A modern pest intrusion: Bed bugs and health care

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Meet the bed bug

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A little history… bed bugs in WWII

“BE ESPECIALLY WATCHFUL AT NIGHT AND ALLOW NO ONE TO PASS AT ANY TIME DON'T LET A BED BUG PUT THE BITE ON YOU! SEEK, SIGHT, *** DESTROY!“

Sulfur candle

Opening a can of Zyklon discsoids (HCN) in an army barracks infected with bed bugs during WWII (1943)

Historical bed bug insecticides
- Hydrogen cyanide
- Sulfur
- Mercury chloride
- Rotenone
- Phenol
- Cresol
- Napthalene
- Kerosene
- Pyrethrum
- DDT
- Malathion

Recognizing bed bugs
- 4-5 mm-long (size of apple seed)
- mahogany-colored, wingless, flattened
- Found crawling or hiding in crevices near beds and sleeping areas
Bed bug life cycle

- Incomplete metamorphosis
- Prefer human hosts
- 50-100+ eggs/female typical
- 2 month life cycle with adults living 4.5 months
- May live 4-5 months without a blood meal

Hosts of the human bed bug

- Humans
- Bats
- Poultry
- Mice
- Rats
- Rabbits
- Horses
- Cattle

Bed bug feeding habits

- Prefer feeding during darkness
- Bites painless
- 50% of people with bed bug infestations may not know they are being bitten

The feeding process

Decade of the bedbug

- Infestations increasing globally (est. 100-500% annually)
- Top 8 cities (Orkin 2016)
  - Baltimore
  - Washington, DC
  - Chicago
  - New York
  - Columbus, OH
  - Los Angeles
  - Detroit
  - Cincinnati, OH
  - ...#15 Dallas

NYC Bed bug complaints – Department of Housing and Preservation Development

Bed bug frequency of occurrence by housing type (NYC)
Why the problem?

- Resurgence likely due to multiple factors
  - Increased international travel (1.1 billion international travelers in 2014)
  - Loss of organophosphate and carbamate insecticides
    • (AChE inhibitors)
  - Resistance to pyrethroid insecticides
    • (a-sonic Na-channel blockers)

Pyrethroids and DDT

- Bed bugs highly controlled with DDT (1940s), but resistance documented within 8 years
- Today, resistance well-documented and widespread to DDT, pyrethroids (both act at same nerve target site)
- Pyrethroids remain primary control tool for bed bugs in industry

Is the bed bug a public health pest?

- “Bed bugs cause a variety of negative physical health, mental health and economic consequences”
  - Mild to severe allergic reactions to bites
  - Bites can lead to secondary infections
  - Mental health impacts
    • Insomnia
    • Anxiety
    • Systemic reactions

http://www.cdc.gov/nceh/ehs/Publications/Bed_Bugs_CDC-EPA_Statement.htm

Is the bed bug a public health pest?

- EPA’s primary concern regards “registration of pesticides to ensure that when used to control pests, they do not harm people or the environment.”
Is the bed bug a public health pest?

- “CDC recognizes that very limited research has been conducted on bed bugs during the past several decades and encourages increased bed bug research to determine the causes of the resurgence, the most effective methods of control and the potential for bed bugs to transmit disease.”

Bed bugs and infection

- BBs found carrying ~45 human diseases--no scientific evidence that field transmission has ever occurred (Goddard & deShazo 2009, Lai et al. 2016)

Bed bugs and HIV

- HIV can be detected in BBs up to 8 days
  - No viral replication
  - No virus detected in BB feces
- One candidate for human disease transmission is hepatitis B virus (HBV)
  - BB collected in So. Africa, Senegal, Egypt, Ivory Coast and China were HBV surface antigen +
  - Unable to transmit HBV to chimpanzees
  - Successful 2 year BB eradication program in Gambia had no effect on rates of HBV infection

Bed bugs and Chagas disease

  - showed efficient and bidirectional transmission of T. cruzi between mice and bed bugs in laboratory.

Bed bugs and Bartonella quintana (trench fever)

  - Bed bugs can acquire and maintain B. quintana for > 2 weeks and release viable organisms into feces

Conclusion

- “To date, no published study has demonstrated a causal relationship between bed bugs and infectious disease transmission in humans”
- “Despite the fact that ...[no] definitive evidence exists...studies [which show that] B. quintana and T. cruzi may survive in laboratory conditions are worrisome.”
Other health effects

• Cutaneous reactions
  – Most common reaction: barely visible puncture with slight reddening
  – Most common noticeable reaction: 2- to 5-mm pruritic maculopapular, erythematous lesions
  – Complex reactions include papular urticaria, bullous rash
  – Timing can vary

• Systemic reactions
  • Few studies
  • Reports include
    – Generalized urticaria
    – Asthma
    – Anaphylaxis

Other health effects

• Anemia
• Secondary infections
  – Impetigo
  – Ecthyma
  – Lymphangitis
• Other pathogens?

Lowe & Romney letter

• 3 patients from downtown eastside Vancouver, BC hospitalized with bed bugs
• High rate of drug use and community-acquired MRSA infections
• 5 bed bugs tested positive for drug-resistant organisms
  – MRSA
  – VRE (vancomycin-R Enterococcus faecium)
• A “plausible potential mechanism for passive transmission during a blood meal”

Mental health impact

• Mental effects
  – Anxiety
  – Insomnia
  – Other systemic effects?
• Complications with delusions of parasitosis

• Over half of consumers calling for bed bug service do not have bed bugs
  – Pest misidentification
  – Illusions of parasitosis
  – Delusions of parasitosis
Definition

- delusions of parasitosis (DOP) - aka Ekbom's Syndrome (1938). A type of somatic delusion in which the victim falsely believes that insects (or other arthropods) are crawling on, biting, or burrowing in the skin.

Typical samples from a sufferer of DOP

- Numerous samples from floor, bed, skin, wash water, vacuum bags, etc.
- Often very detailed descriptions
- Much time devoted to sample

Bed bug management issues

Challenges with bed bugs

- Hiding places diverse
  - 50% on or around bed
  - Upholstered chairs, sofas, nightstands, dressers, other furniture
  - Baseboards, under carpet tack strip, any small cracks, behind posters, clocks, etc.
- Replacing mattress more of a problem than a solution
  - Mattress and box spring encasements the answer

Challenges with bed bugs

- Bed bugs are excellent hitchhikers
  - Suitcases
  - Clothing
  - Backpacks
- Highly mobile within buildings

Challenges with bed bugs

- Control is expensive
  - Labor-intensive
  - Expensive ($500 - $1500+/apartment)
  - Requires 2-3+ visits for success
- Current pesticides not highly effective
IPM tactics for bed bugs

- Pesticides
- Mechanical controls (barriers)
- Physical controls (heat, cold)
- Pest proofing / Sanitation
- Education and Awareness

IPM for bed bugs is a process

- Education
  - Training
  - Certification
- Inspections / Monitoring
  - Building wide
  - Visual inspections and traps in all suspect units
- IPM Actions
  - Non-chemical or minimal insecticide
  - More aggressive insecticide protocol
  - Heat treatment

Bed bug monitoring options

- Visual inspections
- Pitfall traps
- Dogs

Bed bug feet

- Cockroach feet adapted for smooth or rough surfaces
- Bed bug feet lack pads for smooth surfaces

How an interceptor trap works

- Smooth, talcum powdered plastic unclimbable for bbs
- Bb drawn to bed climbs rough outside of cup, falls into moat

Climbup Interceptor
Socio-economic issues

- Bed bug treatment expensive
- Apartment associations writing pre-lease agreements and require tenants to pay for treatments
- System rigged to discourage renters from reporting bed bugs

Bed bugs in hospitals

- Infestations can occur, but not common
  - Reproducing, self-sustaining population of bed bugs
- Hospital introductions increasingly common
  - Patients arriving from infested environments bring isolated bed bugs

Protocols for hospitals

- For patient with bed bugs
  - Isolate belongings (plastic totes or clear plastic bags)
  - Bath patient
  - Wash or dry clothing on high temperature

- For suspected infestation in room
  - Vacuum and encase mattresses
  - Inspect bed, visitor chairs
  - Install bed bug monitors in room
  - Consider CO2 monitor trap
  - Insecticides should be rarely (if ever) needed
    - Silica aerogel dust
    - Alcohol-sprays (Sterifab®)
    - Botanical sprays
      - EcoRaider™
      - Bed Bug Patrol™
Protocols for home health workers

- Risks of picking up bed bugs relatively low...
  BUT if possible
  - Avoid sitting on upholstered furniture
  - Avoid placing purses, backpacks, other containers on or next to upholstered furniture
  - Carry-in supplies in plastic vertical-sided totes or other smooth sided carrier

Roles of public health professionals

- Understand the bed bug crisis
- Understand the role of bed bugs in mental health issues
- Understand socio-economic constraints
  - Better coordination with social service agencies
- Be able to implement common-sense protocols for staff and facilities

Resources

- Insects in the City website http://citybugs.tamu.edu
- Do-it-yourself control options
  - http://citybugs.tamu.edu/fact-sheets/biting-stinging/others/ent-3012
- EPA bed bug site
  - http://www.epa.gov/pesticides/bedbugs

References on bed bugs and human disease


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Questions?

http://insectsinthecity.blogspot.com