- Organize solid waste pick-up





Inspect Neighboring Units

- Bed bugs can crawl to neighboring units through walls, utility pipes and hallways.
- Reported infestations may be coming from a neighboring unit.



Follow-up Service

- 100% elimination of bed bugs is rarely achieved in a single visit.
- A follow-up service is critical: Follow up every two weeks until the bed bugs are eliminated.
- Bug free and bite free after 3 months.



Showering removes bugs from your person



SOCIAL IMPACTS OF BED BUGS


- 2007-2011 data from individuals calling by phone, sending written correspondence, or attending educational / outreach events



- Most commonly used pesticide choices for residents battling bed bugs was **total release foggers**, & **aerosol sprays**
- 9% of residents had applied gasoline on their bed (**one PHA training**)
- 19% of people had attempted non-chemical control
- 31% had used more than two chemicals




- 42% people understand what behaviors put them at risk
- 89% indicated extreme stress, 100% indicated some anxiety
- 4.5% of residents attempted to seal cracks and crevices
- 8.9% had paid a company to remediate the infestation




- Few (>7%) people had no concerns when informed of average remediation costs
- 32% of specimens submitted as bed bugs or possible bed bugs were not bed bugs

\$400-5000

1. Fumigation
2. Heat treatments
3. Pesticides



- Over the counter pesticides used in/on school backpacks
- Children missing school for more than 6 months
- Psychiatric patients refused admission to medical facilities
- Isolation from friends and family
- Bed bug detection dogs providing false positives



- Other observations

Doctors and PA's misdiagnose bed bugs based on bite reactions



In 2012 we developed an on-line survey tool to methodically determine bed bug impacts and analyze the behavioral risk factors associated with bed bug infestations

2014 launch

Bed Bug survey in English:
<http://www.surveymonkey.com/s/DGLQ552>

Bed Bug survey in Spanish:
<https://es.surveymonkey.com/s/F5NZXJK>




Bed bugs in schools





MISUSE – SEVIN DUST

- Grandparents used Sevin Dust to treat bed bugs ... “it worked for someone else”



Number of fatalities US 2009:

Heart disease	779,367
Cancer	568,668
Motor vehicles	36,284
Homicide	16,591
Flu	2,808
Accidental gun	588
WNV	32
Honey bees	~20
Chlorpyrifos &/or pyrophus*	>20 cases
Malaria	4
Bed bugs	0

Number of deaths in US in 2009 = 2,436,682
 * Applied for bed bug control

