

**Stephen L Doggett**

BSc, PestContCert, MASM, is Senior Hospital Scientist, Department of Medical Entomology, ICPMR, Westmead Hospital, New South Wales. stephen.doggett@swahs.health.nsw.gov.au

Richard Russell

BSc, MSc, PhD, FACTM, is Professor and Director of Medical Entomology Department of Medical Entomology, University of Sydney, Westmead, New South Wales.



Bed bugs

What the GP needs to know

Background

Since the mid 1990s, there has been a global resurgence of bed bugs (*Cimex* spp.), which are blood feeding insects that readily bite humans. Patients suffering with bite reactions are increasingly presenting to medical practitioners.

Objective

This article reviews the various clinical consequences of bed bug bites and outlines management strategies.

Discussion

Common dermatological responses include the early development of small macular spots that may later progress into prominent wheals accompanied by intense itching. Patients exposed to numerous bed bugs can present with a widespread erythematous rash or urticaria. Bullous eruptions are not uncommon and anaphylaxis has been reported, albeit rarely. There is no evidence that bed bugs transmit human pathogens, but they are responsible for significant psychological distress, can produce anaemia when abundant, and have been implicated in the triggering of asthmatic reactions. Symptomatic control involves treatment of the patient with antihistamines and corticosteroids, and ensuring that the infestation responsible for the problem is effectively eliminated.

■ **From an early age, the term 'bed bug' is indelibly lodged into our psyche, yet as one journalist recently suggested, for most of us, they are just a 'mythical creature from a childhood nursery rhyme'.¹ However, these insects are very much real and since the mid 1990s there has been an unprecedented global bed bug pandemic. Australia has not been excluded and infestations have risen by an incredible 4500% between 2000 and 2006.²**

So why are these insects such a problem? Bed bugs bite and have a propensity for human blood, and this usually produces some form of skin reaction and irritation. With the growing resurgence, it is likely that more patients with bed bug bites will present to general practitioners.

Pathophysiology

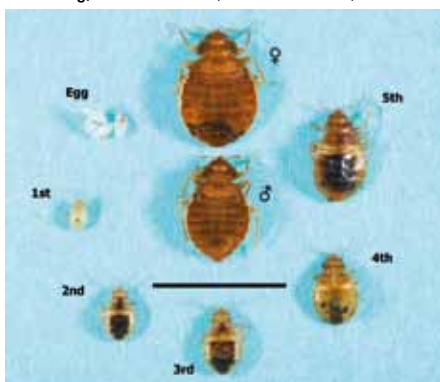
Bed bugs belong to the same order of insects (Hemiptera) that includes common garden plant pests such as aphids and cicadas. The difference with bed bugs is that the family that they belong to (Cimicidae) has evolved to become exclusively haematophagous, ie. blood feeders. Bed bugs are wingless, roughly oval in shape and flattened. The adults have a deep brown colouration, are around 5–6 mm in length when unfed (*Figure 1*), and not dissimilar to the size and colour of an apple seed. There are five juvenile stages, with the youngest being around 1 mm and having a light cream appearance, but progressively becoming darker and larger as they develop.

There are two species that have been introduced to Australia and both bite humans: the common bed bug, *Cimex lectularius*, and the tropical bed bug, *Cimex hemipterus*.²

In the early part of the current resurgence, bed bugs were most likely to be encountered in commercial accommodation with high guest turnover, such as at popular tourism destinations, with people often transferring the insects home via luggage. However, since then, bed bugs have spread to the wider community and infestations have occurred in such diverse locations as trains, charter boats,



Figure 1. The various life stages of the common bed bug, *C. lectularius* (the bar = 5 mm)



cinemas, hospital wards and clinic waiting rooms, staff and student accommodation, and brothels.³ Over the past 3 years, there has been a large rise in bed bug infestations in low income housing, often involving thousands to tens of thousands of bed bugs in a single infestation. Indications of an infestation include unexplained bite reactions, dark spotting on the bed from faecal deposition, and presence of the insects themselves (*Figure 2*).

Clinical presentation

With the re-emergence of bed bugs, there have been several recent reviews of the dermatological reactions caused by bed bugs⁴⁻⁷ and a contemporary clinical experimental investigation.⁸ These papers should be referred to for greater detail.

The mouthparts of bed bugs are especially adapted for piercing skin and sucking blood. During feeding they inject saliva, which has anticoagulant properties and contains protein fractions that can produce various allergic reactions in humans. It is not known if the two bed bugs species produce different clinical reactions. Blood feeding typically occurs at night and often the bites are not noticed until the appearance of a clinical reaction, which can occur some days later. For some, the bite itself is painful and can result in a restless night's sleep,⁹ which can affect the victim's work performance during the day.

It has often been quoted that around 20% of people will show no clinical reaction to the bite;¹⁰ however, such figures have been based on limited data.⁸ In a recent study by Reinhardt et al,⁸ it was found that 11 out of 24 people had no dermatological reaction to a bed bug bite on first exposure. With further bites, most (18/19) developed an obvious clinical skin reaction and the latency period for those that previously reacted decreased substantially. This particular research focused on acute exposure, yet investigations on chronic exposure are virtually nonexistent. In one very small trial, a researcher exposed himself to multiple bed bug feedings over 6 months and failed to become sensitised.¹¹ From the observations of the first author of this article, many individuals in low income housing who are chronically exposed to bed bugs are often unaware that an infestation is present. Whether this is due to a failure of individuals to become sensitised, or that many have become desensitised, or that some have not made

Figure 2. One of the most commonly encountered sites for bed bugs is, as the name implies, on beds. Insects typically harbour along mattress beading. Dark faecal spotting is an indication that bed bugs are or have been present



Figure 3. Bite marks the morning after being bitten by bed bugs; the marks appear as faint, red macular spots



the cognitive link between the bites and bed bugs, is unknown. Clearly more research is needed in this area.

The most commonly affected areas of the body are the arms, shoulders and legs, ie. those that tend to be not covered while sleeping. Reactions to bites may be delayed, with up to 9 days or more before lesions appear.¹² Often the first sign of bed bug bites are small indistinct red macular spots (*Figure 3*), which may later develop into the classic bed bug wheal. These wheals are usually greater than 1 cm (up to 20 cm) across,⁴ and are accompanied by itching and inflammation (*Figure 4*); they usually subside to red spots and can last for several days. It is often reported in the literature that lines of bites may occur and this can be seen in *Figure 4*. However, most bites do not occur in a linear pattern and when they do, it is not known if this is caused by one or by several different bugs. Bites from a large number of bed bugs can present as a widespread erythematous rash or urticaria¹³ (*Figure 5, 6*), which can be chronic if the infestation remains uncontrolled.¹⁴ Bullous eruptions (*Figure 7*) are not uncommon,¹⁵⁻¹⁸ and these may be accompanied by a systemic reaction of fever and/or malaise.¹⁹ Anaphylaxis has been reported in patients with a severe bed bug allergy, although it appears to be rare.²⁰ Like any skin irritation, constant scratching of the bite site can lead to infection and ulceration.²¹



For a haematophagus arthropod, bed bugs take a relatively large blood meal. While it takes many hundreds of bites for even the loss of one millilitre of blood, in India, iron deficiency in infants has been associated with severe infestations,²² and there was a recent report from Canada of severe anaemia in a man aged 60 years due to multiple bed bug bites.²³

Another medical condition suggested to be associated with bed bugs is asthmatic reaction brought about by exposure to the allergens of the insect;^{24,25} not dissimilar to the situation with dust mites. However, such studies are limited and require further investigations.

Differential diagnosis

Misdiagnoses of bed bug bites have been well documented and have included:

- scabies²⁶ (which should always be confirmed by a skin scraping)
- antibiotic reactions
- food allergies
- hives
- mosquito bites
- spider bites
- Staphylococcus infections, and
- chicken pox.²⁷

In one case of a severe allergic reaction that led to anaphylaxis, the patient was initially diagnosed with a coronary occlusion.²⁰ Misdiagnosis often results in inappropriate medical interventions, such as the use of scabicides,²⁶ biopsy of the bite site, and various blood tests,²⁷ with obviously no useful result forthcoming. Unfortunately, insect bites are generally poorly described and categorised and the bite reaction can vary tremendously from individual to individual, even with the same biting pest. Therefore diagnoses of bed bug infestations from only the bite reactions are unreliable. If bed bugs are suspected, then a thorough inspection of the sleeping areas of the patient by an experienced pest manager

Figure 4. This is the same patient as Figure 3, 4 days later. The classic bed bug wheal can be seen, along with the linear pattern of bites that sometimes is apparent with multiple bed bug bites



Photo courtesy Dr Nigel Hill, London School of Hygiene and Tropical Medicine

Figure 5. Urticarial papular bite reactions from bed bugs 4 days after exposure and involving hundreds of bites over the body



Figure 6. This 4 year old girl was bitten by hundreds of bed bugs. There were so many bites on the front lower abdomen that there was the appearance of a broad erythematous rash rather than individual bites



should always be undertaken to confirm the presence of the insect, and to exclude other possible biting arthropods such as fleas, mites (especially bird and rat mites), mosquitoes, ticks and midges.

Infectious diseases

As bed bugs are blood feeders, many people have been concerned that the insects could be capable of transmitting infectious agents like so many other haematophagus arthropods such as mosquitoes and ticks. Indeed, bed bugs have been suspected of the transmission of more than 40 human pathogens.⁷ However, the reality is that currently there has not been a single proven case of an infectious agent passed on to humans by bed bugs.²⁸

Mental health impact

One aspect of the medical affects of bed bug bites that is almost never addressed is the significant psychological distress caused by the bites. This is a very real health problem and should not be ignored. There is an apparent stigma associated with bed bugs that relates the insect with poor housekeeping and hygiene,²⁹ even though five star hotels do not escape infestations. Often when people learn that there is an insect in their bed that is biting them at night, they are horrified and disgusted. This can develop into a delusory state, whereby



Figure 7. Bullous eruptions on the hand and ankle following bed bug bites



the patient feels bites and insects crawling on them, even if the bed bugs have been eliminated for some time.³⁰ As bed bugs often bite on the face and neck, the resulting bite marks can affect an individual's self esteem and possibly interfere with employment performance or prospects. Another aspect of how bed bugs impact on the mental health of people relates to the trauma of the cost of eradication, which can be from hundreds to thousands of dollars per infestation.

Treatment

Despite the dramatic increase in exposure of the human population to bed bugs, to date the literature examining treatment of patients with bite reactions is extremely limited. Also as noted above, it is not possible to determine from the bite reaction alone if the cause is actually bed bugs. For this reason, the general recommendation for treatment is similar to that for other biting arthropods, and usually involves the use of antihistamines and topical and/or systemic corticosteroids.⁷ The clinical review by Goddard and de Shazo⁷ should be consulted for more information on treatment.

Bed bug control

Bed bugs are considered one of the most challenging of all insect pests to control due to the high degree of insecticide resistance they have developed. The cryptic behaviour of the insects means that they are difficult to detect and treat, and thus building treatments can be expensive of labour and chemicals. As such, control should only be undertaken by an experienced pest manager who uses the principles of management as set out in 'A Code of Practice for the Control of Bed bug Infestations in Australia'.³¹ This code can be freely downloaded at www.bedbug.org.au.

Conclusion

As bed bugs are not known to transmit infectious diseases, most regional and local health authorities do not strictly consider them to be a health issue. Clearly, however, they are a community health problem. Bed bugs produce variable irritating skin reactions and are responsible for considerable mental anguish, as well as being

a major economic imposition on the community. Unfortunately, such an apathetic stance by health authorities can allow the bed bug resurgence to continue and become an increasing problem in more communities. As a result, more medical practitioners will be consulted by more victims of bed bug bites.

Summary of important points

- Bed bug infestations are becoming increasingly common.
- Bed bugs are blood feeders that produce variable skin reactions in humans.
- Clinical symptoms may include macular spots, wheals, erythematous rashes, urticaria and bullous reactions, all accompanied by intense itching.
- Bed bugs are not known to transmit human pathogens but are responsible for considerable physical irritation and often psychological distress.
- Control involves treating both the patient's symptoms and elimination of the infestation.

Conflict of interest: none declared.

Acknowledgment

Dr David Mitchell, Senior Staff Specialist, Centre for Infectious Diseases and Microbiology, Westmead Hospital, kindly reviewed a draft of the paper.

References

1. Tucker J. 'Don't let the bedbugs bite' is apt in Pueblo, Colo. Knight Ridder/Tribune Business News 2003; May 21:1.
2. Doggett SL, Russell RC. The resurgence of bed bugs, *Cimex* spp. (Hemiptera: cimicidae) in Australia: Experiences from down under. In: Robinson WH, Bajomi D, editors. Proceedings of the 6th International Conference on Urban Pests. Budapest: Executive Committee of the International Conference of Urban Pests, 2008;407–25.
3. Doggett SL. The resurgence of bed bugs. In: Doggett SL, editor. Bed bug workshop. AEPMA course notes. Sydney: The Department of Medical Entomology, Westmead Hospital, 2009;39–60.
4. Cleary CJ, Buchanan D. Diagnosis and management of bedbugs. *Nurse Practitioner* 2004;29:47–8.
5. Thomas I, Kihiczak GG, Schwartz RA. Bedbug bites: A review. *Int J Dermatol* 2004;43:430–3.
6. Poorten MC, Prose NS. The return of the common bed bug. *Ped Dermatol* 2005;22:183–7.
7. Goddard J, deShazo R. Bed bugs (*Cimex lectularius*) and clinical consequences of their bites. *J Am Med Assoc* 2009;301:1358–66.
8. Reinhardt K, Kempke D, Naylor R, Siva-Jothy MT. Sensitivity to bites by the bedbug, *Cimex lectularius*. *Med Vet Ent* 2009;23:163–6.
9. Pinto L. Bed bugs...they're back. *Pest Cont* 1999;67:10–2.
10. Krueger L. Don't get bitten by the resurgence of bed bugs. *Pest Cont* 2000;68:58–64.
11. Goddard J, de Shazo R. Multiple feeding by the common bed bug, *Cimex lectularius*, without sensitization. *Midsouth Entomol* 2009;2:90–2.
12. Sansom JE, Reynolds NJ, Peachey RDG. Delayed reaction to bed bug bites. *Arch Derm* 1992;128:272–3.
13. Scarupa MD, Economides AE. Letter to the editor: Bedbug bites masquerading as urticaria. *J Allergy Clin Immunol* 2008;117:1508–9.
14. Borts MR. *Cimex lectularius* (bedbug) bites presenting as chronic urticaria. *J Allerg Clin Immunol* 2006;2:S310.
15. Kinnear J. Epidemic of bullous erythema on legs due to bed bugs. *Lancet* 1948;2:55.
16. Tharakaram S. Bullous eruption due to *Cimex lectularius*. *Clin Exp Derm* 1999;24:241–2.



17. Fletcher CL, Ardern-Jones MR, Hay RJ. Widespread bullous eruption due to multiple bed bug bites. *Clin Exp Derm* 2002;27:74–5.
18. Leverkus M, Jochim RC, Schäd S, et al. Bullous allergic hypersensitivity to bed bug bites mediated by IgE against salivary nitrophorin. *Soc Invest Dermat* 2006;126:91–6.
19. LieboldK, Schliemann-Willers S, Wollina U. Disseminated bullous eruptions with systemic reaction caused by *Cimex lectularius*. *E Acad Derm Vener* 2003;17:461–3.
20. Parsons DJ. Bed bug bite anaphylaxis misinterpreted as coronary occlusion. *Ohio Med J* 1955;51:669.
21. Potter M. Battling bed bugs in the USA. In: Robinson WH, Bajomi D, editors. *Proceedings of the 6th International Conference on Urban Pests*. Budapest: Executive Committee of the International Conference of Urban Pests, 2008:401–6.
22. Venkatachalam PS, Belavady B. Loss of haemoglobin iron due to excessive biting by bed bugs. A possible aetiological factor in the iron deficiency anaemia of infants and children. *Trans R Soc Trop Med Hyg* 1962;56:218–21.
23. Pritchard MJ, Hwang SW. Severe anemia from bed bugs. *CMAJ* 2009;181:287–8.
24. Abou Gavra ESM, El-Shayed FA, Morsy TA, Hussein HM, Shehata ESZ. The relation between *Cimex lectularius* antigen and bronchial asthma in Egypt. *J Egypt Soc Parasit* 1991;21:735–46.
25. WanZhen F, KaiShong Y. A clinical study of the relationship between bed bugs and allergic asthma. *Chin J Vect Biol Cont* 1995;6:54–7.
26. Stevens K. Sleeping with the enemy. *NY Times* 2003;25:5.
27. Gooch H. Editorial: Bed bug issue might separate the professional from the not-so-professional. *Pest Cont Buzz Online News* 2008. Available at www.pestcontrolmag.com/pestcontrol/article/articleDetail.jsp?id=109597 [Accessed 24 June 2008].
28. Goddard J. Do bed bugs carry human diseases? A controversy. *Pest Cont Tech* 2003;31:38–40.
29. Thompson J. Bed bug. Agfacts. New South Wales Department of Agriculture information leaflet, 1983.
30. Vandam J. Sleep tight, and don't let...Oh, just forget about it. *New York Times* 2003; Nov 2:14.6.
31. Doggett SL. A code of practice for the control of bed bug infestations in Australia. Draft 3rd edn. Sydney: Department of Medical Entomology and The Australian Environmental Pest Managers Association 2007. Available at http://medent.usyd.edu.au/bedbug/cop_ed3_draft.pdf [Accessed 1 October 2009].