

In the Clinic

Common Cutaneous Parasites

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CME Objective: To review current evidence for diagnosis, treatment, and prevention of common cutaneous parasites.

The information contained herein should never be used as a substitute for clinical judgment.

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Although the ancestors of cutaneous parasites appeared over a 150 million years before mammals, they have maintained a presence in the human population since the latter's evolution (1). In modern history, these organisms have thrived in more densely populated and impoverished areas of society. Although these organisms are not deadly, they are a significant cause of morbidity. Further, some may serve as vectors of more pernicious diseases, such as the rat flea in transmission of *Yersinia pestis* and the plague. As these parasites are often not immediately visible on physical ex-

amination, providers need to have a high index of suspicion to

identify and treat infested patients.

Clinical Overview

According to the Centers for Disease Control and Prevention (CDC), "A parasite is an organism that lives on or in a host and gets its food from or at the expense of its host" (www.cdc.gov/parasites). This review will focus on the biology, clinical presentation, and treatment of the more common skin parasites that providers may encounter in the clinic: scabies, bedbugs, lice, and fleas.

Scabies is a parasitic infection in humans caused by the *Sarcoptes scabiei* var. *hominis* mite. Incidence increases during the winter when overcrowding is more common (2). *Cimex lectularius*, better known as the bedbug, is a human parasite that is becoming more prevalent, possibly due to pesticide resistance, increased travel, inadequate public awareness, and poor pest control programs in the United States (3).

Louse infestation in humans is generally site-specific and is caused by 3 types of sucking lice: the head louse (*Pediculus humanus capitis*), the body louse (*Pediculus humanus humanus*), and the crab or pubic louse (*Phthirus pubis*) (4). Lice are wingless and cannot jump. Thus, they are transmitted through crawling during direct, close contact.

Fleas are 1- to 3-mm wingless insects that are capable of distant jumps. They infest domestic and feral animals; however, they have low host specificity and can transfer from animals to humans.

Are there particular patient populations or living situations in which adults should be screened for common cutaneous parasites?

Any patient with pruritic excoriated papules or vesicles should be evaluated for cutaneous parasites.

Scabies

Scabies are strongly associated with resource-poor communities, in which overcrowding and poor living conditions are most prevalent. Scabies infection is a significant cause of morbidity in the developing world, with an occurrence rate reported to be as high as 46% (5).

Elderly persons, sexually active young adults, and homeless individuals may be especially susceptible to scabies infestation. Pet dogs are the most common animal vector to transmit to humans, but cross-infection between different host species is usually limited. Animal-transmitted scabies typically have shorter incubation periods, have more limited distribution, and are more likely to be self-limited (2). People living in institutional settings, such as prisons, skilled nursing facilities, and chronic care units, are at increased risk (3).

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Crusted scabies, formerly known as Norwegian scabies, is caused by the same mite as classical scabies but develops in patients whose immune system is unable to control mite replication (most commonly those with a defective T-cell response) or in persons who have reduced sensation, neurologic disorders, or physical/mental debilitation (and thus reduced ability to mechanically debride the mites by scratching), leading to the development of mite hyperinfection (4, 6). Whereas a typical scabies infection may involve fewer than a dozen mites at any one time, patients with crusted scabies may have a burden in the millions (7). These populations include institutionalized, elderly, and immunosuppressed (e.g., HIV, human T-cell lymphotropic virus 1, leukemia, or organ transplant) individuals (2, 8).

Bedbugs

Bedbugs can occur in virtually any patient, but persons at higher risk include those who have recently stayed

overnight in a new home, hotel, hospital, or dorm room (9).

Lice

Girls between 3 to 12 years of age and their close household contacts are at elevated risk for head lice infestation because of increased opportunities for hair-to-hair contact. Head lice infestation is common in the United States and occurs across all social and geographic boundaries. Pediculicide sales suggest that head lice affect 6–12 million people per year in the United States, although this could be an inflated number because some people may purchase these products without confirmed infestation (10).

Body louse infestation is rare in developed countries but has reemerged in urban homeless populations in the United States. Body lice affect populations in overcrowded living conditions, such as shelters, refugee camps, and jails. In contrast to head lice, body lice are more common in adults. Body lice are associated with transmis-

Table. Infestations Leading to Systemic Illness

Vector	Pathogen	Disease	Clinical Findings
Body louse	<i>Borrelia recurrentis</i>	Relapsing fever	Episodes of relapsing fevers (up to 40° C), chills, headaches, myalgia, arthralgia, anorexia, neurologic symptoms, bleeding, purpura
	<i>Bartonella quintana</i>	Trench fever	Five-day relapsing fever with severe and persistent pain in legs, may lead to sepsis and endocarditis if untreated
		Bacillary angiomatosis	Vascular, tender nodules/papules with a smooth or eroded surface resembling pyogenic granulomas, usually in immunocompromised patients
<i>Ctenocephalides felis</i> (cat flea)	<i>Rickettsia prowazekii</i>	Epidemic typhus	Febrile exanthem
	<i>Bartonella henselae</i>	Cat scratch disease	Unilateral, tender lymphadenitis with fever, headache, fatigue, anorexia
		Bacillary angiomatosis	Vascular, tender nodules/papules with a smooth or eroded surface resembling pyogenic granulomas, usually in immunocompromised patients
	<i>Rickettsia typhi</i>	Endemic (murine) typhus	Fever, headache, macular/papular rash on trunk, arthralgia, gastrointestinal and respiratory symptoms
<i>Xenopsylla cheopis</i> (rat flea)	<i>Rickettsia felis</i>	Rickettsiosis	Headache, lethargy, macular/papular rash, inoculation site eschar
	<i>Yersinia pestis</i>	Plague	Fever, painful lymphadenitis, fluctuant necrotic lymph nodes (buboes), disseminated intravascular coagulation and sepsis if untreated
	<i>Rickettsia felis</i>	Endemic (murine) typhus	Fever, headache, macular/papular rash on trunk, arthralgia, gastrointestinal and respiratory symptoms

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sion of several gram-negative infections (Table).

Crab lice are usually sexually transmitted. Although infestation occurs in all socioeconomic classes, men seem to be more commonly affected than women (11), and incidence negatively correlates with the number of years of formal education and socioeconomic level (12). The crab louse attaches to pubic hairs but can also attach to other hairs in adjacent areas, such as the abdomen, buttocks, perianal skin, and legs. Less commonly, it may attach to the scalp, eyelashes, and eyebrows. *P. pubis* infestation of eyelashes or eyebrows in children may be a sign of sexual abuse; transmission may also occur through body hairs or shared fomites in the absence of abuse. Up to 30% of patients with crab lice have one or more concurrent sexually transmitted infections (13).

Fleas

The 3 most common species of fleas associated with human infestations are *Ctenocephalides felis* (cat flea), *Ctenocephalides canis* (dog flea),

and *Xenopsylla cheopis* (rat flea) (14). Owing pets or working with animals increases risk for infestation (i.e., puliculosis). Hidden rodents in the home or wild animals in the vicinity have also been associated with puliculosis (15).

Should schools screen for head lice?

The American Academy of Pediatrics (AAP) does not recommend routine school screening for head lice in asymptomatic children because it has not been shown to significantly reduce the long-term incidence of head lice in educational settings (16). Routine school-wide screening for head lice can be costly, impractical, and disruptive. If head lice infestation is found in a classroom, the AAP encourages providers to educate parents on how to diagnose and manage the condition (i.e., with a fine-toothed comb and pediculocide shampoo) (10).

Screening for body lice may be warranted in homeless populations or in persons living in crowded conditions once an infestation has been identified. However, there is a dearth of data supporting

screening. Interestingly, a French study showed that prompt identification and treatment, as well as improved hygiene, did not decrease prevalence of body lice infestation (14, 17). Asymptomatic patients are typically not screened for crab lice.

Clinical Overview... Contacts of persons who have scabies or head or body lice

CLINICAL BOTTOM LINE

should be screened for infestation. School-wide

screening for head lice is not recommended. Screening for pubic lice is not typically done in sexual contacts of affected patients, although patients should notify their partners. Domestic animals and rodents may be a reservoir for flea infestation and thus should be treated or prevented from coming in contact with patients.

Diagnosis

Is clinical diagnosis sufficient or are laboratory tests sometimes needed?

Scabies

The diagnosis of scabies is primarily dependent on the physical examination of the patient and the

history of both patient and close contacts (8). Clinical diagnosis may be made if severely pruritic burrows are detected at a typical predilection site, such as the web spaces of fingers, the glans penis, or other sites on the genitalia (2). The office-based diagnostic procedure is a scabies preparation, which may be done easily in any office that has a microscope and mineral oil. Detection of the mite, ova, or fecal pellets harvested by scraping laterally across the skin with a blade at the site of a burrow has low sensitivity, but is diagnostic (2) (Figure). The skin scraping can then be examined in a drop of mineral oil under a light microscope on low power; potassium hydroxide should be avoided because it can dissolve mite pellets (8). When mites are not found on scraping, a skin biopsy revealing mites surrounded by inflammatory cells, such as eosinophils, lymphocytes, and histiocytes, may confirm the diagnosis (2, 8). Although biopsy often reveals only evidence

of a hypersensitivity reaction (2, 8), a nonspecific result does not exclude a diagnosis of scabies. Scybala (mite feces) and chitin (carbohydrate of the mite exoskeleton) may fluoresce with a Wood lamp. Mites may also stain with gentian violet, which can be painted onto burrows and then removed with an alcohol swab after several minutes. In crusted scabies, systemic levels of interleukin 4 and peripheral immunoglobulin E may be elevated but are not routinely checked (2).

Bedbugs

Diagnosis of bedbugs is primarily based on patient history, physical examination, and detection of mites in the home. Hypersensitivity to bedbug salivary proteins may be tested via intradermal allergy skin testing (9). Bedbugs within the home can be detected by several methods. Visual inspection with a magnifying glass and flashlight (with instructions readily available online) is least expensive but time-consuming. Passive mon-

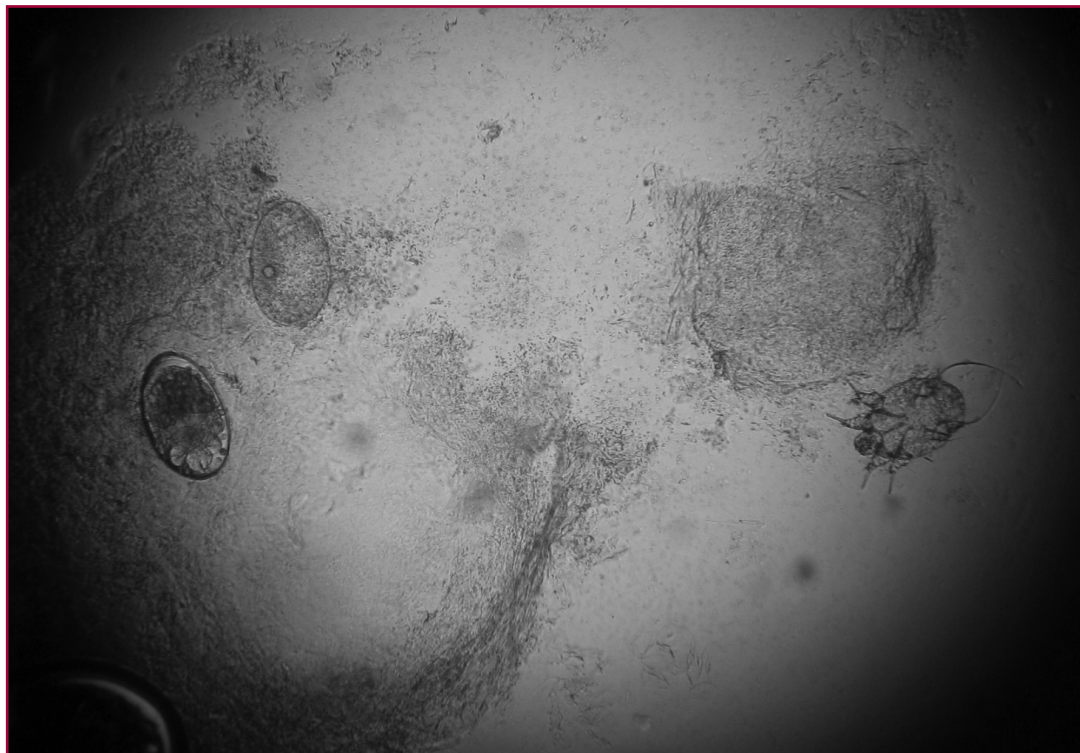


Figure. Scabies mite (*right*) with eggs both empty and containing an additional unhatched mite (*left*).

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itoring devices, such as adhesives, lubricants, and bowls, placed under the bed or sofa legs are traps in which the human host's own heat and carbon dioxide serve as the bait for bedbug detection. Active monitoring devices release chemical attractants or heat to detect bedbugs (18). Trained dogs can detect live bedbugs and eggs while distinguishing those from other urban parasites.

Lice and Fleas

Diagnosis of lice and flea infestations is typically made on clinical grounds without additional tests, as both organisms are visible without magnification. Examining predisposed sites, especially the scalp and groin, may reveal lice on gross inspection. In addition, examining the seams of clothing is an important step in identifying body lice. Fleas do not generally reside on humans but may be found on examination of pets.

What are the clinical symptoms and signs of infestations with cutaneous parasites?

Scabies

Clinical manifestations result from a delayed type IV hypersensitivity reaction to the mite or its saliva, eggs, or scybala (2). Thus, the signs and symptoms of infestation, such as pruritus, burrows, and excoriations, develop 3–4 weeks after primary exposure and 1–2 days after reexposure (2). Pruritus is commonly worse at night, typically spares the head and neck areas, and may be accentuated on genital skin. Crusted scabies may have mild or absent pruritus due to impaired host immune response (8). Skin lesions and pruritus tend to resolve by 4 weeks after treatment (6, 8). If pruritus persists, alternate causes should be investigated (8).

Bedbugs

Most patients bitten by bedbugs are asymptomatic. Lesions are

usually small, itchy, red bumps on skin not covered by bedclothes, although the characteristics of bedbug reactions change with multiple exposures. Specifically, the type of immune hypersensitivity may progress from delayed to immediate with chronicity. Nonexcoriated inflammatory reactions at bite sites typically resolve within 1 week (9).

Lice

All forms of lice infection, regardless of distribution, present with regional (and sometimes generalized) pruritus and excoriated erythematous papules. These papules often have a linear distribution in the affected area. Impetigo, or other secondary skin infections, may occur in excoriated skin. In addition to scalp itching or bumps, patients with head lice infestation may also report cervical lymphadenopathy. A common presentation of pubic lice is intense genital pruritus that is worse at night.

Fleas

Flea bites are characterized by sudden-onset multiple pruritic papules with hemorrhagic crusts, usually around the ankles and other exposed areas of skin. Patients may see bumps arranged in groups of three, the so-called “breakfast, lunch, and dinner” sign. More severe hypersensitivity reactions resembling hives have also been reported (15). Severity can vary among members of a household, probably due to differing propensities toward type I hypersensitivity reactions (19). Exposure history and symptoms should prompt a search for fleas in the home. Bullous reactions to flea (or other insect) bites may suggest hematopoietic neoplasia (20).

What are the usual physical findings in infestations?

Scabies

Patients typically present with a diffuse eruption of small pink papules, with a combination of burrows,

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domed 2- to 3-millimeter papules, and linear excoriations. A burrow is a short, waxy, erythematous pink or white line, resulting from a female mite penetrating and burrowing into the skin. On close inspection (with a dermatoscope or other magnifying glass), a tiny black dot may be observed at one end of the burrow—this is the actual mite. A burrow is most frequently found in the finger webs or on flexor surfaces of the wrists. Less commonly, burrows may occur on the elbows, axillae, buttocks, areolae, and genitalia in adults or on the face and neck in infants, children, and elderly persons (2, 6). Burrows are rare in the head and neck areas of immunocompetent adults. Papules may progress to vesicles or bullae (2). Typically, most erythematous papules in an infested patient are excoriated and do not contain a mite. Crusted scabies may appear as thickly scaled, erythematous plaques that may have a gritty, sand-like texture; these plaques are often most prominent on acral skin. Associated generalized lymphadenopathy may also be present (2). Crusted scabies is often misdiagnosed as psoriasis, eczema, or other papulosquamous skin diseases (8).

Bedbugs

Symptomatic patients present with 2- to 5-millimeter erythematous, often excoriated papules, which may exhibit a central punctum, at bedbug feeding sites (9). Bites may appear in linear clusters of 3 or more lesions, the so-called “breakfast, lunch, and dinner” sign (21). The size, degree of itching, and propensity toward vesiculation all increase with repeated bedbug bites (9). Localized and diffuse urticarial reactions, often with papular morphologic characteristics, have been reported.

Lice

As noted, all forms of lice tend to appear with regional clusters of excoriated papules, often with associated lymphadenopathy. These papules may also exhibit the “break-

fast, lunch, and dinner” pattern. Further, one may often find intact lice (or nits) on close inspection of the affected area. Chronic infestations can lead to generalized thickened and hyperpigmented skin.

In head lice, nits are commonly found in the occipital or retroauricular areas of the scalp and are easier to identify than live lice. Nits can sometimes be difficult to distinguish from hair casts (pseudonits) or black or white piedra, 2 common benign scalp infections. In these cases, microscopic examination via a hair mount may be necessary to establish the correct diagnosis (22).

Body lice lay eggs, live on clothing, and are highly susceptible to the cold. Thus, they prefer seams of clothing or waistbands where the body temperature is warmer. Diagnosis of body lice is often made by inspecting seams or waistbands of clothing for organisms. Alternatively, one may shake clothing over a piece of white paper in search of moving lice.

Pubic lice are visible to the naked eye as small, whitish-appearing concretions attached to the shafts of pubic hairs. Perifollicular erythema and occasionally firm erythematous nodules may also be noted on the genitalia. Inguinal lymphadenopathy may be present. Maculae ceruleae, which are deposits of hemosiderin resulting from the bites of crab lice, are pale blue-gray macules that may appear on the thighs, buttocks, and anogenital skin. This finding is rarely observed but is specific for pubic lice. Eyelash infestation of crab lice, termed *pediculosis ciliaris*, presents as conjunctivitis and crusting and edema of the eyelid margins. Crab lice may be identified with close examination of the eyelashes. A magnifying glass or dermatoscope may be helpful. Because any body hair may be infested, a thorough examination of the entire body should be conducted

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once crab lice infestation has been determined.

Fleas

As noted, flea bites often present as papules with central umbilication and hemorrhagic crusts, often in groups of three. Common sites of involvement include the ankles and other areas of skin that may be unclothed during daytime hours or sleeping.

Are there serious complications of infestations?

Scabies

Burrows and excoriations serve as an entry point for secondary bacterial infections, such as *Staphylococcus aureus* and *Streptococcus pyogenes* (2, 6). As a result, scabies may increase the risk for subsequent acute poststreptococcal glomerulonephritis (2). In crusted scabies, secondary sepsis, with a high risk for mortality, has been reported (6).

Bedbugs

Although rare, systemic reactions, such as asthma, generalized urticaria, and anaphylaxis, have been reported (9). Secondary infection of excoriations may result in folliculitis, impetigo, cellulitis, or an eczematous dermatitis (9). The stigma of bedbug infestation has a significant psychosocial impact that may result in stress, anxiety, depression, insomnia, social isolation, and even suicidal ideation (9, 23).

Lice

Severe head lice infestation may be associated with iron-deficiency anemia, especially in impoverished children (24, 25). Rare allergic reactions, manifesting as rhinitis and asthma, have been reported (26). Focal alopecia is also an atypical manifestation (27). Body lice are associated with several infections (Table) (28, 29). Chronic *P. pubis* infestations of eyelids or eyebrows may lead to blepharitis, conjunctivitis, and corneal epithelial keratitis (30, 31).

Fleas

Prolonged infestations with fleas can lead to papular urticaria, psychological distress, phobias, and insomnia (15, 32). Both cat and rat fleas are known disease vectors. *C. felis* is associated with cat scratch disease, bacillary angiomatosis, endemic (murine) typhus, and rickettsiosis; the rat flea, *X. cheopis*, is associated with the plague and endemic (murine) typhus (Table) (33–35).

What bacterial organisms do the parasites transmit?

In theory, bedbugs may be vectors for a litany of infectious diseases: plague, yellow fever, tuberculosis, relapsing fever, leprosy, filariasis, leishmaniasis, smallpox, yellow fever, *Trypanosoma cruzi*, HBV, and possibly HIV. HIV and HBV can be detected in bedbugs for 8 days and 7 weeks, respectively. However, no study has shown a bedbug's ability to acquire, maintain, or transmit an infection (9).

Head lice have generally not been considered an important vector in bacterial transmission. However, *Borrelia recurrentis* and *Bartonella quintana*, which are typically transmitted by body lice, can be transmitted by head lice on rare occasions (36, 37). There is no evidence that pubic lice are an important vector of disease.

Fleas, however, are important vectors for *Bartonella henselae*, *Rickettsia typhi*, *Rickettsia felis*, and *Y. pestis*. *B. henselae* is associated with cat scratch disease and bacillary angiomatosis. The *Rickettsia* species can lead to endemic (murine) typhus and rickettsiosis. *Y. pestis* causes the plague, which can lead to sepsis and disseminated intravascular coagulation if left untreated (Table) (34, 38).

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Are there situations in which a dermatologist or infectious disease specialist should be consulted?

Despite the low sensitivity of diagnostic tools and the relative safety of treatments, patients with generalized pruritus without a typical eruption or a history of exposure should not be empirically treated for any of these cutaneous parasites. Referral to a dermatologist should be considered if there is a high index of suspicion (8). A concern for an inpatient scabies outbreak merits inpatient dermatology consultation, often in conjunction with infection control services.

Diagnosis... Scabies infestation is frequently suspected but often not clinically confirmed appropriately. Whereas the history and examination may be

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sufficiently suggestive

to warrant a clinical diagnosis in some cases, a scabies preparation, with scraping of burrows with mineral oil onto a glass slide for microscopic examination, should always be attempted on suspicious lesions. A skin biopsy may also capture a scabies mite, but generally has low sensitivity. The diagnosis of bedbugs is best confirmed via inspection in the home; this is typically accomplished by an exterminator or other pest professional. Similarly, flea bites and infestations are difficult to confirm without a home inspection. Lice, including the scalp and pubic variants, are visible to the naked eye and identified as adherent, whitish concretions on hair shafts. For all cutaneous infestations, referral to a dermatologist is reasonable when a suspected diagnosis has not responded to empirical therapy or has not followed an expected clinical course.

Treatment

What topical and other therapies are used to treat cutaneous parasites? What are the potential toxicities of such treatment?

Scabies

For classical scabies, topical permethrin 5% is the first line and most effective treatment (as compared with topical crotamiton, topical lindane, and oral ivermectin) for classical scabies in the United States, United Kingdom, and Australia. Permethrin should be applied from the neck down, although some sources suggest treating the entire body except for the eyes in infants, children, and elderly persons (6, 39). Permethrin should be applied in the evening and left on overnight to maximize exposure (6). The drug's efficacy as an ovicide is not established; therefore, a second dose of permethrin 1–2 weeks later is recommended (39). Alternatively, patients may be treated with 2 doses of off-label oral ivermectin (200 mcg/kg per dose) taken with food for increased absorption. Because ivermectin does not destroy the eggs, a repeated dose is required 1–2 weeks after the first dose to kill the newly hatched mites (6).

Because of comorbid conditions of the host and the high mite load,

42. Tebruegge M, Runnacles J. Is wet combing effective in children with pediculosis capitis infestation? *Arch Dis Child.* 2007;92:818–20. [PMID: 17715448]
43. Madke B, Khopkar U. Pediculosis capitis: an update. *Indian J Dermatol Venereol Leprol.* 2012;78:429–38. [PMID: 22772612] doi:10.4103/0378-6323.98072
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45. Bush SE, Rock AN, Jones SL, Malenke JR, Clayton DH. Efficacy of the Louse-Buster, a new medical device for treating head lice (*Anoplura:Pediculiidae*). *J Med Entomol.* 2011;48:67–72. [PMID: 21337950]
46. Pearlman DL. A simple treatment for head lice: dry-on, suffocation-based pediculicide. *Pediatrics.* 2004;114:e275–9. [PMID: 15342886]

crusted scabies is difficult to treat and often requires a combination of therapies. Both topical permethrin 5%, every 2–3 days for 1–2 weeks, and oral ivermectin, 200 mcg/kg per dose for 3–7 doses, are effective. Ivermectin may be given on days 1, 2, 8, 9, 15, 22, and 29, depending on the severity of infection (6). Off-label benzyl benzoate 25% (with or without tea tree oil 5%) may be used instead of permethrin. Benzyl benzoate 10% or 25% is the standard in resource-poor communities (2). Benzyl benzoate 25% is effective but requires twice-daily application for 2–3 days, which then needs to be repeated in 10 days. It is also limited by side effects of skin irritation and burning (2). Keratolytic creams, such as urea, may be used to remove the associated thick crust. The patient should be rigorously monitored for evidence of infection and sepsis.

The use of lindane 1% for the scabies treatment has been significantly limited by associated neurotoxicity, such as skin numbness, restlessness, anxiety, tremors, and convulsions (2). It is also less effective than other available topical agents (39). Despite reports of resistance to scabicides, treatment failure does not seem to be increasing in frequency, suggesting that this is not a common problem (39).

Bedbugs

The best treatment for bedbug dermatitis is prevention and control of the infestation, largely through insecticides (40). No specific therapy has been proven to shorten the duration of bedbug dermatitis (41). Treatment of bedbug bite reactions is symptomatic. Most reactions are self-limited and resolve in 1–2 weeks (41). For pruritic lesions, intermediate potency topical corticosteroids, such as triamcinolone acetate 0.1%, or topical antipruritic agents, such as pramoxine or doxepin, may be used (9). Topical doxepin may be sedating.

Lice

There are 3 categories of lice treatment: mechanical, topical, and antimicrobial.

The safest, most effective mechanical treatment is shaving the affected area, although this is often undesirable. Manually wet-combing for head lice infestation may be effective but must be done repeatedly, and cure rate is variable (42). Before combing, the hair is moistened and a conditioner or lubricant is applied for 15–30 minutes. This process is repeated every 2–3 days for several weeks or for 2 weeks after the finding of any adult louse (43). Louse-Buster is a hair dryer designed to kill lice by desiccation. The time for treatment is at least 30 minutes (44, 45). Patients should avoid their regular hair dryer to prevent the risk for displacing live lice to people nearby. Applying and sealing Cetaphil cleanser with a hair dryer may also be effective (46).

Traditional topical treatments for head lice include permethrin 1% or 5%, spinosad 0.9%, malathion, lindane, carbaryl, and benzyl alcohol 5%. Permethrin 1% lotion is recommended by the American Academy of Pediatrics as first-line treatment for head lice. However, resistance to permethrin has been noted and may be increasing (47). Further, as permethrin is ideally used in conjunction with nit combs, simpler therapies are more desirable. Spinosad 0.9%, which was approved by the U.S. Food and Drug Administration and Drug Administration (FDA) in 2011, is an attractive alternative for the following reasons: It does not need to be combined with nit combs; unlike permethrin, which is only pediculocidal, spinosad kills both lice and their ova; as a result, it is often effective in a single dose; and most important, in 2 phase 3 randomized, controlled trials, spinosad was roughly twice as effective as permethrin (48). In ad-

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48. Stough D, Shellabarger S, Quiring J, Gabrielsen AA Jr. Efficacy and safety of spinosad and permethrin creme rinses for pediculosis capitis (head lice). *Pediatrics*. 2009;124:e389-95. [PMID: 19706558] doi:10.1542/peds.2008-3762
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50. Ameen M, Arenas R, Villanueva-Reyes J, Ruiz-Esmenjaud J, Millar D, Dominguez-Dueñas F, et al. Oral ivermectin for treatment of pediculosis capitis. *Pediatr Infect Dis J*. 2010;29:991-3. [PMID: 21046698]
51. Foucault C, Ranque S, Badiaga S, Rovey C, Raoult D, Brouqui P. Oral ivermectin in the treatment of body lice. *J Infect Dis*. 2006;193:474-6. [PMID: 16388498]
52. Naumann DN, Baird-Clarke CD, Ross DA. Fleas on operations in Afghanistan—environmental health measures on the front line. *J R Army Med Corps*. 2011;157:226-8. [PMID: 21977711]

dition, lice that are resistant to permethrin respond to spinosad (49).

Systemic therapy choices for head lice include oral ivermectin, sulfamethoxazole/trimethoprim, albendazole, and levamisole. The data are strongest for ivermectin, 1 oral dose of 200 µg/kg repeated a week later if infestation persists (50).

Because body lice are transmitted by contact through improperly washed clothing and bedding, the best treatment for infestations is properly washing the affected articles. The CDC recommends washing in hot water (at least 130° F) with a hot dryer cycle at least once a week. The oral and topical therapeutic options are the same for body lice and head lice. However, they do not replace proper personal hygiene (14).

If the infestation is focal, pubic lice respond best to shaving. The topical and systemic treatments noted previously are also helpful. Treatment of sexual contacts is also recommended. To treat pubic lice on eyelashes, the CDC recommends application of ophthalmic-grade petrolatum to eyelid margins 2–4 times a day for 10 days.

Fleas

Symptomatic fleas bites are usually treated with oral antihistamines and topical corticosteroids (15). Treatment of flea infestation may include removing the source (fleas/nits) manually, treating domestic

reservoirs (pets), or preventing contact with feral animals (i.e., sealing a structure to prevent entrance of rats or other rodents). Eradication of severe cases of infestations may necessitate use of an aerosol insecticide or fogging affected areas in the home (52).

Are there specific safety concerns when treating pregnant women and children?

Scabies

Infants younger than 2 months should be treated with topical crotamiton 10% or topical sulfur 8%–10% (in petrolatum) instead of permethrin because of the risk for systemic absorption (6). Topical application of a sulfur preparation for 3 consecutive days is effective but unpopular because it is messy and malodorous (53). Permethrin (pregnancy category B) is safe for use in pregnant women and children older than 2 months. Sulfur in petrolatum (no pregnancy classification class) may be a safe alternative, especially in resource-poor settings. Patients younger than 5 years, who weigh less than 15 kg, or who are pregnant should not take oral ivermectin (pregnancy category C) due to the increased risk for neurotoxicity (6). In addition, lindane (pregnancy category C) is contraindicated in children younger than 3 years because it also carries a high risk for neurotoxicity (2).

Bedbugs

Most topical corticosteroids are pregnancy category C; low birth-weight correlates with quantity of potent topical corticosteroid exposure (54). Small amounts of mild- to moderate-strength topical corticosteroids (hydrocortisone 1% and triamcinolone 0.1%, respectively) are safest in pregnant women. The authors also prefer mild to moderate potency topical steroid in children. Topical steroids are rarely indicated to treat bedbug bite reactions (54).

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53. Mounsey KE, McCarthy JS. Treatment and control of scabies. *Curr Opin Infect Dis*. 2013;26:133-9. [PMID: 23438966] doi:10.1097/QCO.0b013e32835e1d57
54. Chi CC, Wang SH, Mayon-White R, Wojnarowska F. Pregnancy outcomes after maternal exposure to topical corticosteroids: a UK population-based cohort study. *JAMA Dermatol*. 2013;149:1274-80. [PMID: 24005903] doi:10.1001/jama-dermatol.2013.5768
55. Kennedy D, Hurst V, Konradsdottir E, Einarson A. Pregnancy outcome following exposure to permethrin and use of teratogen information. *Am J Perinatol*. 2005;22:87-90. [PMID: 15731987]
56. Elston CA, Elston DM. Treatment of common skin infections and infestations during pregnancy. *Dermatol Ther*. 2013;26:312-20. [PMID: 23914888] doi:10.1111/dth.12075

Lice

Treatment of lice infestation should be limited to mechanical removal and safe topical treatments in infants and pregnant women. As noted, mechanical removal may include shaving, manual wet combing, or hair drying. Permethrin is generally safe in pregnant and lactating women and in children older than 2 months. Spinosad is FDA-approved for children older than 4 months and is pregnancy category B; it also is probably safe in pregnant women and older infants. Precipitated sulfur in petrolatum is safer for infants younger than 2 months (55).

Malathion (pregnancy category B) should be avoided during lactation because it can lead to respiratory depression of the infant (56). Oral ivermectin should be avoided in pregnant or lactating women and children younger than 5 years (as in the treatment of scabies) due to potential neurotoxicity.

Treatment... In nonpregnant adults, permethrin is an effective topical treatment for scabies and lice. Given concerns of increasing resistance of head lice to permethrin, spinosad is a good alternative. In pregnant patients and infants older than 2 months, topical permethrin may be used because it is generally safe in these populations. Spinosad is FDA-approved for children older than 4 months and is generally safe in pregnant patients. Precipitated sulfur in petrolatum is also a safe topical alternative. Oral ivermectin, which is effective against scabies and lice, should not be given to pregnant women or children younger than 5 years. Lice may also be treated with shaving. Bedbugs and fleas are best prevented by targeting the reservoirs where the parasites may be residing (bedding vs. pets and pests, respectively).

Prevention

How can cutaneous parasites be prevented in the individual patient?

Scabies

There is no evidence demonstrating effectiveness of treating contacts of scabies-infested patients to prevent transmission (57). However,

close contacts of patients with scabies are often advised to be treated at the same time as patients, ideally with a single application of topical permethrin 5% applied in the evening and left on overnight. Alternatively, close contacts may be treated with oral ivermectin 200 mcg/kg taken with food as a single dose. In addition to treatment, appropriate education, isolation, and minimization of overcrowding are all helpful in controlling infestations.

Bedbugs

Prevention of bedbug bites can only be achieved through avoidance. Whereas mosquito repellent and oil of lemon eucalyptus may decrease bedbug infestation, no repellents have been found to definitively prevent infestation (41).

When sleeping in unfamiliar environments or purchasing used furniture, patients are advised to check for evidence of bedbugs or their excreta (9). Bedbugs typically avoid light, hiding during the day and feeding at night. Inspection should be within 3–6 feet of potential hosts—in mattress seams, crevices in box springs, headboards, picture frames, loose wallpaper, and suitcases (9).

Lice

Clothing in close contact with hair, such as hats and scarves, should be separated and cleaned. All infested clothing, towels, and bedding should be washed in hot water followed by drying with a hot dryer cycle to prevent reinfestation. All close contacts should be screened for live lice and treated only if an active infestation has been determined (43). As with scabies, proper personal hygiene with frequent clothing changes and minimizing overcrowding will prevent transmission of body lice (17). Pubic lice may be prevented by avoiding sexual contact, or

57. FitzGerald D, Grainger RJ, Reid A. Interventions for preventing the spread of infestation in close contacts of people with scabies. *Cochrane Database Syst Rev*. 2014;2:CD009943. [PMID: 24566946] doi:10.1002/14651858.CD009943.pub2
58. Halos L, Beugnet F, Cardoso L, Farkas R, Franc M, Guillot J, et al. Flea control failure? Myths and realities. *Trends Parasitol*. 2014;30:228-33. [PMID: 24661796] doi:10.1016/j.pt.2014.02.007
59. Centers for Disease Control and Prevention. Parasites—scabies: control. Accessed at www.cdc.gov/parasites/scabies/health_professionals/control.html on 7 July 2014.
60. Bouvresse S, Chosidow O. Scabies in healthcare settings. *Curr Opin Infect Dis*. 2010;23:111-8. [PMID: 20075729] doi:10.1097/QCO.0b013e328336821b

sharing a bed, with a person with a known infestation. Sexual contacts should be screened, and if unable to present for evaluation, may be treated with mechanical methods (such as shaving).

Fleas

Human infestations of fleas can be prevented by ensuring pets (cats or dogs) remain flea-free, which may be challenging. A good flea control regimen should include mechanical removal of infestation (vacuuming, washing affected bedding); use of antiflea products on pets (veterinary-registered products); the appropriate method of application for a particular pet (e.g., body spray, collar, shampoo, or oral insecticides); and compliance with treatment schedules (58).

What environmental measures can be taken to prevent infestation with cutaneous parasites?

Scabies

The CDC recommends that bedding and clothing worn or used next to the skin anytime during the 3 days before treatment should be machine washed and dried using the hot-water (>60° C) and hot dryer cycles, be drycleaned the day after treatment, or stored in sealed plastic bags for several days to a week (59). Although clothing rarely serves as a fomite in classical scabies, the presence of live mites on chairs in homes of patients supports the use of environmental measures (8). Of note, clothing may transmit crusted scabies given the high mite load. Other exposed objects and surfaces should be disinfected (60).

Bedbugs

Bedbug eradication is a difficult, multistep process. It begins with identification of the bedbug species present. Patients should be educated on the recalcitrance of bedbug infestations. A professional exterminator should be

consulted to identify infested areas. A mix of chemical (e.g., pesticides) and nonchemical (e.g., vacuuming, heat/steam, mattress encasements, and discarding furniture) control measures should be undertaken (41). Reevaluation 10–21 days after treatment is crucial (9, 41). Bedbugs do not travel on human hosts; however, they may spread actively through ventilation ducts and walls (41). As they may travel in suitcases, luggage seams should be scrubbed with hot water (>120° F) and soap (41). Dry cleaners treating affected clothing should be notified of infestation. Clothing should be heat-treated (>120° F for at least 2 hours) or cold-treated (< 23° F for 5 days) (41).

Lice

Lice transmission may be prevented by washing all infested clothing and bedding in hot water with a hot dryer cycle. Alternative methods include drycleaning or sealing clothing and bedding for 2 weeks. As noted above, affected hair care items should be segregated and/or discarded.

Fleas

Transmission of fleas from household pets or domestic animals can be prevented by maintaining distance between pets and humans (i.e., sheltering pets outside). As this is often undesirable, regular grooming will reduce flea burden on pets. Prompt identification and treatment of flea infestation is important in limiting flea bites on humans. Veterinary topical medications should be applied to flea-prone areas, such as the head and neck. The organophosphates dichlorvos and propetamphos may be used for disinfecting hard surfaces, fabrics, and carpets (61). Rats and other feral animals, which may carry less quotidian species of fleas, should be prevented from taking up residence in a home by sealing openings to the

61. Elston DM, Do H. What's eating you? Cat flea (*Ctenocephalides felis*), part 2: prevention and control. *Cutis*. 2010;85:283-5. [PMID: 20666187]
62. Obasanjo OO, Wu P, Conlon M, Karanfil LV, Pryor P, Moler G, et al. An outbreak of scabies in a teaching hospital: lessons learned. *Infect Control Hosp Epidemiol*. 2001;22:13-8. [PMID: 11198016]
63. Centers for Disease Control and Prevention. Parasites—scabies: prevention & control. Accessed at www.cdc.gov/parasites/scabies/prevent.html on 7 July 2014.
64. Scheinfeld N. Controlling scabies in institutional settings: a review of medications, treatment models, and implementation. *Am J Clin Dermatol*. 2004;5:31-7. [PMID: 14979741]

outside, placing physical barriers, and using exterminators as needed (15).

What infection control measures for cutaneous parasites need to be taken in hospitals and long-term care facilities?

Scabies

Although some studies suggest isolation of any patient with suspected or confirmed scabies (62), the CDC currently recommends isolation only of patients with crusted scabies. For single or multiple cases of noncrusted scabies, the CDC recommends heightened surveillance for early detection of new cases and avoiding direct skin-to-skin contact when handling patients and handwashing (63). In institutional outbreaks, symptomatic patients should be treated according to classical scabies and crusted scabies guidelines. Asymptomatic potentially

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exposed contacts should also be treated. In refractory cases, all residents and staff may be treated with topical benzyl benzoate or

oral ivermectin (6). Linens should be washed in water hotter than 60° C and machine dried on high heat. Environmental measures are

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unnecessary and not indicated in classical scabies. In crusted scabies, routine cleaning and

vacuuming of the room should be done; however, insecticide sprays and fumigants are not recommended (60). The patient should also be isolated and placed on contact precautions (4, 64).

Bedbugs

As noted, the most important steps are avoidance and prompt treatment of infested areas.

Prevention... Although evidence is lacking, close contacts of patients with scabies infestation are commonly prescribed a single overnight application of permethrin 5% cream or, less commonly, oral ivermectin as a single dose. In infested patients, all contacted bedding and clothing should be washed with high heat (>60°C) to help prevent transmission and/or reinfestation. Bedbug infestation is an emerging public health concern, especially in metropolitan areas. Inspecting bedding when traveling in hotels and other public lodging areas and inspecting suitcases upon return are recommended. For head lice, close contacts, such as schoolmates, should be screened with visual inspection. In the case of pubic lice, all sexual contacts should be notified by the patient and potentially screened; screening infested patients for other sexually transmitted infections is also important. Personal hygiene and good care and hygiene of household pets are the most important factors in preventing flea infestations. When pets are affected, instructions from veterinarians should be followed carefully, and all prescribed medication courses completed fully.

Conclusion

The organisms discussed here, although generally not life-threatening, may be a scourge to patients. The well-in-

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formed practitioner should be able to identify and treat these nuisances and understand when it is important to refer these patients to a specialist.

Common Cutaneous Parasites

ACP Smart Medicine Modules

<http://smartmedicine.acponline.org/content.aspx?gbosId=43>
<http://smartmedicine.acponline.org/content.aspx?gbosId=264>

Access the American College of Physicians Smart Medicine modules on insect bites and scabies.

Other Clinical Information

<http://www.aad.org/dermatology-a-to-z/diseases-and-treatments/q---t/scabies>

Information on Scabies from the American Academy of Dermatology.

www.cdc.gov/parasites/

Information on parasites from the Centers for Disease Control and Prevention.

www.aad.org/dermatology-a-to-z/diseases-and-treatments/e--h/head-lice/diagnosis-treatment

Diagnosis, treatment, and outcomes of head lice from the American Academy of Dermatology.

www.cdc.gov/nceh/ebs/Publications/Bed_Bugs_CDC-EPA_Statement.htm

Joint Statement on controlling bedbugs from the Centers for Disease Control and Prevention and the Environmental Protection Agency.

Patient Information

www.cdc.gov/parasites/bedbugs/faqs.html

Frequently asked questions about bedbugs from the Centers for Disease Control and Prevention.

www.nlm.nih.gov/medlineplus/bedbugs.html

Information on bedbugs the National Institutes of Health MedlinePlus.

www.fda.gov/ForConsumers/ConsumerUpdates/ucm171730.htm?utm_campaign=Google2&utm_source=fdaSearch&utm_medium=website&utm_term=head%20lice&utm_content=1

[m?utm_campaign=Google2&utm_source=fdaSearch&utm_medium=website&utm_term=head%20lice&utm_content=1](http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm171730.htm?utm_campaign=Google2&utm_source=fdaSearch&utm_medium=website&utm_term=head%20lice&utm_content=1)



Information on managing head lice from the U.S. Food and Drug Administration.

WHAT YOU SHOULD KNOW ABOUT COMMON CUTANEOUS PARASITES

What are common cutaneous parasites?

Scabies, bedbugs, lice, and fleas are common parasites that can infest human skin.

What are the signs and symptoms?

For More Information

- **Scabies.** Small itchy bumps usually on hands and wrists but also on elbows, knees, penis, breasts, or shoulder blades.
- **Bedbugs.** Small pink or crusted bumps, often in groups of 3 or 4. Bumps most often appear on skin not covered by clothing at bedtime, such as forearms, neck, and ankles.
- **Lice.** Itching on the scalp (head lice), in the groin (pubic lice), or on the body between the shoulders and at knees (body lice). Lice appear as tiny white dots attached to hairs or sometimes on the skin surface.



1. A 24-year-old female medical student presents to clinic complaining of itchy bumps on her legs. She recently traveled to South America on vacation, where she lodged in several "questionable" hostels. On a travel Web site reviewing one of the hostels, several other travelers have complained of a similar rash. Which of the following is the most effective treatment for the patient's rash?
 - A. Ivermectin
 - B. Permethrin
 - C. Sulfur in petrolatum
 - D. Triamcinolone acetate

2. The patient is worried that she may have brought the causative organism into the United States. You advise the patient that she should closely examine which of the following:
 - A. Clothing
 - B. Scalp, body, and pubic hair
 - C. Luggage
 - D. Pet dog

3. A 20-year-old male college student presents to clinic complaining of an itchy groin rash for 3 weeks, which he states started shortly after he began having intercourse with a new partner. Physical examination reveals numerous white nits noted within the pubic hair. Which of the following is an effective treatment?
 - A. Shaving
 - B. Ivermectin
 - C. Permethrin
 - D. All are effective

4. The patient should be screened for which of the following?
 - A. Scabies
 - B. Body lice
 - C. Child abuse
 - D. HIV

5. A 38-year-old woman who is 34-weeks pregnant presents to your clinic after she learned her 5-year-old daughter was recently diagnosed with head lice during an outbreak at school. The patient shares a brush with her daughter and feels her scalp is very itchy. Which treatment should be avoided in your patient?
 - A. Permethrin
 - B. Topical sulfur in petrolatum
 - C. Ivermectin
 - D. Shaving

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