



# PESTS

## That Affect Human Health

Entomology 365

### Scabies

Scabies is a contagious disease of humans and other mammals. It is caused by the mite, *Sarcoptes scabiei*, which burrows into the dead layer of the human skin (stratum corneum). Sarcoptic mites are obligate parasites which spend most of their lives in burrows in the skin. If the mite invades a person's skin, and establishes itself, symptoms of scabies will become apparent, although it may take four to six weeks.

Scabies is transmitted from person to person by close personal and prolonged skin contact. Transmission also occurs when people are sleeping together and can be common in families, dormitories, institutions and nurseries. While it may be possible to acquire a scabies infestation via inanimate, contaminated items of clothing or bedding, this is not generally regarded as a significant method of transmission.

Human scabies infestations are not confined to poor, illiterate, or unclean populations. Cases can be found among all economic and education levels. Although the mites have never been shown to vector any other infectious agent, the discomfort they cause makes them an important dermatological problem. Currently, sporadic outbreaks and epidemics in communities, nursing homes, schools, hospitals and other institutions, and epizootics in wild and domestic animal populations are frequently reported.

Historically, the epidemics of human scabies have occurred on a worldwide basis in 30-year cycles with 15-year gaps between them. Although many opinions have been given, there is no satisfactory explanation for the significant fluctuations in scabies prevalence. Two notable increases occurred in the last 50 years; one peaked in the mid 1940s, and a second began in the mid- to late 1960s on a worldwide basis and in the early 1970s in the United States.

### Host Specificity and Cross-Infestivity

The condition caused by an infestation of *Sarcoptes scabiei* is referred to as scabies in humans and mange in other mammals. Other mammals known to be infested include dogs, cats, rabbits, cattle, pigs and horses. Despite this diversity of hosts, a detailed study has failed to reveal any species-level characteristics that differentiate mites from different hosts. *Sarcoptes scabiei* is now considered to be one species. Populations found on different host species differ physiologically more than

morphologically and are referred to as forms (that on humans, for instance is *S. scabiei* form *hominis*). It is important to note that mites of one species do not establish themselves on another species. Humans can become infested from horses or dogs (animal scabies), but such infestations are mild and should disappear spontaneously.

### Life Cycle

Scabies mites are very small, adult males and females being about 0.2 millimeter and 0.4 millimeter in length respectively. *Sarcoptes scabiei* is recognized by the characteristic oval, ventrally flattened, and dorsally convex tortoise-like shape. The body is covered with various specialized dorsal scales and bristles. The two sets of anterior legs in both sexes end in stalked pulvilli that are called suckers because of their disk-shaped appearance. The pulvilli help the mite grip the host's skin and so aid movement. In the female, the two posterior pairs of legs end in long bristles, but in the male only the third pair ends in bristles (the fourth resembling the first two pairs in having stalked pulvilli).

Usually, the infestation of a new host is accomplished by a newly fertilized female. The mite can move on the warm surface of the skin, traversing as much as 2.5 centimeters in a minute.

The parasite exercises some selection in the part of the body into which it burrows, but it may be related to the body part contacting another infected individual. In one early study of 900 cases of scabies, most mites (over 60 percent) were recovered from the hands and wrists.

The female mite takes approximately one hour to bury itself in the horny layer of the skin, and it never tunnels deeper than this. The burrow is driven parallel to the skin surface and the speed at which the burrow is made is variable (0.5 to 5.0 millimeters per day). The mite usually remains in her burrow for the rest of her life. The mites feed by consuming the host's lymph and lysed tissue. Victims frequently scratch out mites with their finger nails. Although this may prevent the infestation from achieving its potential growth in numbers, it does not achieve a cure. More commonly, it results in secondary skin infections, thus compounding the problem.

Within a few hours of starting the burrow, the gravid female mite begins egg-laying. Two or three eggs are laid each day for up to two months. Typically, the female mite is in the anterior end of the burrow and the eggs are in the burrow behind her. The speed at which the mite moves under the skin seems to have little influence on the rate of egg production.

The eggs take three to four days to hatch. The first immature stage is the larva and it possesses three pairs of legs. Newly emerged larvae move to the skin surface to find shelter, and probably food, in the host's hair follicles. The two nymphal stages (protonymph and tritonymph) have four pairs of legs as do adults. The two nymphal stages that precede the adult are also found in hair follicles. The nymphal molt to the adult stage occurs four to six days after egg hatch. The adult males are not commonly found and do not live nearly as long as females. While males are known to construct only short burrows (less than 1 millimeter), they spend much of their life on the skin surface in search of unfertilized females. The unfertilized females likewise make only small burrows in which they remain for a day or two. Mating probably occurs on the skin surface. There is a high mortality at this stage as males and females locate each other. The period from egg to gravid female takes 10 to 14 days.

## Symptoms

The skin sensations felt in scabies are quite complicated and infested patients describe several distinct reactions. During the first four to six weeks of infestation, there are virtually no symptoms, yet the mite population is increasing and burrowing in the skin. While this is the average time for sensitization, the duration is variable and may be as short as two weeks or as long as one year. It is not until the immunologic reactivity or sensitization develops that the host becomes acutely aware of the problem. In an institutional setting this long incubation period is important because residents and staff may be further infesting other individuals before they exhibit any symptoms. Severe itching, which may come on gradually, is one of the first symptoms associated with scabies. It is due to the sensitization of the host. Until this sensitization occurs, a diagnosis is almost impossible. In subsequent reinfestations (secondary infestations) sensitization and similar signs and symptoms are evident within 24 to 48 hours and develop rapidly, presumably because the host has been sensitized by the previous infestation.

Studies have indicated that intercellular fluid from lower skin zones may seep into the mite burrows or into an area close to the mites and their mouthparts. Apparently, this aqueous material provides a medium for soluble antigens (presumably from the mite's body), saliva and other body secretions, and feces to diffuse into the dermis and stimulate the immune reaction previously mentioned.

The intensity of parasitic infestation (mite number) at the time patients are diagnosed usually bears no relationship to the intensity of discomfort experienced. Some patients with very few mites complain of intolerable itching, and others with

much larger numbers appear to suffer little inconvenience. Itching typically occurs throughout the day, but may intensify at night.

The clinical presentation of scabies varies greatly with host age. The scabies mite has a predilection for specific sites for burrowing on the skin surface. This may be related to the site of mite transfer, the thickness of the skin layer or the slightly higher temperatures in the skin. The hands and wrists of adult patients usually are involved. Other common sites are the axillae, umbilicus, inner thighs, posterior lower legs and feet. The penis and scrotum in males and nipples in females are other areas that may be affected. Although the mite burrow itself often is described as a clinical sign and it may appear in classic cases, in the majority of cases the burrows are not evident.

The most common location of mite burrows can be contrasted with the reactions of the various parts of the body to attack by *Sarcoptes*. The hands and wrists give comparatively less reaction as compared with the softer body parts. The intense reactions set up, for instance, on the genitals and buttocks, stimulate the patient to scratch; scratching causes the obvious signs by which scabies is often diagnosed, but it also frequently destroys the mites. Eczematous changes are very common in infants and young children. The distribution of lesions in children frequently involves the head, neck, palms, and soles—areas typically spared in adults. Children commonly have secondary bacterial infections with pustules, bullous impetigo and ecthyma.

In the elderly, a diminished inflammatory or sensitization response to the infestation is presumably due to the individual's diminished immune competence. Nevertheless, intense itching may be present. Patients who are bedridden or have limited mobility may have extensive involvement of the buttocks and back.

Crusted scabies is a relatively rare, highly contagious infestation. Mites in these cases build up to high numbers, and patients shed large numbers of organisms via crusted debris. This variety of scabies often is responsible for miniepidemics of conventional scabies infestations in nursing homes and other institutions. The condition predominantly affects the mentally disabled, immunologically compromised, or neurologically deficient. The crusted, thick, scaling plaques involve primarily the same sites as conventional scabies. Itching is often minimal or absent, since patients do not mount a significant immune response to the organism.

## Diagnosis

It is a great advantage for anyone dealing with cases of scabies to be able to find and isolate the causative *Sarcoptes* mites. Once the parasite has been discovered, there is no doubt about the diagnosis. Ova (eggs) or scybala (feces), if clearly identified, also confirm the diagnosis. Failure to find mites, ova or feces does not rule out scabies, however, because the recommended scraping techniques may only be successful

40 to 60 percent of the time in clinical cases. In institutional settings, select patients or staff for scraping who have the most lesions, and evaluate those with less involvement later. When scraping, select papules or burrows that have not been scratched or disturbed.

It is important to have some criteria for a scabies diagnosis. A diagnosis of scabies made by a general practitioner should probably be accompanied by recovered mites. If no mites are recovered or if there is any uncertainty, the patient should be referred to a dermatologist. Treating patients for scabies in the absence of any definitive diagnosis often confuses the picture. Scabies mites may be elusive and dermatologists who encounter the infestation regularly may be comfortable in diagnosing it based on the clinical presentation. This criterion is especially important as it relates to the justification for large-scale treatments of asymptomatic patients and staff in institutional settings.

Scabies has developed a reputation as a “great imitator.” Secondary excoriation, eczematization, and infection are characteristic of many other pruritic (itching) skin conditions. Differential considerations include atopic dermatitis, contact dermatitis, impetigo, insect bites, vasculitis and neurodermatitis.

The misdiagnosis of scabies is increased by the liberal use of topical and systemic corticosteroids, which are commonly prescribed to relieve a great variety of itching skin conditions. The inhibition of itching and associated rashes may allow for the progression of individual cases with increased mite populations, delay the accurate diagnosis of scabies, and facilitate the infestation of additional individuals, especially in institutional settings.

## Personal Hygiene and Sanitation

*Sarcoptes* mites are not capable of surviving for any prolonged period away from the host and usually will die in a few days. Survival off the host is greatly dependent on ambient temperature and relative humidity. Lower temperatures and higher relative humidity, which reduce desiccation, generally favor longer survival. In a detailed study of nursing home scabietic patients, live mites were infrequently recovered from bedding, floors and furniture. Regular housekeeping practices, frequent bed linen changes, and stringent hygienic standards in the nursing homes studied minimized contamination of inanimate objects, and higher room temperatures resulted in higher mite mortality due to desiccation.

Laundry temperatures of 120°F (49°C), which may be reached by using the hot water cycle of a washing machine, will kill the mites in 10 minutes. Simple washing of bed sheets and pillowcases in the hot-water cycle of a washing machine is sufficient disinfection to render these items safe for reuse.

## Chemical Treatment

Several compounds are effective when applied properly. Permethrin 5 percent cream (Elimite), Lindane (Kwell or Scabene), Crotamiton (Eurax), and 4 to 6 percent precipitated sulfur ointment are the materials most used for treating scabies. Patients with heavy encrustations should thoroughly soak in a bath, scrubbing their entire skin area to remove encrusted debris that may otherwise impair the effectiveness of the drug application. It is important that adults be treated from the chin to toes. The treatment protocol will depend on the material used and the extent of the infestation. In classical scabies the treatment may be repeated in six to seven days to ensure that any newly hatched larvae are killed. In more severe cases (crusted scabies), a more aggressive treatment plan usually is required as a normal treatment may not kill all mites. Physicians should be consulted on specific treatment regimens. Special care must be taken when treating pregnant women and young children.

The more difficult job of treatment, however, is that of asymptomatic contacts. These are the people that are most likely to spread the infection well before they develop any clinical symptoms. In institutional settings, try to identify the index (first) case and follow up and treat all significant contacts. If one is to get ahead of a scabies outbreak and terminate it, it is absolutely essential that the, as yet, asymptomatic contacts be treated just as thoroughly as the index case. It is during this asymptomatic period of four to six weeks, before sensitization develops, that the individual is most likely to pass the organism on to others. Yet, because individuals have no symptoms, physicians may be reluctant to prescribe treatment or contacts may be reluctant to treat themselves and proper therapy is avoided. Persistence in the search for contacts and persuasiveness in discussing treatment are key elements in a successful control campaign.

It also is important to remember that the itching may persist for up to a month after the mites are killed. The antigenic material is still present in the epidermis and dermis and may trigger immune responses. Hence, symptomatic treatment of the itching may be necessary. The fact that itching continues should not necessarily be taken as an indication of treatment failure. Some medications may cause itching and patients should not retreat themselves until consulting a physician.

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