

Cockroaches, Bed Bugs, and Public Health



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Outline

1. Cockroaches

- What are cockroaches?
- Health effects

2. Bed Bugs

- What are bed bugs?
- Health effects

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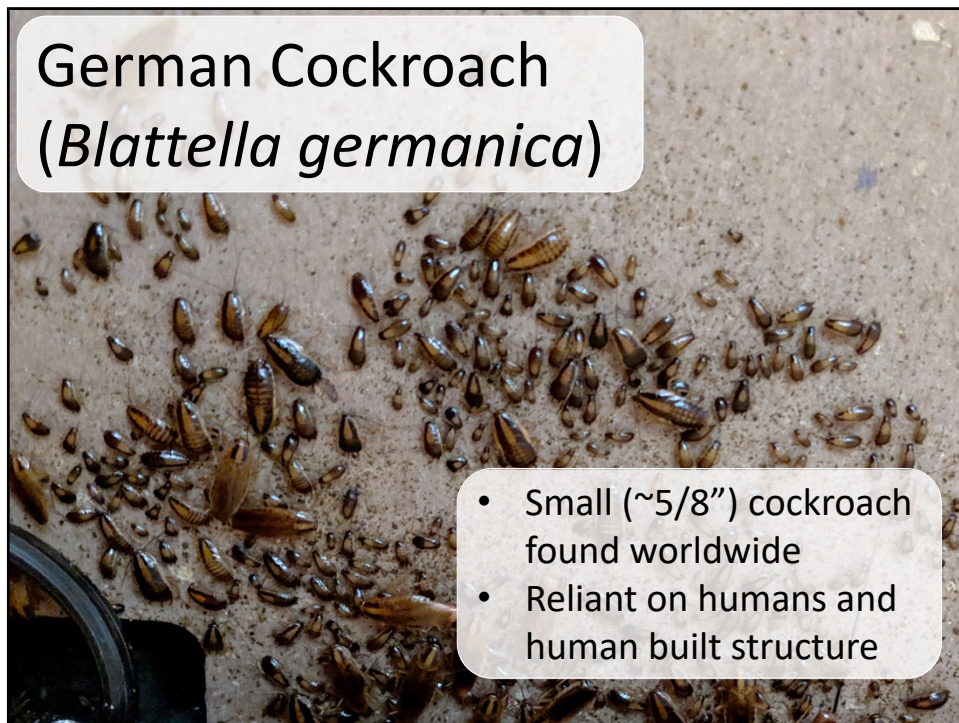
© Patty Alder

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© Coby Schal

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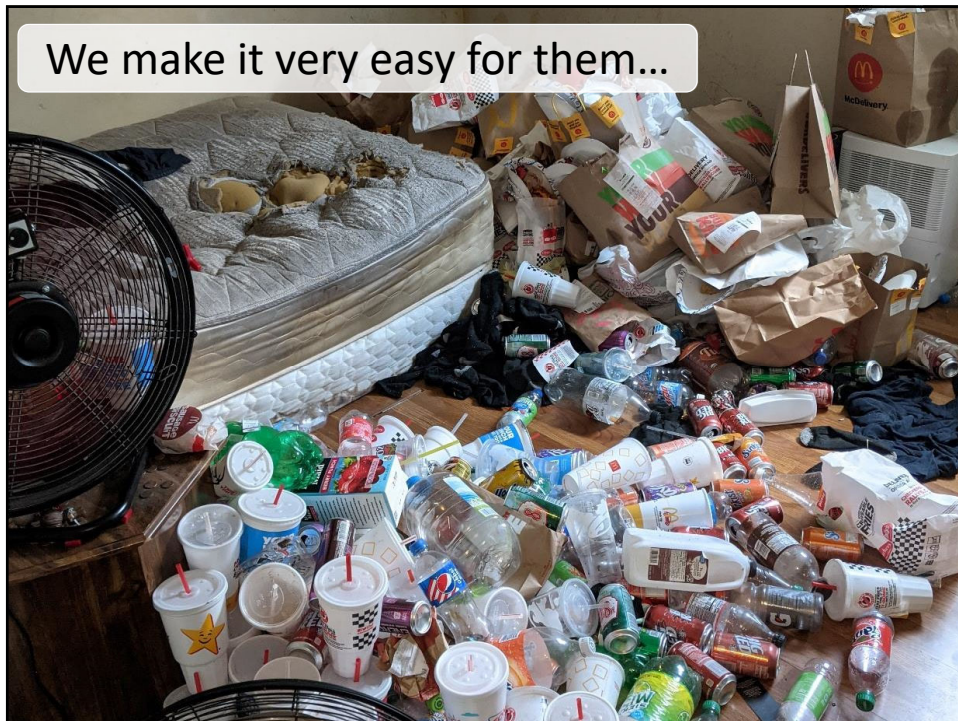
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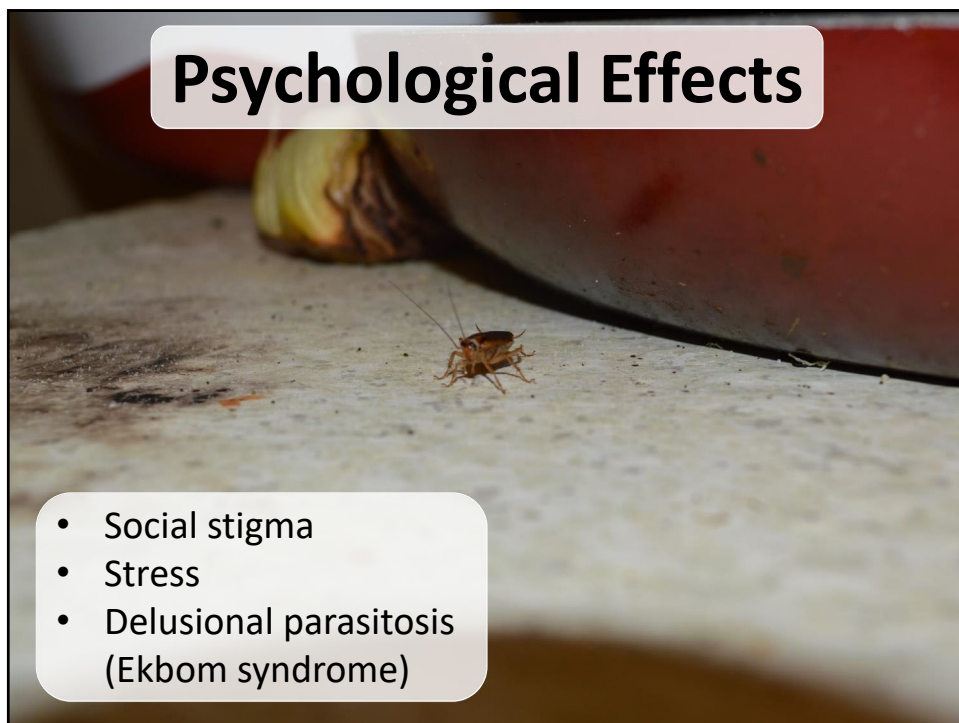


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- Resistant to most spray-based formulations (pyrethroids)
- Baits highly effective when used correctly
- Significant effects on human health

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Psychological Effects

- Social stigma
- Stress
- Delusional parasitosis (Ekbom syndrome)

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Cockroaches and Pathogens



- Mechanical transmission
- Lots of nasty things in garbage and sewage!

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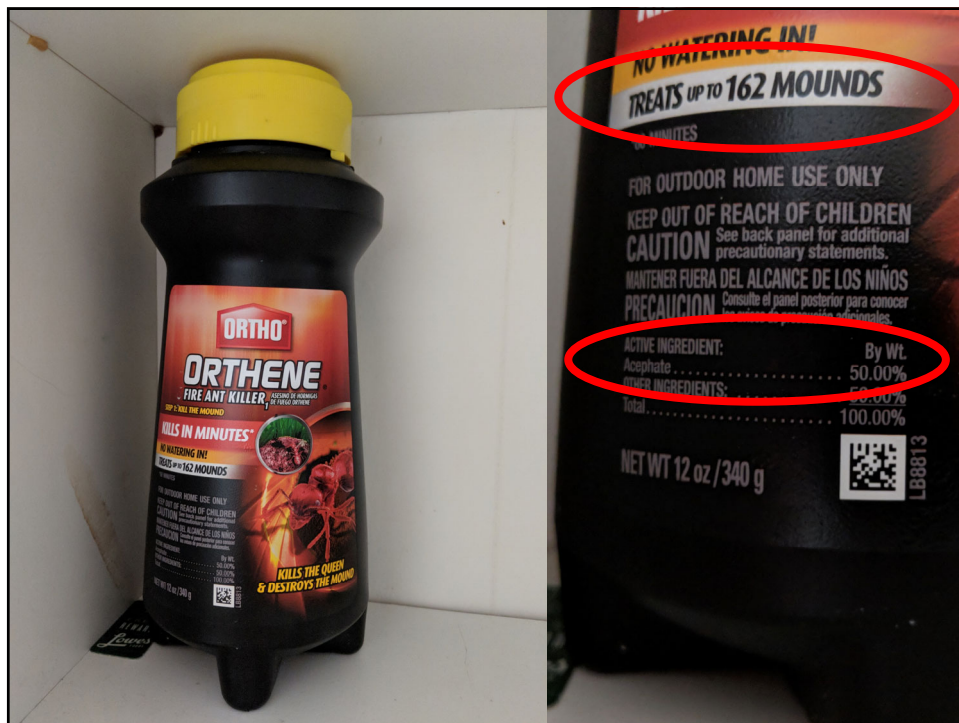
Diseases likely transmitted by cockroaches

- Bubonic plague
- Dysentery
- Diarrhea
- UTI
- Food poisoning
- Gastroenteritis
- Pneumonia
- Diphtheria
- Tuberculosis
- Salmonella
- Leprosy

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Bug bomb explosion causes NYC building collapse

Jul 11, 2013



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NEWS | CRIME + PUBLIC SAFETY

North Hollywood 'bug bomb' explosion breaks windows, knocks doors off hinges

wood 'bug bomb'...



July 10, 2019, at this apartment on the 6400 block of Denny Avenue in North Hollywood, blowing out windows and...

Firefighters went to the 6400 block of Denny Avenue about 10:15 a.m. on a report of an explosion, said Margaret Stewart of the Los Angeles Fire Department.

No injuries were reported, but a Los Angeles police officer who responded to the scene was taken to a hospital in fair condition for treatment of a "medical complaint, likely respiratory irritation," Stewart said.



1 of 4

An officer was affected by fumes from the "bug bomb" explosion on Wednesday, July 10, 2019, in North Hollywood. (Photo by Mike Meadows/Special to the Los Angeles Daily News)

An LAFD hazardous materials squad "used sensitive odor detection equipment and found no existing life hazard in the structure," she said, adding that an Urban Search and Rescue team was summoned to evaluate the structural integrity of the building.

"While there does not appear to be any significant damage to the building as a whole ... they are 'yellow-tagging' the two-story apartment building — denying entry — while awaiting L.A. Building and Safety for their complete evaluation and determination," Stewart said.

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NEWS CRIME + PUBLIC SAFETY

Bug Bombs Hospitalize Three WA Firefighters
 Firehouse.com (press release) (blog) - Jan 17, 2019
 Three Spokane Valley firefighters were hospitalized Wednesday afternoon after being exposed to chemicals from a **bug bomb**. The firefighters ...

Bug bomb mishap hurts 4, blows out windows in Brooklyn
 KTRK-TV - Dec 8, 2017
Bug bomb mishap hurts 4, blows out windows in Brooklyn ... of Buildings, Office of Emergency Management and fire marshals were on scene.

Bug bomb blamed for explosion inside Philadelphia home
 6abc.com - Jun 25, 2019
 Barbera said police, fire, paramedics and the **bomb** squad came to her home after the explosion. She felt short of breath and was checked out ...

'Bug bomb' causes Putney house fire
 The Albany Herald - Apr 12, 2016
 ALBANY — After a **fire** Monday night tore through a house in Putney, officials with the Albany Fire Department said the blaze was caused by ...

Explosion in Apartment Highlights Risks of Using Chemical Foggers to ...
 New York Times - Jul 12, 2013
 "These **bug bombs** are very flammable," Mr. Byrnes said. ... Besides the risk of explosions and fires, he said, there is also the risk of **poisoning**.

doors off

on a report of an explosion,

selection equipment and found no

Urban Search and Rescue team was

to the building as a whole ... they are

entry — while awaiting L.A. Building

Stewart said.

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DeVries et al. BMC Public Health (2019) 19:96
<https://doi.org/10.1186/s12889-018-6371-z>

BMC Public Health

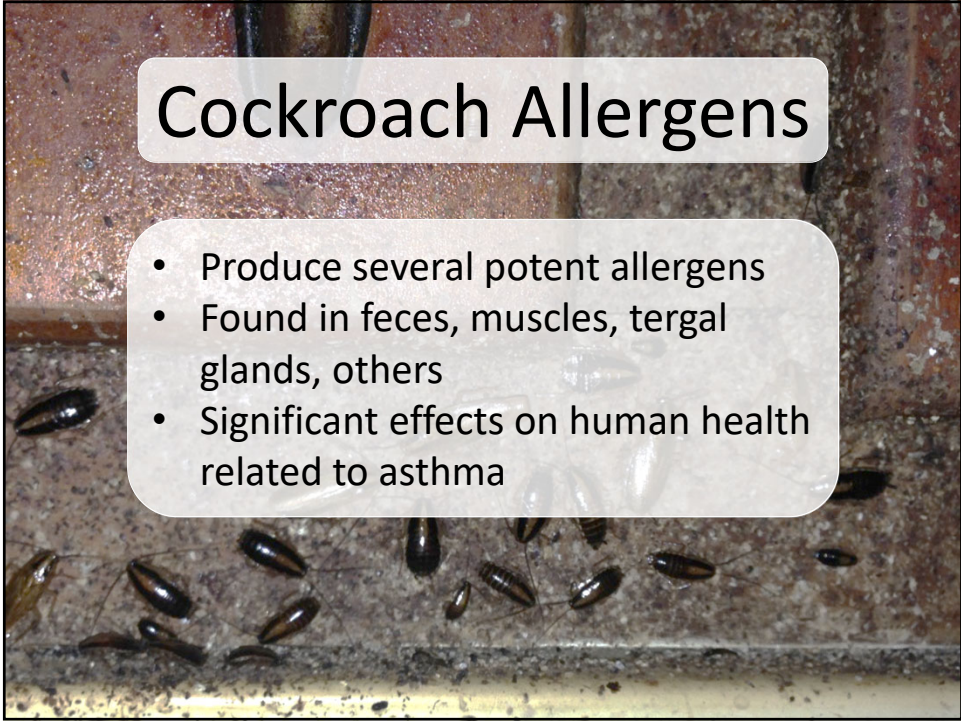
RESEARCH ARTICLE Open Access

Exposure risks and ineffectiveness of total release foggers (TRFs) used for cockroach control in residential settings

Zachary C. DeVries^{1,2,3*}, Richard G. Santangelo¹, Jonathan Crissman^{1,4}, Russell Mick¹ and Coby Schal^{1,2,3}

- TRFs are ineffective and should not be used for cockroach control
- TRFs leave behind high levels of pesticide residues
- Baits are highly effective and are similarly priced to TRFs
- Unclear why TRFs are still being used

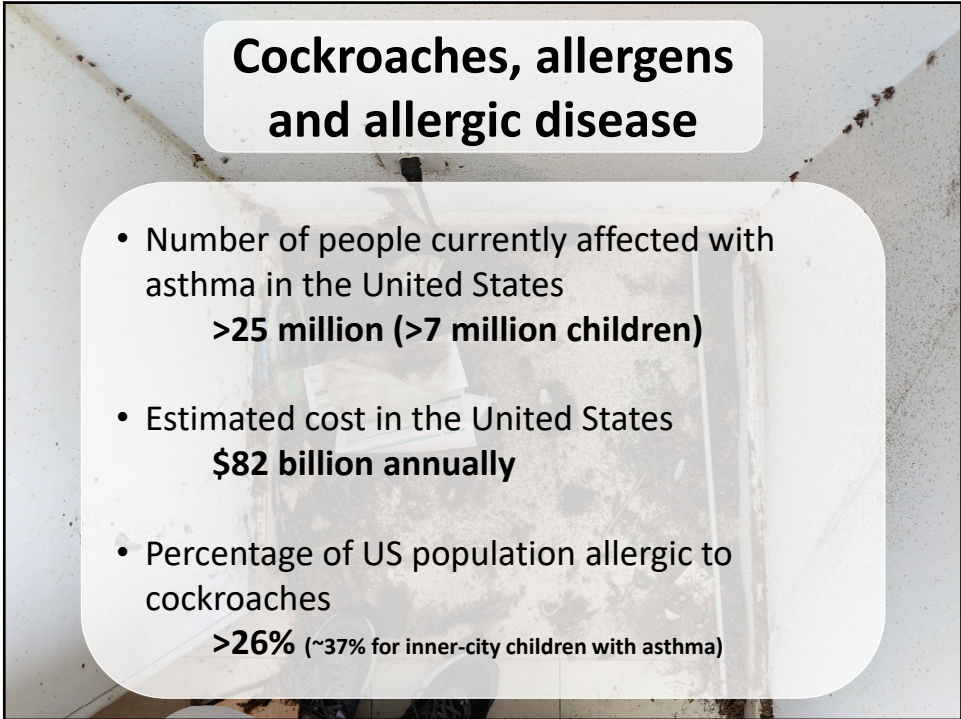
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Cockroach Allergens

- Produce several potent allergens
- Found in feces, muscles, tergal glands, others
- Significant effects on human health related to asthma

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Cockroaches, allergens and allergic disease

- Number of people currently affected with asthma in the United States
>25 million (>7 million children)
- Estimated cost in the United States
\$82 billion annually
- Percentage of US population allergic to cockroaches
>26% (~37% for inner-city children with asthma)

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Asthma Disproportionally Effects Children, Women, Minorities, and those Living in Poverty

- Children have 2x as many ER visits compared to adults
- Asthma associated deaths are 2x higher in women compared to men
- Asthma hospitalization rate is 3x higher among African Americans compared to Caucasians
- Low-income environments were found to be associated with the development of asthma

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Cockroach Allergens

- 1 female = **~156 μg of allergen (Bla g 1) per day!**
- Human Sensitization Threshold = **0.2 $\mu\text{g/g}$ dust**
- Morbidity Threshold = **0.8 $\mu\text{g/g}$ dust**

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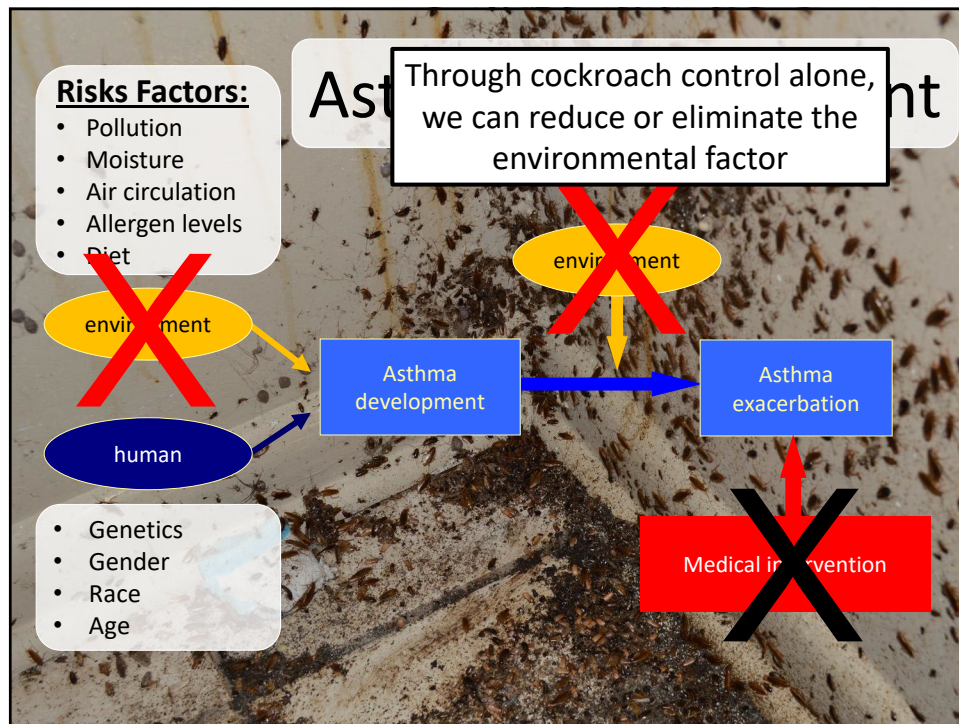


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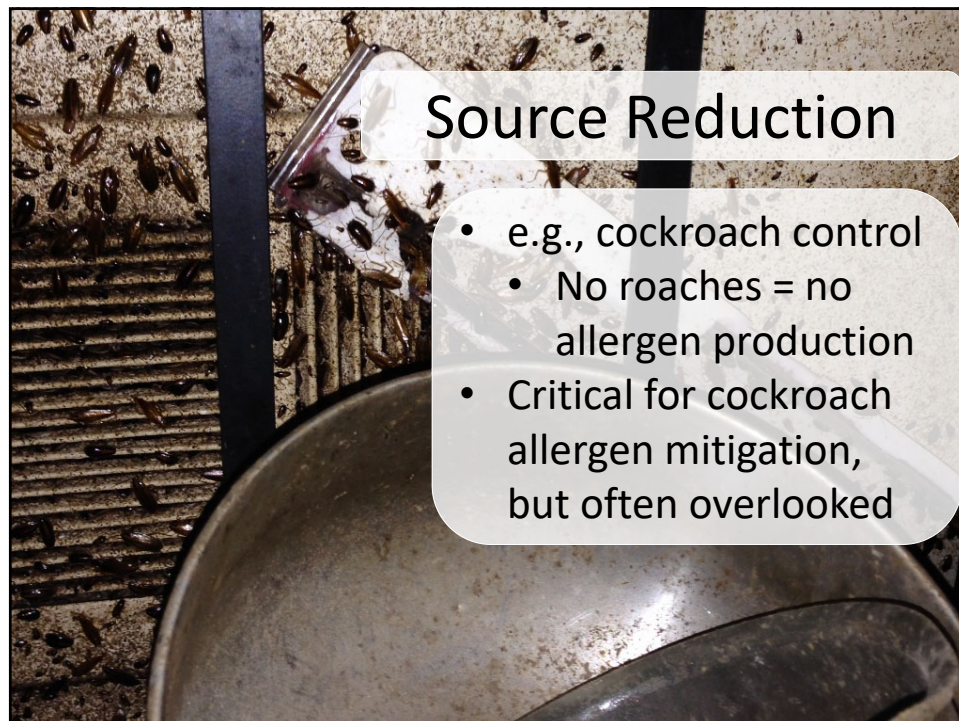
Allergen	MW (kDa)	IgE prevalence (%)	Protein family and putative function	Allergen accession number*
Bla g 1			Digestion	
Bla g 1.0101	46, 21	30–40	Midgut microvilli protein; digestion	AF072219, AF072221
Bla g 1.0102	90	30–40	Midgut microvilli protein; digestion	L47595
Bla g 1.0201	56	30–40	Midgut microvilli protein; digestion	AF072220
Bla g 2	36	55–71	Inactive aspartic protease; digestion	U28863
Bla g 3	78			GU086323
Bla g 4	21			U40767
Bla g 5	23			U92412
Bla g 6				
Bla g 6.0101	17			DQ279092
Bla g 6.0201	17	14–66	Troponin C; muscle	DQ279093
Bla g 6.0301	17	14–66	Troponin C; muscle	DQ279094
Bla g 7	33	13–54	Tropomyosin; muscle	AF260897
Bla g 8	21	16	Myosin light chain; muscle	DQ389157
Bla g 9	40	34	Arginine kinase; metabolism	DQ358231
Bla g 11	57	41–73	α -Amylase; digestion	KC207403
Bla g 12	58	30	Chitinase	KJ789158

Some allergens are cross-reactive among cockroach species

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Can we reduce cockroach allergens by controlling cockroaches?

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Cockroach Control, Education, Cleaning, and Allergen Mitigation

- Recruited cockroach infested homes
50-1000 roaches trapped (highly infested)
- Received intensive interventions:
 - Baiting
 - Education
 - Professional Cleaning

Environmental and occupational disorders

Abatement of cockroach allergen (Bla g 1) in low-income, urban housing: A randomized controlled trial

Samuel J. Arbes, Jr, PhD,^a Michelle Sever, BS,^a Janet Archer, MSc,^b Elizabeth H. Long, BSN,^a J. Chad Gore, MS,^c Colby Schatz, PhD,^a Michelle Wolter, MS,^a Stacy Nuebel, BA,^a Dan Vaughan, MS,^a Herman Mitchell, PhD,^a Eric Liu, BS,^a Nicholas Collette, BS,^a Peter Adler, BS,^a Megan Sandel, MD,^a and Darryl C. Zeldin, MD^a *Research Triangle Park, Durham, Raleigh, and Chapel Hill, NC; and Boston, Mass*

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Insecticidal Baits

- Insecticide inside a food matrix
- Cockroaches ingest the food, then succumb to insecticide

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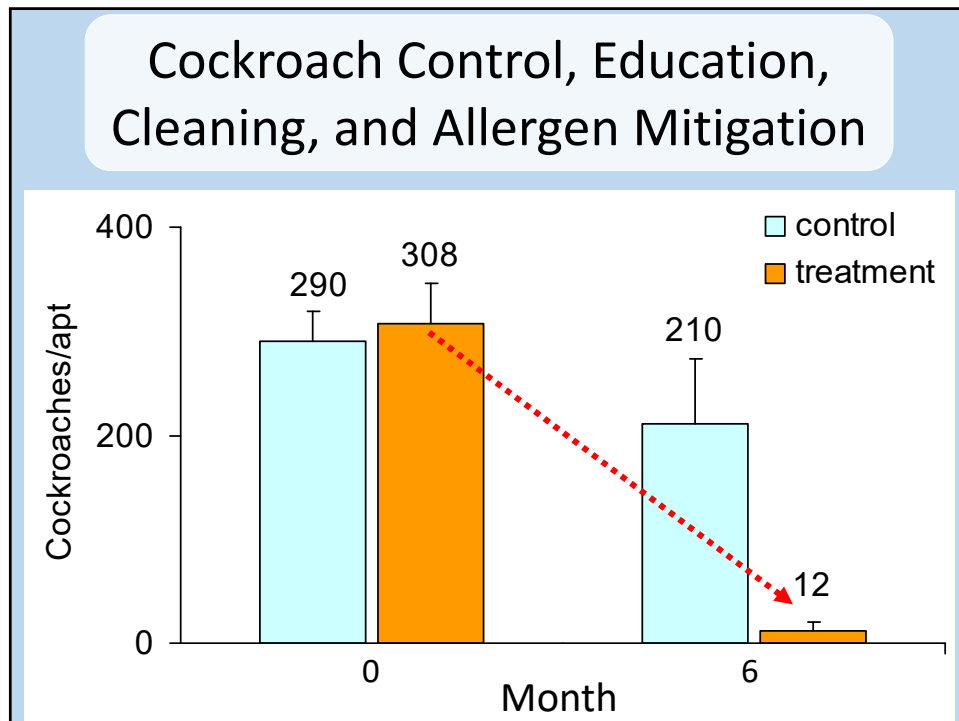
Education

- Importance of sanitation
- Value of traps and routine inspections/monitoring
- Health risks associated with cockroaches

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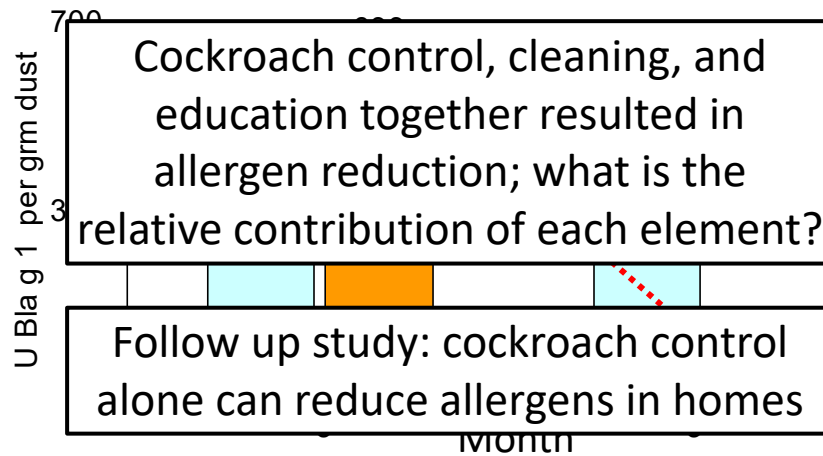


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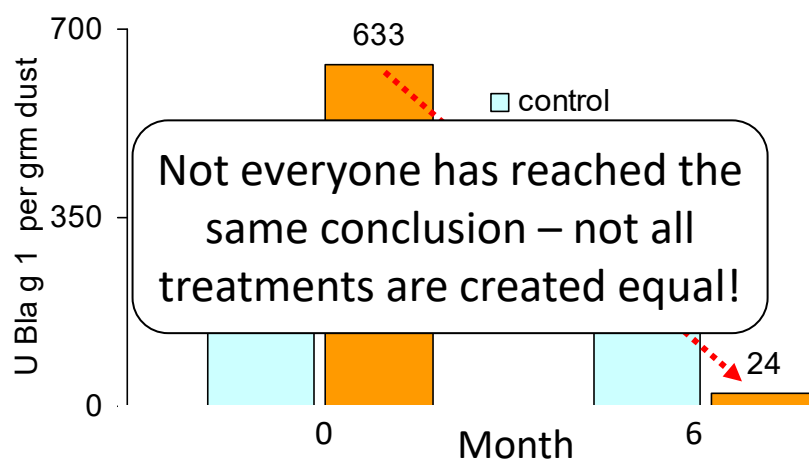
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Cockroach Control, Education, Cleaning, and Allergen Mitigation



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Cockroach Control, Education, Cleaning, and Allergen Mitigation



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Cockroach Control – What Works?

An integrated approach is key!

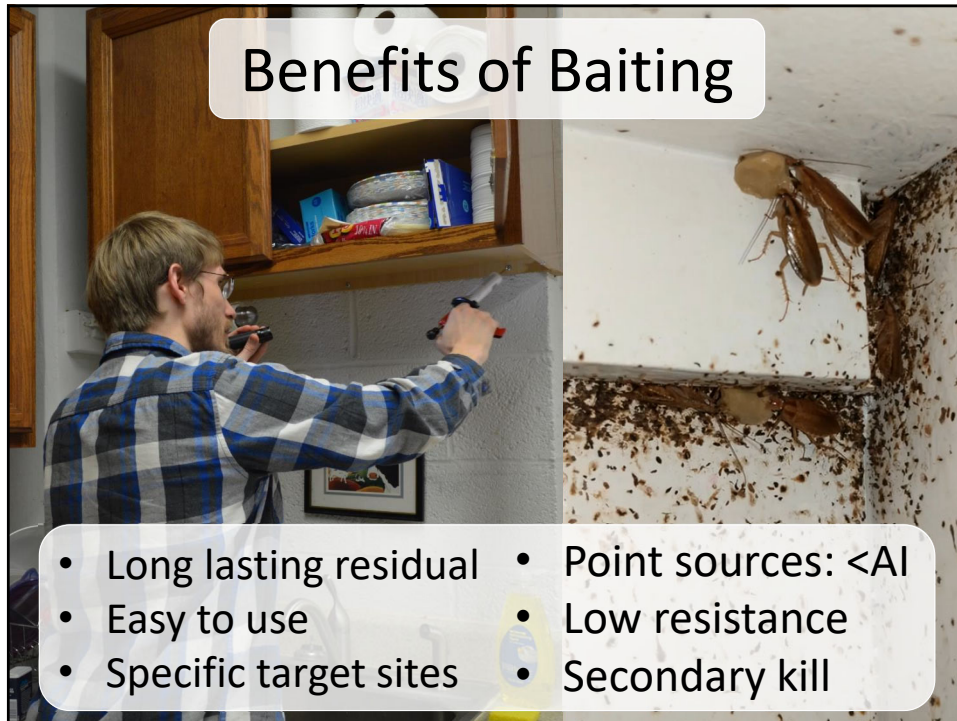
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Residual Insecticides

Poor efficacy due to insecticide resistance

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Benefits of Baiting



- Long lasting residual
- Easy to use
- Specific target sites
- Point sources: <AI
- Low resistance
- Secondary kill

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Why it All Matters: Cockroach Eradication Can Improve Human Health

Environmental and occupational disease

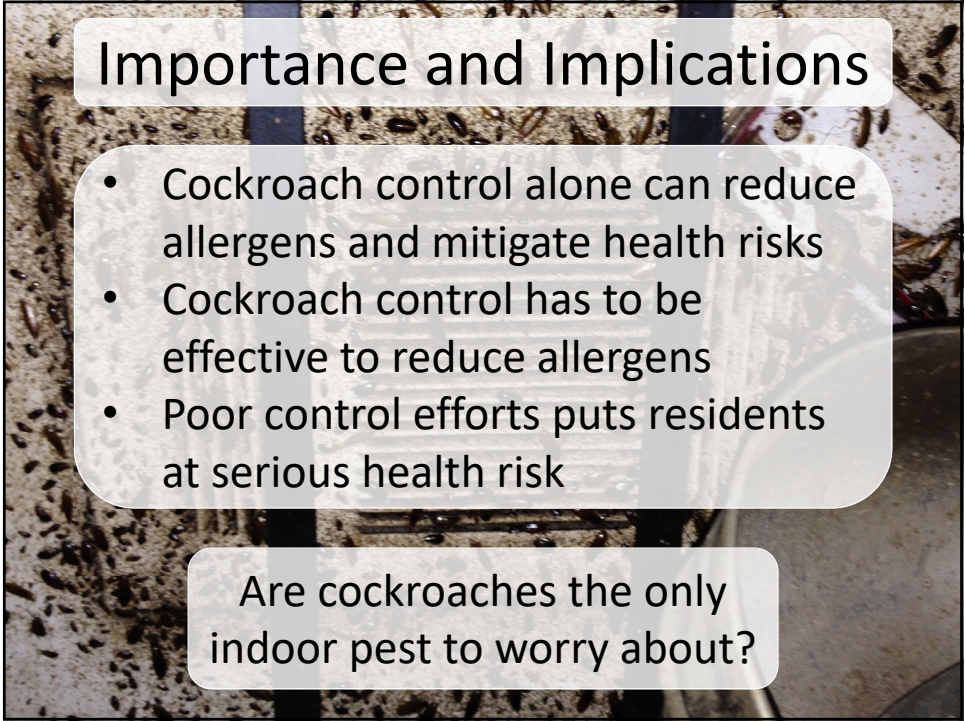
A single intervention for cockroach control reduces cockroach exposure and asthma morbidity in children



Felicia A. Rabito, PhD, MPH,^a John C. Carlson, MD, PhD,^b Hua He, PhD,^a Derek Werthmann, MPH,^a and Coby Schal, PhD^c *New Orleans, La, and Raleigh, NC*

Children in control homes had more asthma symptoms, poorer lung function, and more unscheduled health care utilization

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Importance and Implications

- Cockroach control alone can reduce allergens and mitigate health risks
- Cockroach control has to be effective to reduce allergens
- Poor control efforts puts residents at serious health risk

Are cockroaches the only indoor pest to worry about?

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Recent Resurgence!

- Disappeared in the 1950s, but re-appeared in the early 2000s
- Found everywhere!

Video courtesy of Rutgers University

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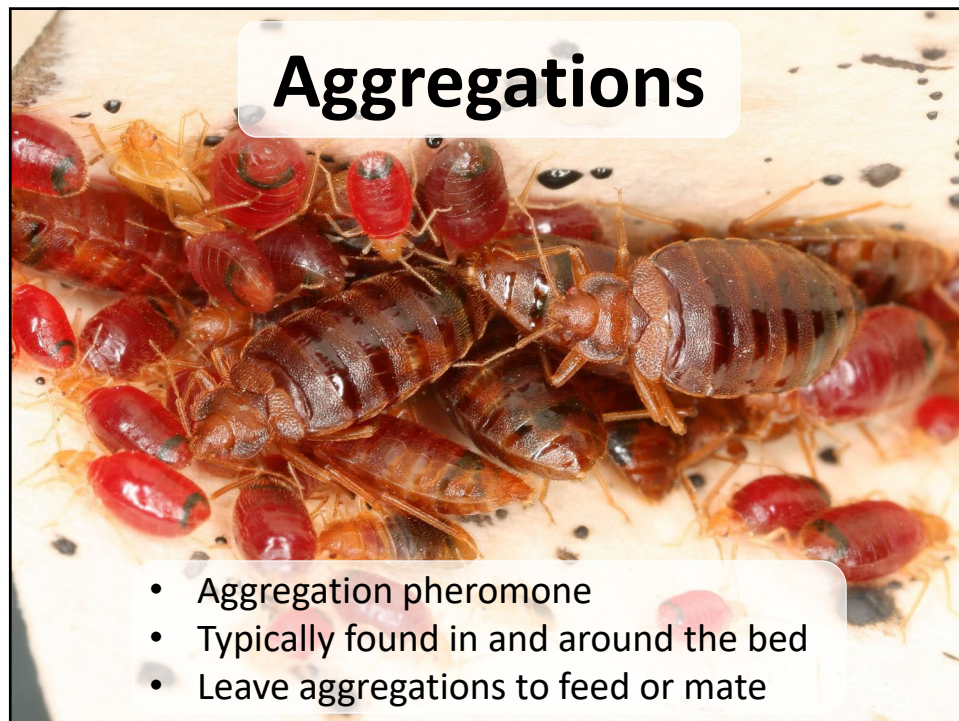
Small, but visible



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Known Effects on Human Health

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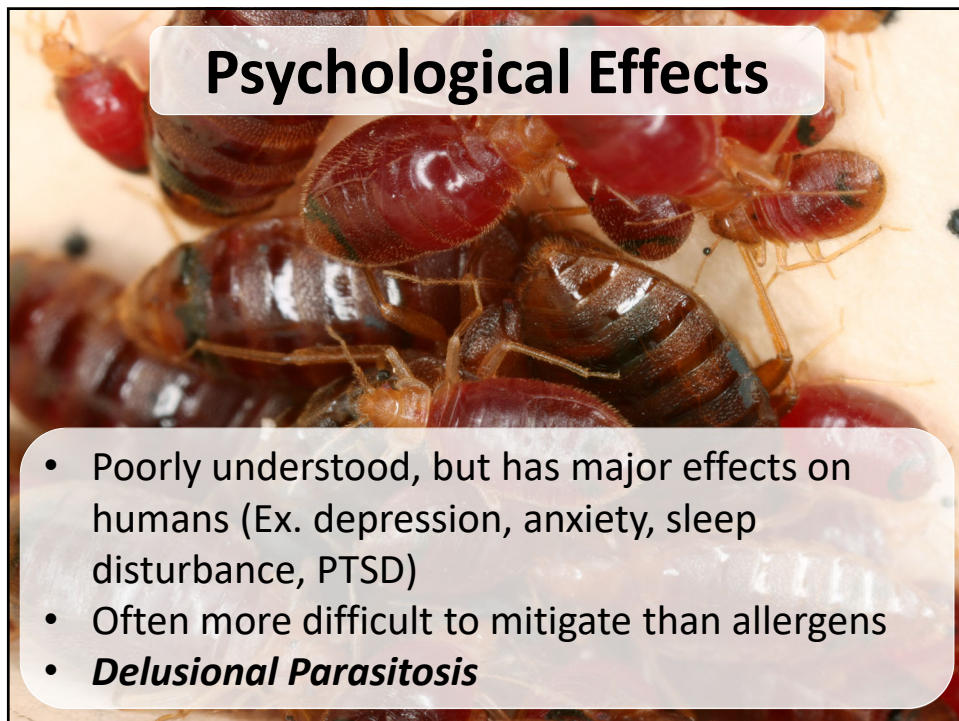
Not known to transmit any diseases in nature!

- Two papers showing POTENTIAL to vector pathogens
- ONLY in the lab

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Psychological Effects

- Poorly understood, but has major effects on humans (Ex. depression, anxiety, sleep disturbance, PTSD)
- Often more difficult to mitigate than allergens
- ***Delusional Parasitosis***

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Do-it-Yourself (DIY) Harm

- Often occurs when residents over- or incorrectly use pesticides (ex. TRFs)
- Most recently, trying to conduct heat treatments on their own

9 ON YOUR SIDE AT NOON
FD: FIRE STARTED WHEN TEEN TRIED TO BURN BEDBUGS
HAWAIIAN TERRACE IN MOUNT AIRY
abc 9 ON YOUR SIDE wcpa.com 12:01 55°

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Angewandte
Chemie

DOI: 10.1002/ange.201409890

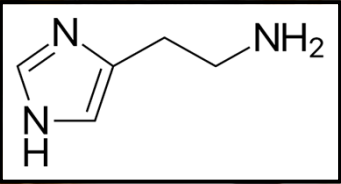
Insect Pheromones

Bed Bug Aggregation Pheromone Finally Identified**

Regine Gries, Robert Britton,* Michael Holmes, Huimin Zhai, Jason Draper, and Gerhard Gries*

Aggregation Pheromone

1. Dimethyl disulfide
2. Dimethyl trisulfide
3. (E)-2-hexenal
4. (E)-2-octenal
5. 2-hexanone
6. Histamine



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Angewandte
Chemie

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The Body's Response to Histamine Release



Aggregation Pheromone

1. Dimethyl disulfide
2. Dimethyl trisulfide
3. (E)-2-hexenal
4. (E)-2-octenal
5. 2-hexanone
6. Histamine

NH₂

DRJOCKERS.COM

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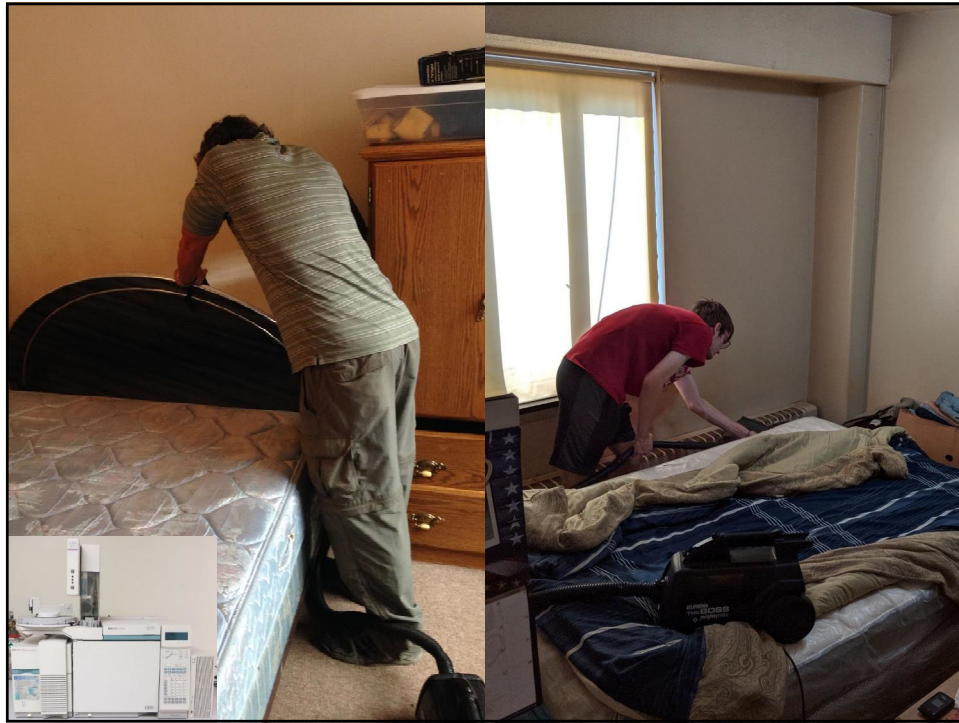
Driving Questions:

1. Does histamine accumulate in household dust?
2. Does histamine persist after bed bug eradication?
3. What is the relationship between indoor histamine and human health?

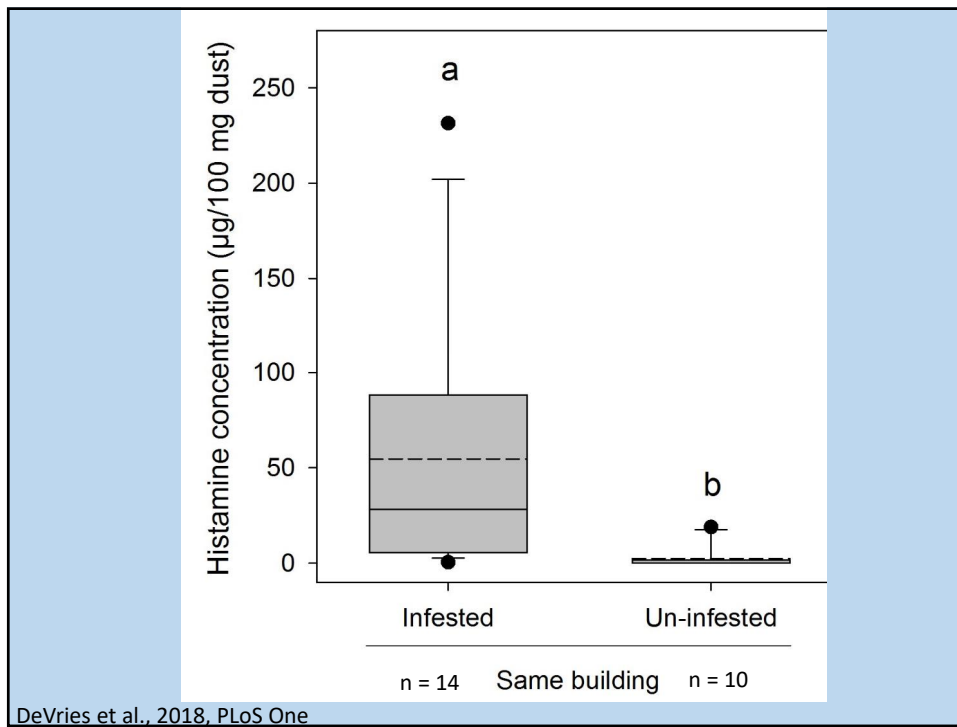
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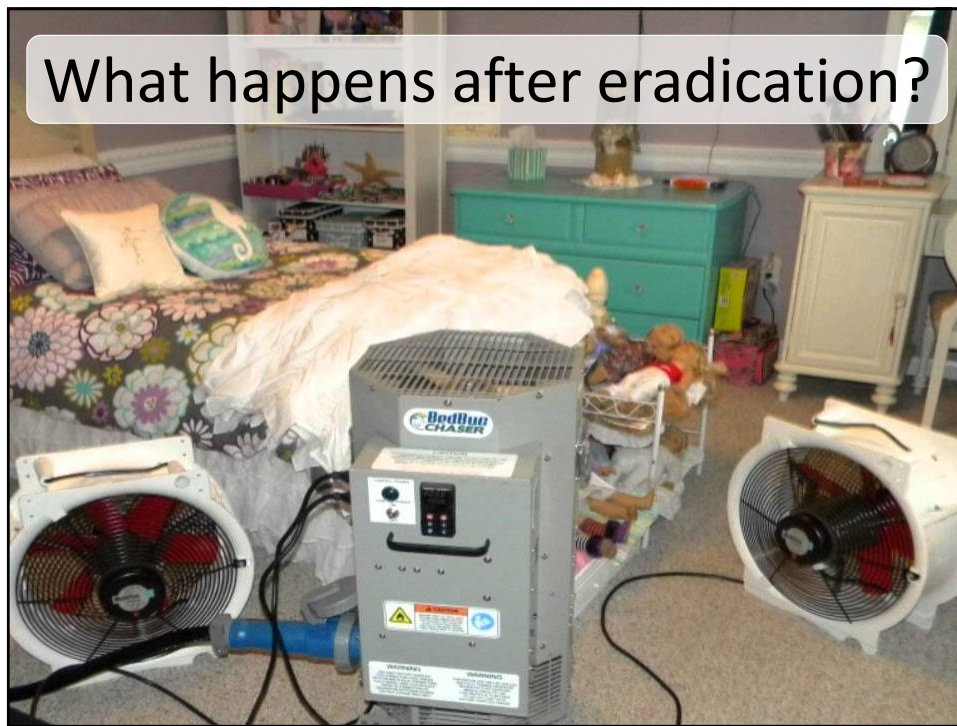
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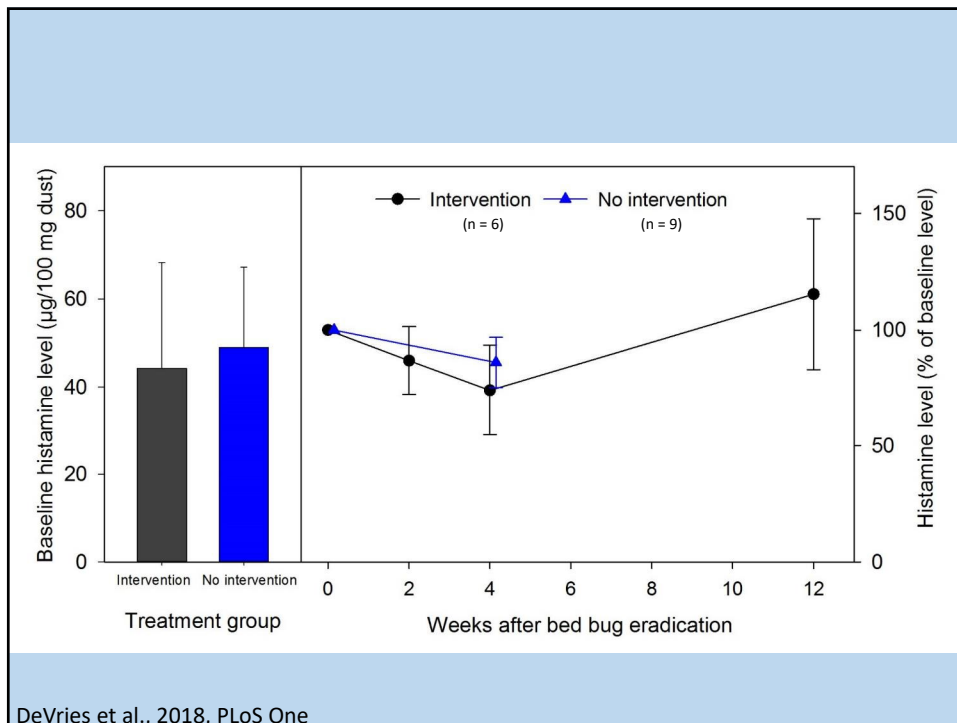
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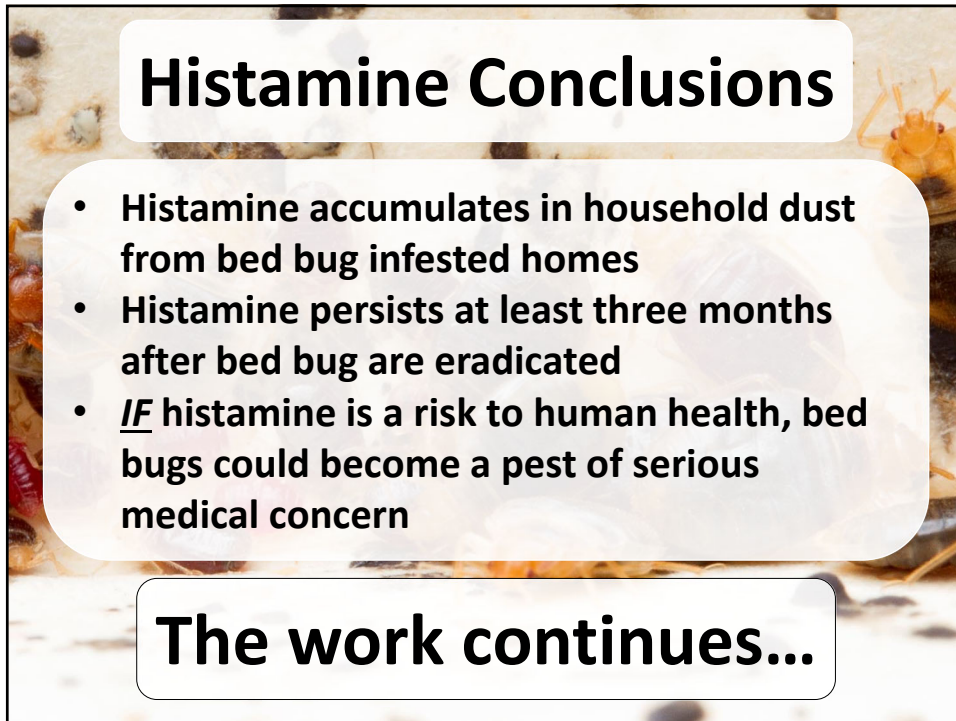
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Histamine Conclusions

- Histamine accumulates in household dust from bed bug infested homes
- Histamine persists at least three months after bed bug are eradicated
- IF histamine is a risk to human health, bed bugs could become a pest of serious medical concern

The work continues...

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Bed Bug Control – What Works?

Call a professional!

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A close-up photograph showing several bed bugs of various sizes (adults and nymphs) on a light-colored, textured surface. Some bugs are dark red, while others are lighter, translucent. A white text box with the word "Prevention" is overlaid on the top right of the image.

Prevention

- Many small things can be done to prevent bed bugs
- Main idea is to change the way we think
- Being alert is perhaps the most beneficial

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A close-up photograph showing bed bugs on a white rope and a blue and white patterned fabric. One large, dark red adult bed bug is prominent in the foreground. A white text box with the words "Early Detection" is overlaid on the top right of the image.

Early Detection

- Bed bugs are commonly found directly in and around the bed when infestations are small

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Practical Tips

- Be aware of your surroundings
 - Watch where you sit/stay!
- Take preventative measures if you suspect you've encountered bed bugs
 - Launder or freeze your belongings
- Regularly inspect your own home
- Use repellents

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Thank You!

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**Always looking
for opportunities
to collaborate!**

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