

# An Epidemiologic and Therapeutic Reassessment of Scabies

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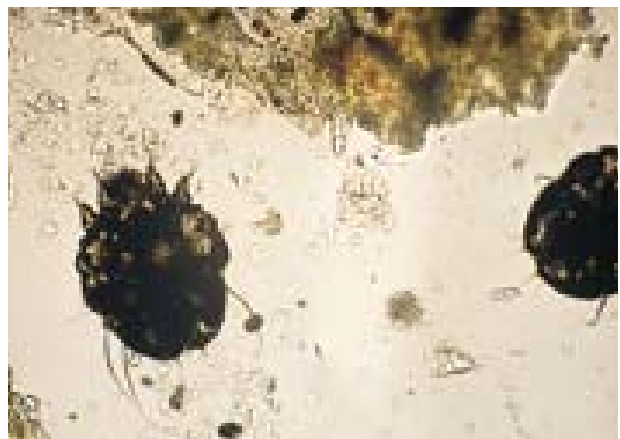
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*Scabies is a highly contagious infestation that causes considerable discomfort. Newer information concerning therapeutics and epidemiologic dogma needs assessment. An epidemiologic evaluation of available world data is analyzed, as well as an assessment of therapeutic alternatives. Using epidemiologic techniques, the following points are proven: scabies is not primarily a sexually transmitted disease; 30-year cycles of scabies do not exist; scabies spreads in households and neighborhoods in which there is a high frequency of intimate personal contact or sharing of inanimate objects; and fomite transmission is a major factor in household and nosocomial passage of scabies. Epidemiologic evaluation proves the necessity of fomite precautions and of treatment of asymptomatic family members and physical contacts of all cases of scabies. Single oral-dose therapy of ivermectin (Stromectol®) appears to be the treatment panacea for this infestation.*

Scabies is a highly contagious condition caused by a mite and manifested clinically as an intensely pruritic cutaneous disease. Various sources indicate that there has been a major increase since 1991, with numerous reports of outbreaks in nursing homes and hospitals.<sup>1</sup> The epidemiologic characteristics of scabies infestations, as well as characteristics of the parasite, clinical considerations, preventive measures, and treatment options, are reviewed.

Human scabies is caused by the mite *Sarcoptes scabiei* var. *hominis*, an arthropod of the order Acarina. The mite is white, eyeless, translucent, and oval with transverse corrugations, brown spines, bristles on the dorsal surface, and eight short legs (Figure 1). The male mite is approximately  $0.2 \times 0.15$  mm, and the larger female counterpart is  $0.4 \times 0.3$  mm. Therefore, the mite is just slightly too small to be seen by the naked eye.



**FIGURE 1.** Two adult female mites, *Sarcoptes scabiei* var. *hominis*, in a mineral oil preparation.

*S. scabiei* var. *hominis* is an obligate parasite to humans. The mite can exist in a sterile test tube for 3 days away from human skin,<sup>2,3</sup> and it can survive for 7 days in mineral oil.<sup>2,4</sup> Live mites recovered from bed linens of an infested host are able to reinfest the patient after being isolated from the host for 96 hours.<sup>3</sup> Female mites are able to move 2.5 cm/min, and their movement is dictated by host odor and thermal stimuli.<sup>5,6</sup> The mites complete their entire life cycle on humans. The female mite, after being fertilized, excavates a sloping burrow in the stratum corneum to the boundary of the stratum granulosum. Along a path that may be up to 1 cm long, the female mite lays 10 to 25 eggs before dying (Figure 2). The eggs hatch within 3 to 4 days, and the emerging larvae leave the burrow to mature on the skin surface. This maturing process takes an additional 14 to 17 days. It is estimated that fewer than 10% of the eggs laid result in mature mites.

The number of mites living on an infected host was previously considered to be from 3 to 50 ovigerous female mites at any one time,<sup>7,8</sup> but the number is several-fold more in most infested individuals, with considerable variance among human hosts.<sup>9,10</sup> In a rare con-



**FIGURE 2.** Eggs of a scabies mite, hatched eggs (egg casings), and feces (scybala) in a mineral oil preparation. Eggs reveal developing larvae, and the hatched eggs show characteristic longitudinal split.

dition known as Norwegian scabies, millions of mites infest a single host, who clinically demonstrates extensive crusted skin lesions.<sup>5,11</sup> These patients have a defective immunologic response, due to a primary immune disorder or secondary to immunosuppressive agents, causing mites to flourish on the skin surface. Similarly, patients with scabies who are human immunodeficiency virus (HIV)-infected occasionally have their external surface teeming with millions of mites.<sup>10,12,13</sup> Furthermore, some otherwise healthy individuals with no keratotic, crusted lesions are nevertheless heavily infested with mites, and prove to be as contagious as individuals with Norwegian scabies.<sup>5,14</sup> Such patients are designated as having severe scabies.<sup>5</sup> In these three subtypes of patients hosting millions of mites (Norwegian scabies, some HIV-infected patients, and severe scabies), there is minimal pruritus, despite their highly contagious status.

The skin disease associated with scabies results from a type IV immunologic reaction to the itch mite or its fecal pellets.<sup>7</sup> The incubation period prior to symptoms used to be considered to be from as little as 3 days to 6 weeks,<sup>5,6,15,16</sup> but prolonged latency periods of 7 months or more are now reported.<sup>9,17,18</sup> Furthermore, there are asymptomatic infested people.<sup>18</sup> Similar to the three subtypes of scabies (Norwegian scabies, some patients with HIV-infected scabies, and severe scabies), the mite can inhabit the skin without eliciting pruritus. Similar to the human response to other insects such as fleas, mosquitoes, and chiggers, there is a wide range of clinical responses. Within the same household, some of the occupants may be totally asymptomatic, while others demonstrate considerable itching. The mites often infest all members of the household within a short time period after inoculating the index case.<sup>9</sup>

## Epidemiology

The prevalence of scabies varies. In some underdeveloped countries, prevalence has been reported to be between 4 and 27% among the general population.<sup>19</sup> In underdeveloped countries, scabies tends to have a higher prevalence in preschool children and adolescents, whereas in developed nations, prevalence is similar in all ages.<sup>9,20</sup>

It is no longer accepted that epidemics of scabies occur in 30-year cycles due to changes in the immune status of the host population.<sup>7,21</sup> Charting available data, Andrews<sup>22</sup> has shown that two pandemics coincided with the two World Wars. Besides these two pandemics, localized and unrelated epidemics do occasionally occur as noted in New Zealand and in Germany in the 1930s. No regular cycling in incidence is apparent.

## Fomite Transmission

Scabies can be transmitted directly between individuals, or indirectly by fomite transmission. The spread of scabies via inanimate objects has slowly been accepted.<sup>9</sup> The first proof was obtained from mite count studies in patients with Norwegian scabies. A population density of 6312 mites/g was demonstrated from the dust from bed linen of such a patient.<sup>23</sup> Dust samplings from the sheets revealed 2154 mites/g, while 840 mites/g were totaled from the floor; 666 mites/g were counted from the screening curtain, with 333 mites/g on two nearby chairs.<sup>23</sup> Similarly, 2 days' worth of sheets, pillow cases, pillow slips, pajamas, and nightshirts from a case of Norwegian scabies were washed, and the total sediment contained 7640 mites.<sup>5</sup>

Other studies have demonstrated the prevalence of mites in the personal environment of normal scabies patients.<sup>3,15</sup> Arlian *et al*<sup>15</sup> obtained dust samples from 37 confirmed cases of normal scabies. Sixty-four percent of dust samples from patients' rooms containing organisms revealed live mites. The live mites were most often recovered from bedroom floors, overstuffed chairs, and couches. Realizing that mites can easily live for at least 3 days off the skin surface,<sup>2,4</sup> that they have host-seeking behavior,<sup>6</sup> and that they exist alive on inanimate objects,<sup>15</sup> it becomes apparent that people can be infested via mites temporarily existing on articles or objects in contaminated homes, schools, nursing homes, and work environments. Such data demonstrate the vast potential of fomite transmission to anyone who enters the room or house of a scabiatic patient. Studies have documented the existence of live mite organisms in the bedding, floors, mattresses, curtains, laundry baskets, and furniture from normal scabiatic patients in nursing homes as well.<sup>15</sup> Such data confirm much of our knowledge of transmission of this disease, such as transmis-



**FIGURE 3.** A burrow (circled), the pathognomonic lesion of scabies, with surrounding excoriated erythematous papules on a child's foot.

sion occurring mostly within families and among those who spend nights with friends and exchange clothing with others.<sup>9</sup> Indeed, fomites play a significant role in the transmission of scabies—possibly more than direct physical contact.

### Clinical Manifestations

The typical presentation of scabies is that of severe pruritus, most incapacitating at night. The sites of the lesions are roughly symmetric and include the interdigital webbing of the hands, and the flexural aspect of the wrist, axillae, waist, feet, and ankles. In men, the penis and scrotum, and in women, the skin around the nipples of the breast, often are affected. In adults, the head and neck are rarely involved, but in infants, all skin surfaces are susceptible.

The appearance of lesions differs. The pathognomonic lesion is the burrow (Figure 3), representing the tunnel that the female mite excavates while laying her eggs. The burrow is wavy, thread-like, grayish-white, and elevated, measuring 1 to 10 mm in length. The terminal end of the burrow often is capped with a small vesicle. Mineral oil enhancement, and the burrow ink and tetracycline fluorescence tests are useful to better demarcate the burrows.<sup>5,24</sup> Other lesions often seen include excoriations, vesicles, indurated nodules, and eczematous dermatitis (Figure 4). These latter lesions are not necessarily diagnostic, but their distribution can suggest the disease.

The diagnosis of scabies is made by the clinical presentation of intense pruritus associated with the

lesions described above. A history of contact with infested persons, family members, or institutions with infested patients also supports the diagnosis. The diagnosis can be verified by skin scrapings from the surface of suspicious areas and by identifying the organism or its eggs under the microscope. Skin biopsy specimens can also show the organism.

### Treatment

The treatment of scabies has always been topical, marked with several caveats. A scabietic lotion or cream is applied overnight to the entire body surface, sparing only the head in adults. It is critical to apply the preparation to every square inch of the body, not just where the eruption is present. Areas to be treated therefore include finger and toe creases, cleft of the buttocks, navel, and beneath fingernails and toenails. In the case of infants, young children, and the elderly, the scabicide should also be applied to the neck, scalp, hairline, and face. After 8 to 14 hours, the preparation is washed off. To reduce the potential of reinfestation by fomite transmission, clothing, linens, and towels used within the previous 2 days should be washed in hot water. If deemed significant, sweaters and jackets can be stored for 2 weeks to allow mites to die. Because of the common occurrence of asymptomatic mite carriers in the household of an infested patient, all household members and sexual contacts should be treated simultaneously. By adhering to these principles, recurrence is dramatically reduced, and retreatment becomes unnecessary.



**FIGURE 4.** Excoriations with eczematous dermatitis on the forearms.

Inasmuch as the pruritus (in patients who experience this symptom) is due to the movement of the mite, antigens on the surface of the mite, or their fecal pellets, the itching and the rash can persist for as long as 2 to 4 weeks after successful treatment (until the mite and its antigens are sloughed off with the dead skin layers). However, most patients experience relief from the pruritus within 3 days.<sup>9</sup>

Permethrin 5% cream is presently the preferred topical scabiecidal agent.<sup>25</sup> It is a synthetic insecticide derived from chrysanthemum pyrethrins. It is very poorly absorbed through the intact cutaneous surface and has minimal toxicity.<sup>25</sup> Its safety record allows its consideration for usage in infants and in pregnant women. Adverse effects are very mild and consist primarily of itching and brief stinging upon application. To date, there are few documented cases of resistance to permethrin for scabies.

Lindane in a 1% lotion or cream is another popular scabiecide. This product is also applied overnight to the entire body surface. It is slightly less effective than permethrin.<sup>25</sup> When applied as directed, there are no toxic side effects<sup>5</sup>; nevertheless, the drug can induce neurotoxic and hemotoxic effects<sup>26</sup> and should not be used in infants or pregnant women. Furthermore, there continue to be cases of possible scabies resistance to lindane.<sup>5,14,24,25</sup>

An alternative scabiecide is crotamiton. Formulated in a 10% lotion and cream, crotamiton requires two applications applied at 24-hour intervals. The medication has an antipruritic effect. Side

effects are limited to the skin, inasmuch as crotamiton is irritating to denuded skin and capable of inducing a contact allergic reaction. Although most cases can be cured with crotamiton, the drug is less efficacious than either permethrin or lindane.<sup>5</sup>

Five to 10% sulfur in a petrolatum base also is scabiecidal. The preparation is applied on three successive nights. Although the product is messy and malodorous, tends to stain, and can produce an irritant dermatitis, some prefer sulfur because of its presumed safety. However, the efficacy of sulfur has not been critically evaluated.<sup>5</sup>

Treatments with benzyl benzoate (either by itself or in combination with other drugs), malathion, and thiabendazole are not presently approved for scabietic therapy.

### **Ivermectin: A Possible Solution**

Although the treatment of scabies has conventionally been with topical insecticides, the use of drugs for systemic efficacy against insect parasites is widely practiced with domestic animals. Oral ivermectin (Stromectol<sup>®</sup>) has proven to be an excellent antiparasitic agent in veterinary medicine for a variety of nematodes, insects, and acarine parasites.<sup>27,28</sup> It is derived from a class of compounds known as avermectins. Structurally, it is a macrocyclic lactone similar to the macrolide antibiotics but without antibacterial activity. For animals, it is formulated for both topical and oral delivery, for administration in food, and as a subcuta-

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neous injection.<sup>10</sup> It is given every 2 months to horses to prevent reinfestations. Ivermectin has proven beneficial for sarcoptic mange in domesticated animals.<sup>29</sup>

Ivermectin has been used extensively to treat 6 million people in 30 countries for onchocerciasis, caused by the filarial worm, *Onchocerca volvulus*.<sup>28,30</sup> Ivermectin also has proven effective for the human diseases, loiasis, strongyloidiasis, bancroftian filariasis, and cutaneous larva migrans.<sup>28,30-33</sup>

Several studies have now evaluated ivermectin for human scabies.<sup>10,29,34-38</sup> At a dosage of 200 µg/kg, results have been excellent.<sup>10,35-38</sup> Meinking *et al*<sup>10</sup> reported 100% clearance with one single oral dose of ivermectin in 11 patients with uncomplicated scabies. In scabietic patients who also were HIV-infected, 91% clearance at 4 weeks was achieved with a single oral dose of ivermectin (two of the patients were given a second oral dose at the 2-week interval). It is noteworthy that two of the HIV-infected patients had Norwegian-type scabies, which is normally quite recalcitrant to standard therapy. Marty *et al*<sup>38</sup> reported 100% clearance with single dosages of ivermectin to control a scabies outbreak in a 53-patient nursing home.

It appears that a single oral dose of ivermectin has anti-scabietic activity for 6 weeks; thereafter, reinfestation from other family members or sexual contacts, or via fomite transmission is possible.<sup>10</sup> There were no side effects reported with the use of the drug in any of the scabies studies to date, except for one bizarre report of fatal complications in patients from a long-term care facility.<sup>39</sup> The affected patients had been treated with various therapies, including "repeated topical application of lindane," as well as an abundance of antipsychotic drugs prior to a single oral dose of ivermectin.<sup>39</sup> These same individuals experienced lethargy, anorexia, and listlessness prior to their deaths—adverse effects not previously associated with any of the millions of patients worldwide who have taken ivermectin for various parasitic diseases. However, these side effects have been associated with overdosage of lindane. It is important to note that in this latter report, a single oral dose of ivermectin completely corrected a 6-month epidemic of scabies in a 210-bed facility within 5 days.<sup>39</sup>

The FDA approved ivermectin for general use in 1996. Our office has successfully treated more than 100 index cases of scabies with ivermectin. Our patients did not experience side effects or recurrences when all family members and others in intimate contact were also treated.<sup>40,41</sup> The dosage requirement now appears to be 250 µg/kg. Similar to therapy with topical products, symptomatic pruritus can easily remain for 2 to 4 weeks after treatment, while the dead mites in the outer layers of skin are sloughed off with normal exfoliation.

Moreover, a definite worsening of the skin eruption can occur in terms of lesion count and inflammation at the sites of infestations for the first few days after oral therapy. Patients need to know that such a reaction does not imply treatment failure, but rather that the body's immune system is still reacting to the mite feces or toxin products produced during mite expiration. Ivermectin appears to be a new direction in scabietic therapeutics.

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