

# Chapter 9

## PROTECTION OF THE SKIN

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SUMMARY

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## INTRODUCTION

The purpose of this chapter is to provide general information on the skin and its contribution to health, general skin care, factors that contribute to skin disease during deployment, skin protection during deployment, and skin diseases affected by deployment. This chapter includes a review of the effects of skin disease on military operations during deployment and the necessity of adequate medical planning for managing skin disease in the field.

Relative to the other immediate hazards of deployments, skin protection is seldom considered a priority in the US Armed Forces. For example, it is common to see personnel working in military installations without adequate skin protection from ultraviolet (UV) light. Actions that protect against UV

exposure can also help prevent heat injuries. Many military personnel have been plagued by skin malignancies, as well as by skin infections and dermatitis from insufficient skin protection. These preventable diseases cause a significant loss of man-hours to garrison and field forces. However, once diagnosed, skin diseases can be treated easily, thus allowing the affected service member to return to duty (Figure 9-1).

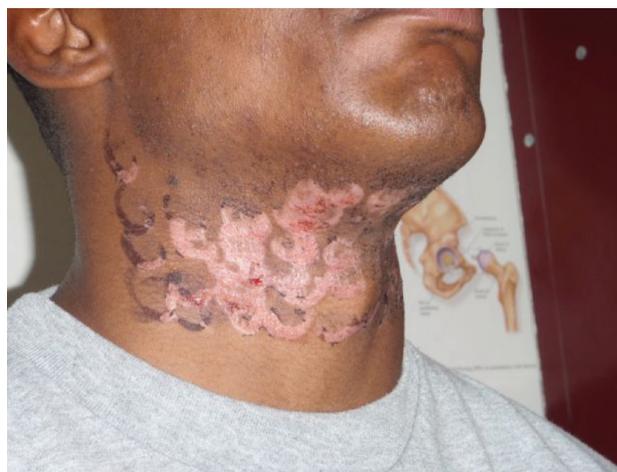
When skin diseases occur from insufficient skin protection, service members might be evaluated by healthcare providers who have limited training and experience in the management of skin disease. Inexperienced providers use a set array of therapeutic options to treat patient symptoms without diagnosing the illness. Often, this results in multiple visits and failed patient treatments. In addition, it results in great cost to the military healthcare system (Figure 9-2 and Figure 9-3). For the care and management of skin diseases, readers are referred to a more complete reference on the military importance of diagnosing and treating skin disease.<sup>1</sup>



**Fig. 9-1.** Benign neoplasms are the second most frequent dermatological cases in recent deployments; skin cancers are less frequent, but their early diagnosis and treatment are critical. This case of a malignant melanoma in a 30-year-old soldier was originally considered simply a cosmetic issue. AKO (Army Knowledge Online) teleconsultation from Afghanistan quickly led to evacuation, excision, treatment, and return to duty of this soldier, possibly saving his life. In April 2004, the US Army Medical Department approved the use of the US Army e-mail system (AKO) for teledermatology consultations from deployed providers in Iraq, Kuwait, and Afghanistan.

Data sources: Henning JS, Firoz BF. Combat dermatology: the prevalence of skin disease in a deployed dermatology clinic in Iraq. *J Drugs Dermatol.* 2010;9:210–214. Poropatch RK, DeTreville R, Lappan C, Kohuth C. The US Army telemedicine program—general overview and current status in Southwest Asia. *Telemed J e-Health.* 2006;12:396–408).

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0274040909.



**Fig. 9-2.** Pseudofolliculitis barbae (PFB) is a common form of skin irritation on the face in men with curly hair, where shaved hair tends to curl into the skin leading to an inflammatory reaction. The skin irritation can become a serious problem for some soldiers, leading to papules and over time cause keloid scarring in the beard area. This case illustrates a peculiar pattern of burns and depigmentation in a soldier who obtained incorrectly applied laser treatment for PFB and associated keloids from a local provider during deployment. He received successful corrective treatment from military dermatologists.

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0293090815.

Media and public opinion focus on healthcare priorities and affect planning during military operations. Rapid communications magnify the effect of real or rumored skin diseases on operations (Figures 9-4 and 9-5). Newspapers described the difficulty of controlling lice and skin disease among Cuban detainees during Operation Sea Signal.<sup>2</sup> This media report resulted in

large-scale evaluation and treatment of all refugees in Guantanamo Bay, Cuba. Outbreaks of skin disease in a large number of Bosnian fusiliers were reported by a British newspaper, which forced a large-scale investigation of the involved unit.<sup>3</sup> Unexpected demands on medical personnel and supplies are but one result of such media reports and are often difficult to anticipate in planning.

### SKIN AND ITS CONTRIBUTION TO HEALTH

The skin is our largest organ. It is also a complex organ composed of three layers:

- epidermis
  - stratum corneum
  - keratinocytes
  - basal layer
- dermis
  - blood vessels
  - lymph vessels
  - hair follicles
  - sweat glands
  - nerves
  - sebaceous glands
- subcutaneous fat.

skin color. The *dermis* (or middle layer) provides skin pliability and elasticity. The *subcutaneous fat* layer is between the muscle fascia and the dermis. Skin is essential to a person's survival, and it:

The *epidermis* is the outermost layer that contains



**Fig. 9-3.** Granulomatous tattoo reaction in a deployed 34-year-old military contractor. Red tattoo ink is commonly associated with nodular tattoo reactions. Cinnabar (mercury sulfide) coloring is a likely cause of this reaction 4 months after the tattoo. Definitive treatment includes surgical excision or intralesional steroid injection, and should include patient education.

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0493081022.



**Fig. 9-4.** Vigorous response to smallpox immunization in a 25-year-old airman during deployment to Afghanistan 10 days after smallpox and typhoid vaccinations in the left arm and anthrax immunization in the right arm. Antihistamine therapy was prescribed, with resolution of the rash within 1 week. Safety of militarily specific vaccines, such as anthrax and smallpox, has been a controversial issue in the past, with public perceptions fed in part by relatively infrequent and manageable immunological hyperresponsiveness.

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0169110501.



**Fig. 9-5.** Leishmaniasis is a parasitic infection transmitted to humans from rodents by sand flies and has been an important military issue since the first Gulf War, when soldiers deployed to areas where the infection is endemic. There was much misinformation about symptom complaints following the 1991 Gulf War; leishmania infection was briefly implicated in mystery illnesses, and redeploying soldiers were even banned from blood donations for a period of time. This case illustrates lesions on the hands of a soldier with cutaneous leishmania infection in Afghanistan in 2011. Data source: Martin S, Gambel J, Jackson J, et al. Leishmaniasis in the United States military. *Mil Med.* 1998;163:801–807. Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0020110119.

- provides a barrier that prevents harmful substances and microorganisms from entering the body,
- protects body tissues against injury,
- controls the loss of life-sustaining fluids (eg, blood and water),
- helps regulate body temperature, and
- protects against the sun's damaging UV rays.

The epidermis provides the barrier function of the skin. The stratum corneum—an epidermal layer composed of interlocking acellular keratin plates—acts as a barrier against microbe invasion and loss of water. Sweat aids lipid distribution. The accumulation of sweat on the skin dilutes antigens and microbes that collect there. Through sweat accumulation, keratin plates become saturated by water on the skin. This antimicrobial barrier is augmented by *Langerhans cells*, which are an integral part of the cell-mediated immune system. These cells attach to foreign material and present it to the T lymphocytes for destruction. Disruption of this barrier causes a loss of body fluid

(particularly noted in blisters and burns) and increases the risk of infection.

Protection from UV radiation is provided by a protein barrier in the stratum corneum and melanin. Melanin is a pigment produced by melanosomes in the basal layer of the epidermis. It absorbs UV radiation and produces a “tanned” color. Skin that lacks the ability to produce melanin has a higher risk for production of UV or solar-induced skin cancer. Skin types with little melanin production seldom tan, but they burn easily. Although the ability to tan indicates a lower risk of sunburn, the long-held belief that a good tan is a healthy sign is false. A deep tan is indicative of excessive exposure to UV radiation without adequate skin protection.

The primary site for heat exchange between the body and the surrounding environment is the skin surface. Dermal blood vessels provide nutritional support to the skin and regulate body temperature by transferring heat to the body surface. Body temperature is maintained near 37°C primarily by action of the blood vessels and sweat glands. Blood flow to the skin is regulated by dilation and constriction of these blood vessels. When the body has excess heat, these dermal blood vessels dilate, thus allowing heat dissipation by radiation, convection, and conductance. Water is secreted by sweat glands in the dermis. Water reaching the skin surface reduces core body temperature by evaporation. Skin disease associated with a large buildup of scale impairs sweat. Impaired sweat production makes a service member vulnerable to hyperthermia.<sup>4</sup>

Psoriasis, atopic dermatitis, seborrheic dermatitis, eczema, and contact dermatitis are skin diseases that can cause a generalized inflammation of the skin. Patients with these conditions present with generalized erythema (redness), which is caused by vasodilation of the dermal blood vessels. Generalized cutaneous vasodilation brings additional heat from the body core to the skin surface, where it is normally lost to the external environment. Radiant heat loss, which is exclusively a function of surface temperature, can increase significantly. This loss of body heat, which is not controlled by any thermoregulatory mechanism, causes the core body temperature to fall. These patients have very warm red skin, complain of being cold, and shiver. Treatment is aimed at vasoconstricting the dermal blood vessels.

The skin also plays a role in the synthesis of activated vitamin D. Activated vitamin D is essential in the regulation of calcium and in the differentiation of epidermal keratinocytes.<sup>5</sup> The importance of vitamin D to overall health—including a possible protective function for nonskin cancer—and vitamin

deficiencies in different populations must be balanced against concerns over rising skin cancer rates. The merits of dietary vitamin D supplements versus

natural synthesis mediated by exposure to sunlight are also part of an ongoing debate, as described in Exhibit 9-1.

## GENERAL SKIN CARE

### Skin Cleansing and Lubrication

Guidelines for bathing frequency in the field were established to prevent body louse infestation and louse-borne disease.<sup>6,7</sup> This bathing frequency, however, does not address its effect on morale or rate of bacterial skin infections among service members. Bathing frequency became important during deployments to Iraq and Afghanistan because of the logistical requirements of supplying water. In 1991, after reviewing after-action reports and correspondence on bathing and skin disease in field environments, Troychok<sup>8</sup> noted that:

- daily bathing/showering was recommended but, at a minimum, bathing or showering should occur at least weekly;
- loose clothing should be worn; and
- skin integrity must be maintained.

Operations in extremely cold environments also present challenges in terms of bathing frequency. In a 1991 report on the role of showering frequency in the reduction of skin infections among military personnel in the field, the US Army Medical Research and Development Command made the following four recommendations<sup>9</sup>:

1. The interval between showers should not exceed 24 hours in personnel deployed to the tropics if chlorhexidine antiseptic or medicated soap is used with water. Using unmedicated soap requires more frequent showers.
2. In a tropical environment, wounded or abraded skin will need to be cleaned twice a day if medicated soap or chlorhexidine is used with water. Cleaning with unmedicated soap should be performed three times a day on damaged skin.
3. Showers or baths should be taken at least every 7 days to prevent body lice infestations in the military.
4. The role of antimicrobial additives in preventing skin infections among service members in the field warrants further research. Chlorhexidine is the only substance shown to have prophylactic activity against skin infections.

Cleansing of the skin with soap and water enhances the removal of oil, grime, and microbes. Deodorant soaps have added antimicrobial ingredients to reduce skin bacterial counts, but these antimicrobial additives do not improve the cleaning ability of soaps or detergents. Using antibacterial/deodorant soaps promote the growth of *Streptococcus pyogenes* on the skin.<sup>10</sup> Plain soap reduces the growth of *S pyogenes*, but does not affect the growth of *Staphylococcus aureus*. Antibacterial soaps inhibit the growth of normal skin bacteria, which can have an inhibitory role in the growth of *S pyogenes*.<sup>10,11</sup>

Skin cleansing during military operations in cold or minimal water environments is limited by water supply and the practicality of field bathing. Lipid-free skin cleansers (eg, Aquanil [Person & Covey, Inc, Glendale, Calif] or Cetaphil [Galderma Laboratories LP, Fort Worth, Tex]) can be used in these environments. These cleansers are wiped on and then wiped off. For years, these products have been used to cleanse patients suffering from skin diseases exacerbated by soap and water cleansing. Aquanil freezes at around 27.6°F to 28.4°F. Extended freezing of Aquanil for a 10-day period caused the product to clump or become watery. This finding was not observed during periods of brief freezing (RA Crowell, Director of Quality Assurance, Person & Covey, Inc, personal communication, 1977). There are no other data available on the stability of these products in hot or freezing environments. These findings should be examined further for future deployments.

### Solar Protection and Skin Cancer

Skin cancer is the most common form of cancer in the United States. It is estimated that more than 1 million nonmelanoma skin cancers are diagnosed each year; nearly 60,000 cases of melanoma were diagnosed in 2005.<sup>12</sup> Basal cell carcinoma (BCC), although seldom fatal, accounts for 80% of skin cancers. BCCs are locally destructive. Squamous cell carcinoma (SCC) is the second most common form of skin cancer.<sup>12</sup> Its incidence has increased from 4% to 8% since 1960.<sup>13</sup> SCC and BCC both cause local tissue destruction. Cutaneous SCC is responsible for about 2,300 deaths per year. Melanoma, the most aggressive form of skin cancer, caused almost 7,700 deaths in the United States in 2005. Nonmelanoma skin cancers caused approximately 2,800 deaths in the same year.<sup>12</sup>

In the past 6 years, increasing numbers of service

## EXHIBIT 9-1

### VITAMIN D VERSUS SKIN CANCER

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Clothing, as well as the ultraviolet (UV) index, provides protection from UV radiation (UVR). Excessive exposure to sunlight is associated with an increase in morbidity from skin cancer and other skin diseases. There is a worldwide effort to reduce individual exposure to UVR, best illustrated by Australian government programs.<sup>(1-5)</sup> The take-home message from these public health programs has, in some cases, been reduced to a blanket directive to minimize exposure to UVR.

However, some media<sup>(6)</sup> coverage has been given to contradictory scientific evidence that suggests excessive avoidance of UVR is detrimental to overall health.<sup>(7-10)</sup> The basis for this apparent contradiction lies in the following argument:

- Vitamin D provides protection against some cancers and represents other possible health benefits.<sup>(11)</sup>
- If the best human source for vitamin D is UVR-mediated synthesis, then complete avoidance of exposure to UVR can result in vitamin D deficiencies and associated morbidity.

Historically, diseases such as rickets have provided proof that vitamin D deficiencies can be detrimental, and, under some circumstances, exposure to sunlight can both prevent and treat the disease.<sup>(11,12)</sup>

The underlying science is more complicated than simply making a choice between complete protection and full exposure. The following factors can contribute to ensuring an adequate source of vitamin D:

- latitude and time of year,
- length of exposure,
- age,
- skin type (melanin),
- clothing coverage,
- lifestyle,
- body fat,
- natural dietary sources of vitamin D, and
- various vitamin D supplements.

Ironically, vitamin D deficiencies have been identified even in Australian populations.<sup>(13)</sup> Although vitamin D deficiencies are more common in older people, deficiencies have been identified in populations of young adults, including urban medical personnel in US cities.<sup>(14)</sup> Although UVR intensity is too low at higher latitudes during the winter months, there are seasonal variations in vitamin D (ie, fat storage from other seasons can offset that situation). In obese individuals, stored vitamin D might not be accessible.<sup>(11)</sup> More melanin reduces vitamin D production relative to the UVR exposure; therefore, individuals less prone to sunburn would need a longer exposure time to produce the recommended levels of vitamin D. Within some ethnic communities, religious or cultural practices set a standard of modesty that requires that, in public, clothing covers most or all of the body surface. Vitamin D deficiencies have also occurred within these groups.<sup>(15,16)</sup> This might be an important consideration when providing medical care to civilian populations.

When UVR intensity is sufficient to simulate vitamin D production, only limited exposure of the face, hands, arms, and/or legs for 5 to 15 minutes, 2 to 3 times per week, is necessary.<sup>(11)</sup> Vitamin D production is determined by the finite amount of precursor; therefore, when the precursor supply is converted, additional exposure does not result in additional production of vitamin D. Thus, the length of exposure required to ensure optimal vitamin D production is not long. As noted during the winter months, UVR intensity is not sufficient to stimulate vitamin D synthesis. Holick<sup>(11)</sup> reported that the same conditions that decreased UVR during the winter months at higher latitudes, lowered solar angles, and created a longer pathway for light through the atmosphere (see Exhibit 9-6) also occurred in the early morning and late afternoon. Holick recommended specifically that the short exposure time occurred between 1000 and 1500 hours local daylight time. This time period near solar noon corresponded to the guideline for skin cancer protection that sunlight exposure be minimized. He showed that the limited recommended exposure time would not cause sunburn.

To a degree, the media positions presented in the scientific literature might reflect professional biases. Public health officials, as well as many dermatologists, facing alarming statistical evidence of an increase in skin cancer with patients

(Exhibit 9-1 continues)

**Exhibit 9-1** *continued*

presenting with melanoma and other sun-related skin morbidity might be less than enthusiastic about the health benefit claims of maintaining adequate levels of vitamin D if it encourages greater UVR exposure.<sup>(12)</sup> In addition, nutritionists and scientists who examine cancer epidemiology might promote the importance of vitamin D. Also, some dermatologists might favor vitamin D supplements over calls for UVR exposure.

Other nutritionists might place more emphasis on external dietary or supplementary vitamin D. In Europe, vitamin D supplements in food is restricted because of toxicity from excessive supplement use.<sup>(11)</sup> For US military personnel, generally, the MRE (Meal, Ready-to-Eat) rations do not include many foods naturally rich in vitamin D, nor is there good access to foods with supplemental vitamin D under field conditions.

The problem of balancing concerns over vitamin D deficiencies versus skin cancer is similar to the dilemma of ensuring adequate hydration while avoiding hyponatremia (see Montain, Chapter 7). (Hyponatremia refers to a low concentration of sodium in the blood; also known as “water intoxication.”) Emphasis on the importance of hydration in the prevention of heat injury has, in a few cases, lead to hyponatremia and fatalities. During military deployment, both vitamin D deficiencies and overexposure to UVR are possible. The addition of dietary supplements to military rations is under consideration. Currently, most military training occurs in the southern latitudes of the continental United States, and the majority of military deployments are to the Middle East, other desert climates, or higher altitudes. Despite the emphasis on sunscreen—and directives to wear uniforms in a manner to maximize protection against sunburn, insects, and abrasion—it seems unlikely that most US Army personnel with outdoor duties would not receive enough UVR exposure to ensure adequate vitamin D production levels. Despite the apparent benefits of vitamin D, soldiers, generally, should avoid excessive exposure to solar radiation, tanning, and sunburn.

Note: Exhibit courtesy of Staff, US Army Research Institute of Environmental Medicine, Natick, Massachusetts.

Data sources: (1) World Health Organization, 2002. *Global Solar UV Index: A Practical Guide*. WHO/SDE/OEH/02.2. <http://www.who.int/uv/.2002> Accessed July 24, 2006. (2) McCarthy W. The Australian experience in sun protection and screening for melanoma. *J Surg Oncol*. 2004;86:236–245. (3) Albert MR, Ostheimer KG. The evolution of current medical and popular attitudes toward ultraviolet light exposure: part 3. *J Am Acad Dermatol*. 2003;49:1097–1106. (4) Ferrini RL. American College of Preventative Medicine Practice Policy: skin protection from ultraviolet light exposure. *Am J Prev Med*. 1998;14:83–86. (5) Kaminester LH. Current concepts: photoprotection. *Arch Fam Med*. 1996;5:289–295. (6) Klado B. The good sun? *Boston Globe*. August 29, 2005. (7) Ness AR, Frankel SJ, Gunnell DJ, Smith GD. Are we still dying for a tan? *J Cosmetic Dermatol*. 2002;1:43–46. (8) Grant WB. An estimate of premature cancer mortality in the U.S. due to inadequate doses of solar ultraviolet-B radiation. *Cancer*. 2002;94:1867–1875. (9) Grant WB, Strange RC, Garland CF. Sunshine is good medicine. The health benefits of ultraviolet-B induced vitamin D production. *J Cosmetic Dermatol*. 2004;2:8698. (10) Zittermann A. Vitamin D in preventive medicine: are we ignoring the evidence? *Br J Nutr*. 2003;89:552–572. (11) Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *Am J Clin Nutr*. 2004;80(suppl):1678S–1688S. (12) Albert MR, Ostheimer KG. The evolution of current medical and popular attitudes toward ultraviolet light exposure: part 2. *J Am Acad Dermatol*. 2003;48:909–918. (13) Nowson CA, Margerison C. Vitamin intake and vitamin D status of Australians. *Med J Aust*. 2002;177:149–152. (14) Tangpricha V, Pearce EN, Chen TC, Holick MF. Vitamin D insufficiency among free-living healthy young adults. *Am J Med*. 2002;112:659–662. (15) Glerup H, Mikkelsen K, Poulsen L, et al. Commonly recommended daily intake of vitamin D is not sufficient if sunlight exposure is limited. *J Intern Med*. 2000;247:260–268. (16) Matsuoka LY, Wortsman J, Dannenberg J, Hollis BW, Lu Z, Holick MF. Clothing prevents ultraviolet-B radiation-dependent photosynthesis of vitamin D<sub>3</sub>. *J Clin Endocrinol Metab*. 1992;75:1099–1103.

members have been diagnosed with skin cancer. At least 2% of BCC occurs in an age group less than 30 years old. These younger patients have an increased risk of developing additional skin cancers later in life. Seventy percent of BCCs in this age group are located on the nose and cheek, with most patients being women. Because of cosmetic concerns, younger patients are more likely referred for tissue-sparing procedures (ie, Mohs surgery). A second age group (31–55) accounts for 6% to 8% of the total number of BCC cases.<sup>14</sup> People in both of these age groups serve in the military.

Recreational and occupational exposure to sunlight is associated with the development of skin cancer, as indicated by the predominant region of involvement. Although sunlight over the entire spectral range of

solar radiation (200 to  $8 \times 10^4$  nm) contributes to general body warming, only a small amount of the total solar energy—in the UV spectral range of 280 to 400 nm—is associated with skin damage. The potential for skin damage from UV exposure is broken down further into UVA rays ([UV light ray A] UV radiation [UVR] from 320 to 400 nm) and UVB rays ([UV light ray B] UVR from 290 to 320 nm). In men, 75% of SCC and 80% of BCC develop on the face, head, and neck regions. An additional 18% of SCCs develop on the upper extremities in men; however, only 1.3% occur on their lower extremities.<sup>15,16</sup> The involved areas correspond to regions that received the greatest amount of UV radiation on a daily basis.<sup>17</sup>

Prevention of these skin cancers among service

members and, thus, eventual retirees, focuses on protecting the areas of the skin that develop the most skin cancers. The upper extremities can be protected by requiring the service member to wear the battle dress uniform (BDU) with the sleeves down. Wearing the uniform in this manner protects against UV light exposure and biting insects. Service members who wear their BDUs with the sleeves rolled up must wear sunscreens. These sunscreens need to be reapplied regularly, especially when the individual sweats. Uniforms currently worn by service members provide excellent protection from

UVA and UVB rays to the covered areas (Table 9-1).

Headgear also provides protection against solar radiation. In general, headgear should shade the entire face and neck area from direct sunlight during the time of maximum exposure to solar radiation. Unfortunately, almost no issue headgear offers protection from solar radiation that is reflected off the ground or other surfaces; therefore, facial sunscreen is still essential. Additional information on the selection of headgear for protection against solar radiation is included in the section on Protection from Solar Radiation.

## FACTORS THAT CONTRIBUTE TO SKIN DISEASE DURING DEPLOYMENT

Service members are exposed to a wide range of environmental conditions during deployment. Physical factors in the environment that impact the skin include temperature, humidity, rainfall, wind, and sunlight. Individual factors that can affect skin disease include the following:

- age,
- gender,
- medications,
- stress, and
- general health.

In addition, the type of clothing and footwear worn alters conditions at the skin surface.<sup>18</sup> In other disciplines, microclimate refers to meteorological factors that directly impact an individual for a given set of locations in time and space. Conditions at the interface between skin and the environment are so important that physiologists refer to physical conditions at the skin surface as “the microclimate.” Table 9-2 is a summary of known skin diseases that are affected by environmental and psychological changes.

The role that climate plays in skin disease is easily observed in tropical operations, which are characterized by an abundance of bacterial and fungal infections because of the combination of high temperatures and high humidity. Observations have shown that high levels of humidity, in combination with a lower dry bulb temperature, promote sweat duct occlusion with the formation of miliaria (or sweat rash) and hidradenitis suppurativa (a chronic inflammation of the apocrine glands).<sup>19</sup> High temperatures promote increased sweating; however, high humidity reduces the evaporation of moisture from the skin. Buildup of moisture in the stratum corneum dilutes the surface lipids and reduces its barrier properties. Continued accumulation of moisture on the skin raises the protective acidic skin pH to a neutral level. Increased hydration of the stratum corneum promotes the growth of gram-positive cocci

on the skin.<sup>19</sup> In the tropics, bacterial skin infections are caused predominately by *S pyogenes*.<sup>11,20</sup>

Climate also affects the activity of insects and, therefore, insect-borne disease. As a general rule, the risk of insect-vectored diseases is greater at lower latitudes and warmer climates; but, locally, the risk of exposure can also vary with season or time of day. Canizares,<sup>21</sup> for example, found a relationship between temperature and insect numbers. Few cases of insect-borne disease were seen during Operation Desert Storm, because it occurred during the winter months. With year-round exposure, the incidence of leishmaniasis has increased significantly during Operation Iraqi Freedom/Operation Enduring Freedom, beginning in 2002<sup>22</sup> (Exhibit 9-2).

A decrease in humidity during the winter months causes its own problems by promoting the development of dry skin. Drying of the stratum corneum causes a loss of epidermal flexibility, with cracking and fissuring ensuing. Uncontrolled pruritus soon develops. The only satisfactory treatment is rehydration of the stratum corneum. Periods of low humidity also exacerbate skin diseases affecting the stratum corneum. Chapping of the skin has been associated with periods of low air moisture following periods of high air moisture.<sup>23</sup> Extreme cold weather increases the granular layer of the skin on the dorsum of the hands. In addition, a loss of dermal elastic tissue was seen with this change.<sup>24</sup> (Additional information on the effects of cold weather exposure can be found in *Medical Aspects of Harsh Environments*, Volume 1 [see Section II: Cold Environments].)

Clothing and footwear, especially if designed to be “waterproof” or impermeable, reduce the loss of body heat and impair or block evaporation of moisture from the skin. Close-fitting clothing allows heat and moisture buildup to produce a localized tropical environment on the skin folds, particularly the feet. Aly and colleagues<sup>25</sup> noted that prolonged skin occlusion changed the normal, protective acidic skin pH to neutral. Skin maceration and loss of barrier function

develop from this localized environment. Some service members experience this problem when wearing the Vapor-Barrier military boots (commonly known as “Mickey Mouse” boots; AirBoss Acton [Acton Vale, Quebec, Canada]), which were designed for extreme cold weather use.<sup>26</sup> Impermeable footwear promotes the growth of bacteria and fungi, and it is not uncommon to see the rapid development of cellulitis arising

from tinea pedis (or athlete’s foot; Figure 9-6).

During deployment, service members are also exposed to new medications and vaccines. Military personnel should start all new medications about 2 to 3 weeks before deployment. Development of drug reactions or exacerbations of preexisting disease might occur before deployment. (Table 9-3 lists skin diseases that flare up from medications during deployment.)

## SKIN PROTECTION DURING DEPLOYMENT

**TABLE 9-1**  
**PERCENTAGE OF UVA AND UVB TRANSMISSION AND UPF VALUES FOR THREE CAMOUFLAGE FABRICS**

Uniform	Color	Status	UPF*	%UVA	%UVB
<b>Desert</b>					
BDU	Lt tan	Initial	240	1.35	0.31
	Lt tan	Washed <sup>†</sup>	414	0.76	0.17
	Lt brown	Initial	1,440	0.16	0.06
	Lt brown	Washed <sup>†</sup>	2,035	0.09	0.05
	Khaki	Initial	413	0.56	0.19
	Khaki	Washed <sup>†</sup>	687	0.31	0.12
<b>Hot-weather woodland</b>					
BDU	Lt green	Initial	856	0.23	0.10
	Lt green	Washed <sup>†</sup>	920	0.17	0.10
	Dk green	Initial	1,484	0.10	0.07
	Dk green	Washed <sup>†</sup>	1,698	0.07	0.06
	Brown	Initial	1,498	0.08	0.07
	Brown	Washed <sup>†</sup>	2,049	0.05	0.05
	Black	Initial	16,597	0.01	0.01
	Black	Washed <sup>†</sup>	6,262	0.02	0.02
<b>Temperate woodland</b>					
BDU	Lt green	Initial	576	0.33	0.15
	Lt green	Washed <sup>†</sup>	666	0.26	0.13
	Dk green	Initial	884	0.17	0.11
	Dk green	Washed <sup>†</sup>	1,152	0.12	0.08
	Brown	Initial	977	0.13	0.10
	Brown	Washed <sup>†</sup>	1,328	0.09	0.08
	Black	Initial	2,237	0.06	0.04
	Black	Washed <sup>†</sup>	2,324	0.05	0.04

\*All fabrics in the dyed colors would be labeled UPF 50+ (“Excellent UV Protection”) in accordance with ASTM D6603 standards.

<sup>†</sup>Washed = 40 wash cycles + UVR exposure to simulate 2 years of wear. BDU: battle dress uniform; Dk: dark; Lt: light; UPF: ultraviolet protection factor; UVA: ultraviolet light ray A; UVB: ultraviolet light ray B.

Data source: Winterhalter C, DiLuna K, Bide M. *Characterization of the Ultraviolet Protection of Combat Uniform Fabrics*. Natick, Mass: US Army Soldier and Biological Chemical Command, January 2002. Technical Report NATICK/TR-02/006.

Skin disease is a major factor in lost man-hours during ship operations. Vidmar et al<sup>27</sup> found that pyoderma accounted for a large percentage of morbidity during cold water deployment. Commanders can reduce the incidence of skin disease among their personnel by preventing conditions that cause occlusion with skin maceration. (Maceration of the skin occurs when the skin is consistently wet. Thus, the skin softens, turns white, and becomes easily infected with bacteria or fungi.) Preventive measures are shown in Exhibit 9-3. The effect of skin disease in tropical operations is reduced by preventing maceration and occlusion through the reduction of moisture buildup on the skin. Measures should also be taken to reduce skin maceration when service members are not in the field (Exhibit 9-4).

### Protection from Hot Weather Environments

In a desert environment, low humidity and reliance on the use of a limited amount of potable water for all purposes can cause different skin problems. Table 9-4 lists clothing properties for current issue uniforms, including the water vapor permeability index ( $i_m$ ) values. The  $i_m$  scale is 0 to 1, with 0 representing

**TABLE 9-2**  
**FACTORS THAT AFFECT SKIN DISEASE**

Factor	Disease
Humidity	
Low	Eczema, atopic dermatitis, psoriasis, dry skin, hand dermatitis, ichthyosis
High	Fungal infections, bacterial infections, atopic dermatitis, Hailey-Hailey disease, acne, warts, miliaria, hidradenitis suppurativa
Sunshine	Discoid lupus erythematosus, Darier’s disease, porphyria, herpes simplex
Stress	Atopic dermatitis, psoriasis, lichen planus, acne

## EXHIBIT 9-2

### DERMATOLOGY INFORMATION AVAILABLE THROUGH ARMY KNOWLEDGE ONLINE

Army Knowledge Online (AKO) provides dermatology information to all service members in the US Army who have AKO accounts. For example, this site provides information on leishmaniasis\* and teledermatology.<sup>†</sup> To access this information, follow these eight steps:

1. Access the AKO Web site at <https://www.us.army.mil/suite/login/welcome.html>.
2. Select "Login to AKO."
3. Login with established user name and password.
4. Go to far left at top of screen and click "Home," then use arrow to scroll down to click on "site maps."
5. Scroll down to "search sites," fill in "name of site" block as "60L Dermatology," then click under "type of site," then "organizational sites," and then click "search."
6. A series of organization names will appear; the first one should be "60L Dermatology"—click "Homepage."
7. A page should appear with the first left-hand column heading in black—"Dermatology Support for OIF/OEF."
8. Scroll down through the items to the black heading entitled "Leishmaniasis Information."

Although the layout of Web sites invariably changes with time, the basic approach to accessing information by narrowing the focus of the search through directories and subdirectories will be similar from one version to the next. Contact your unit's information management officer if you have any difficulties accessing the AKO site or navigating through it.

\*A parasitic disease spread by the bite of infected sand flies.

<sup>†</sup>Delivery of healthcare for persons with skin diseases using long-distance communication.

impermeable clothing and 1 representing bare skin<sup>28</sup> (Table 9-4 and Figure 9-7). Commanders should consider that wearing heavy or starched clothing, body armor, or chemical-biological protective clothing significantly limits evaporation of perspiration. Service members wearing these types of clothing suffer acute, heat-related disease because of their inability to regulate core temperature when the pathways for heat exchange via convection, radiation, conductance, or especially evaporation are blocked or severely reduced. Long-term wear creates a tropical microclimate with eventual skin maceration. Exhibit 9-5 describes protective measures for desert deployment.

#### Protection from Cold Weather Environments

Skin protective measures during cold weather operations are similar to those during desert operations. With a lack of humidity in the air, all exposed skin loses moisture and dries out. This drying of the stratum corneum causes chapping of the skin, which can be prevented by frequently applying an emollient lotion to lubricate the skin. Lubrication follows cleaning of the skin. Reversal of dry skin is achieved by applying an ointment to the skin after it has been moistened. The affected area (hands

and feet) should be covered with socks, and other areas should be covered with clean, long underwear. Crisco (J. M. Smucker Company, Orrville, Ohio) or lard can be used as an ointment if white petroleum jelly is not available. Lip protection using a wax-based sunscreen is advised.

Relative to operations in cold, dry environments, there are additional concerns to consider during operations in cold, wet environments. In the wetter environments, clothing should keep the skin warm and dry. Being wet in cold weather is a life-threatening condition because of the danger of losing core body heat. Service members must dry the affected area immediately and put on dry clothing. Exposed areas of the skin can dry and crack. However, frequent applications of emollient creams or lotions<sup>29</sup> can manage and prevent this problem.

#### Protection from Solar Radiation

During deployment, wearing effective sun protective headgear is essential. Many deployments require the use of the Kevlar (E. I. du Pont de Nemours and Company, Wilmington, Del) helmet for protection against fragments or gunshot wounds. When service members are not required to wear the Kevlar helmet, they should wear the hot weather hat.



**Fig. 9-6.** Tinea pedis with secondary bacterial infection in a 45-year-old seaman aboard ship. The bacterial infection often includes gram-negative organisms (*Pseudomonas*). This was treated following teleconsultation with a combination of antibiotic, oral antifungal, and attention to foot hygiene, including modification of foot wear.

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0135110413.

Sometimes, a cotton neckerchief is issued for additional sun protection and as a sweat cloth. The solar protection provided by a brimmed hat is greater than the beret or the BDU cap—or the newer Army Combat Uniform-billed patrol cap—that is similar to civilian baseball caps. The BDU cap protects the forehead and nose; however, the ears, cheeks, and back of the neck have minimal or no protection<sup>30</sup>

(Figure 9-8). Diffey and Cheeseman<sup>31</sup> found that a hat with at least a 7.5-cm brim provided the best protection for the face, cheeks, chin, and back of the neck, whereas peaked baseball-style caps protected only the nose and the forehead.

The official headgear of the Army, the beret, provides less solar protection of the head and neck than the BDU cap. The beret is an asymmetric brimless hat. There is a 1-inch to 2-inch part of the beret that drapes over the right scalp and upper right ear. How far the beret drapes depends on the amount of molding performed by the wearer. Solar protection would only occur in hatband areas and in those areas covered by the draped beret. Schissel<sup>32</sup> reported that the beret provided a 75% reduction in UVB radiation to the vertex of the scalp, an area that the beret covers when worn. Furthermore, he reported that the beret provided only a 2% reduction in UVB radiation to the ear and chin, and a 12% reduction to the neck. In this study, the ear monitor was located near the left ear, the side *not* covered by the beret.<sup>32</sup> The beret might provide greater protection to the right scalp and right upper ear when it drapes over these areas.

The 1989 study conducted by Keeling and colleagues<sup>30</sup> monitored the upper and lower ear separately on live subjects and noted little change in the solar protection provided to those two areas. The headgear in their study covered either the entire ear or not at all. Bilateral solar protection in asymmetric headgear has not been measured. The beret, although limited in its design to protect the head and neck of the wearer, might provide equivalent protection to the right scalp

**TABLE 9-3**

### SKIN REACTIONS CAUSED BY DIFFERENT CLASSES OF DRUGS

Skin Reaction	Drug Class	Examples
Phototoxic	Antimicrobials	Tetracyclines, quinolones, sulfonamides, nalidixic acid
	Cardiac	Nifedipine, quinidine, propranolol
	Acne medication	Retinoids
	Tricyclic antidepressants	Nortriptyline
	Diuretics	Furosemide, hydrochlorothiazide
	Nonsteroidal antiinflammatory	Ketoprofen, naproxen, piroxicam
	Hyperglycemic agents	Sulfonylureas
Pruritus	Antimalarials	Chloroquine
Psoriasis	Cardiac	Beta blockers, angiotensin-converting enzyme inhibitors, quinidine
	Antimalarials	Chloroquine, primaquine
	Nonsteroidal antiinflammatory	Ketoprofen, naproxen, ibuprofen, indomethacin
Xerosis	H <sub>2</sub> -receptor blockers	Cimetidine, ranitidine, famotidine
	Acne medication	Isotretinoin, tretinoin

Data source: Litt JZ, Pawlak WA. *Drug Eruption Reference Manual*. New York, NY: Parthenon Publishing Group; 1997: 481, 485, 496–497.

### EXHIBIT 9-3

#### PREVENTION OF SKIN DISEASE FOR SAILORS

Sailors should adhere to the following guidelines to help prevent skin disease:

- Dry all wet clothing after wearing. Avoid continued wearing of wet clothing.
- Sleep in dry clothing only.
- Shower after work shift.
- Wear wet weather gear (including boots) when working in wet environments (especially for service members working in the galley).
- Change shoes and socks daily. If appropriate, wear sandals when not on duty to allow feet to dry.
- Wear rubber gloves when performing wet work. After removing gloves, hands should be rinsed, dried, and lubricated with a lotion.
- Replace any wet weather footwear or handwear if it contains a hole.
- Personnel on deck should wear a lotion-based sunscreen on exposed skin areas and use a lubricating lotion when out of the sun.

and right upper ear similar to that provided to the vertex of the scalp. Because the beret provides limited solar protection to the facial area, service members with lupus, a history of melanoma, or multiple skin cancers should wear an alternative hat when assigned to sunny climates.

Medical personnel need to advocate solar protection for soldiers in the field. Service members working on flight lines should wear a sunscreen preparation of titanium dioxide or zinc oxide (“clown white”) or both. Sunscreen should be applied to all exposed areas of the face and arms. Gel formulations of sunscreens can be applied to the face after shaving. Reapplication of sunscreen is essential after heavy sweating or swimming. The addition of titanium dioxide or zinc oxide, or both, to sunscreens provides total protection against UVB and UVA rays. Some commercially available preparations (eg, Total Block COTZ [Contains Only Titanium and Zinc—it is a mineral-based, sun care product produced by Fallene Ltd, King of Prussia, Pa]) have these compounds as their primary active sunscreens in a micronized particle form. These are usually water and sweat resistant and are nonirritating. Sun exposure should be limited during a time block centered around solar noon, when the solar irradiance and UVR

### EXHIBIT 9-4

#### SKIN PROTECTION FOR TROPICAL DEPLOYMENTS

Service members deployed to tropical areas should follow these guidelines for preventing skin disease:

- Wear well-ventilated clothing to prevent the buildup of moisture on the skin. Clothing should be hung up to dry after being worn. Flies lay eggs in clothing dried on the ground, and myiasis\* can develop. Clothing should be washed in potable water.
- Wear dry socks and footwear. Ventilated footwear, such as hot weather boots, should be worn during tropical deployments.
- Wear sandals† when not in the field to allow feet to dry.
- Wear insect repellent and use mosquito nets at night to reduce insect bites.
- Use sunscreens. Commanders should encourage personnel, whenever outside, to wear the hot weather jungle hat or a similar, wide-brim hat.
- Bathe immediately on return from field operations. Cleansing with deodorant soap reduces the bacterial count on the skin.
- Encourage commanders to limit operations in watery terrain to 48 hours if the tactical situation permits. Longer operations increase the risk of skin infection.

\*Infestation of the organs/tissues of host animals by the larvae (maggots or grubs) of flies.

†From 1969 to 1970, the 9th Infantry and other units were issued lightweight footwear (officially labeled as “comfort shoes,” but also referred to as “bivouac slippers”) to be worn during bivouac and other situations so that soldiers could remove their jungle boots, but still have some foot protection. These shoes are described in the following source: Stanton S. *U.S. Army Uniforms of the Vietnam War*. Harrisburg, Pa: Stackpole Books; 1989: 139.

Data source: Memorandum on prevention of skin disease in the Ninth Infantry Division, HQ Ninth Infantry Division, APO San Francisco, Calif; October 28, 1968. Adapted from: Army Regulation 40-29. *Prevention of Skin Disease Among Troops Operating in Inundated Areas*. US Army Vietnam (US-ARV); January 10, 1968.

is strongest. The width of the time block can vary with latitude, time of year, and assumed acceptable level of exposure. However, limiting UVR exposure is highly recommended during the summer months in the southern United States or during year-round overseas deployments to low latitude environments, 1000 to 1600 hours Daylight Savings Time (Exhibit 9-6; with

**TABLE 9-4**  
**WATER VAPOR PERMEABILITY AND**  
**INSULATION OF US ARMY UNIFORMS**

Uniform	$I_T^*$ (clo)	$i_m^\dagger$ (ND)	$i_m/clo^\ddagger$ (ND)
Army Combat Uniform	1.35	0.45	0.34
Army Combat Uniform + Body Armor with small arms protective inserts (SAPI plates)	1.47	0.44	0.31
Chemical and biological agent protective ensemble with Joint Service Lightweight Integrated Suit Technology (JLIST) overgarment over Army Combat Uniform fully encapsulated	2.53	0.39	0.15

BDU: battle dress uniform; clo: units of total insulation;  $i_m$ : vapor permeability index;  $I_m$ : permeability index;  $I_T$ : total insulation measurement; ND: nondimensional units; SAPI: small arms protection inserts.

\*Total clothing insulation in clo units ( $1 \text{ clo} = 0.155 \text{ K} \times \text{m}^2/\text{W}$ ).

†Water vapor permeability nondimensional (ND) index: values—0 = impermeable, 1 = bare skin.

‡Ratio approximate “cooling power” of clothing. Values measured at  $0.4 \text{ m} \cdot \text{s}^{-1}$ .

Data source: US Army Research Institute of Environmental Medicine (Natick, Mass).

accompanying Exhibit Table E6-1 and Exhibit Figures E6-1 and E6-2). Although this is not practical during an operational environment, training schedules should factor in sun exposure risk when planning exercises.

Commanders should discourage tanning as a means of reducing sun exposure risk among service members. Myths about the benefits of tanning cover a wide range. The facts are as follows:

- Tanning does not promote heat endurance. Only working in hot environments promotes heat endurance.
- Tanning does not promote physical endurance. Only physical activity promotes physical endurance.
- A tan obtained in a tanning salon does not protect against sunburn. Tanning salons have UVA light sources. These only protect against UVA burns. The immediate sunburn experienced from direct, as well as indirect (ie, reflection of the sun’s rays off water or other reflective surfaces), exposure to the sun is caused by UVB radiation. A UVA tan obtained in a tanning salon does not protect against a UVB burn.
- A tan is not a sign of good health. Tanning



**Fig. 9-7.** Clothing properties are tested on a thermal manikin. Values obtained for insulation and water vapor permeability are used to compare clothing as inputs to thermal models. The uniform ensemble shown is the Interceptor Body Armor worn with a Marine Corps Combat Utility Uniform with mismatched camouflage patterns. Photograph: Reproduced from the US Army Research Institute of Environmental Medicine (Natick, Mass).

is only a sign that exposure to UVB or UVA radiation has occurred. Tanning is a fashion trend, not a health practice.

## EXHIBIT 9-5

### SKIN CARE IN DESERT OPERATIONS<sup>(1-3)</sup>

Service members deployed to desert environments should follow these guidelines for avoiding skin disease:

- Use emollient-based sunscreen on the skin regularly. Protect lips by using a lip wax/sunscreen protectant. Wear a wide-brimmed hat (or jungle hat) to protect the face from solar radiation.
- Wear ventilated footwear and clothing. Do not starch clothing. Keep clothing clean.
- Clean skin regularly with soap and water. Nonlipid skin cleansers (eg, Cetaphil or Aquanil)\* can be used if water is unavailable for showering. These cleansers clean and lubricate the skin.
- Lubricate the skin. Use nonlipid cleansers. If skin becomes dry, use an emollient lotion after bathing.
- Wear insect repellent.

\*Brand names: Cetaphil, Galderma Laboratories (Fort Worth, Tex); Aquanil, Person & Covey, Inc (Glendale, Calif).

Data sources: (1) Pace JL. Sun, sand, and skin: the Persian Gulf. *Int J Dermatol*. 1991;30:247-249. (2) US Army Research Institute of Environmental Medicine, Walter Reed Army Institute of Research, US Army Medical Research and Materiel Command. *Sustaining Soldier Health and Performance in Southwest Asia: Guidance for Small Unit Leaders*. Natick, Mass: USARIEM; 1994. Technical Note 95-1. (3) US Army Research Institute of Environmental Medicine. *Sustaining Health and Performance in the Desert: A Pocket Guide to Environmental Medicine for Operations in Southwest Asia*. Natick, Mass: USARIEM; 1990. Technical Note 91-2.

- Self-tanning lotions do not protect against sunburn. These preparations are cosmetic stains that change skin color. No UVR protection is gained from their application.
- Sunscreens do not allow longer exposure to the sun for tanning purposes. Sunscreens, by design, limit UVB or UVA radiation exposure to the skin and, therefore, prevent tanning.
- Skin cancer affects people of all ages, not just

the elderly. Eighty percent of a person's total lifetime exposure to solar radiation occurs prior to military service before the age of 18; thus, early prevention programs are important.

This incidence of skin cancer can be reduced by educating service members and their commanders about proper skin care and informing them about the tanning misconceptions (Figure 9-9).

### SKIN DISEASES AFFECTED BY DEPLOYMENT

Common skin diseases can cause problems among military personnel. Field conditions—such as heat, humidity, poor hygiene, occlusive clothing, secondary infection, inadequate nutrition, UV light, etc—can exacerbate these disorders. An understanding of the following skin diseases and their management is vital:

- acne,
- hidradenitis suppurativa,
- psoriasis,
- atopic dermatitis,
- lichen planus,
- discoid lupus erythematosus,
- Darier's disease, and
- hand dermatitis.

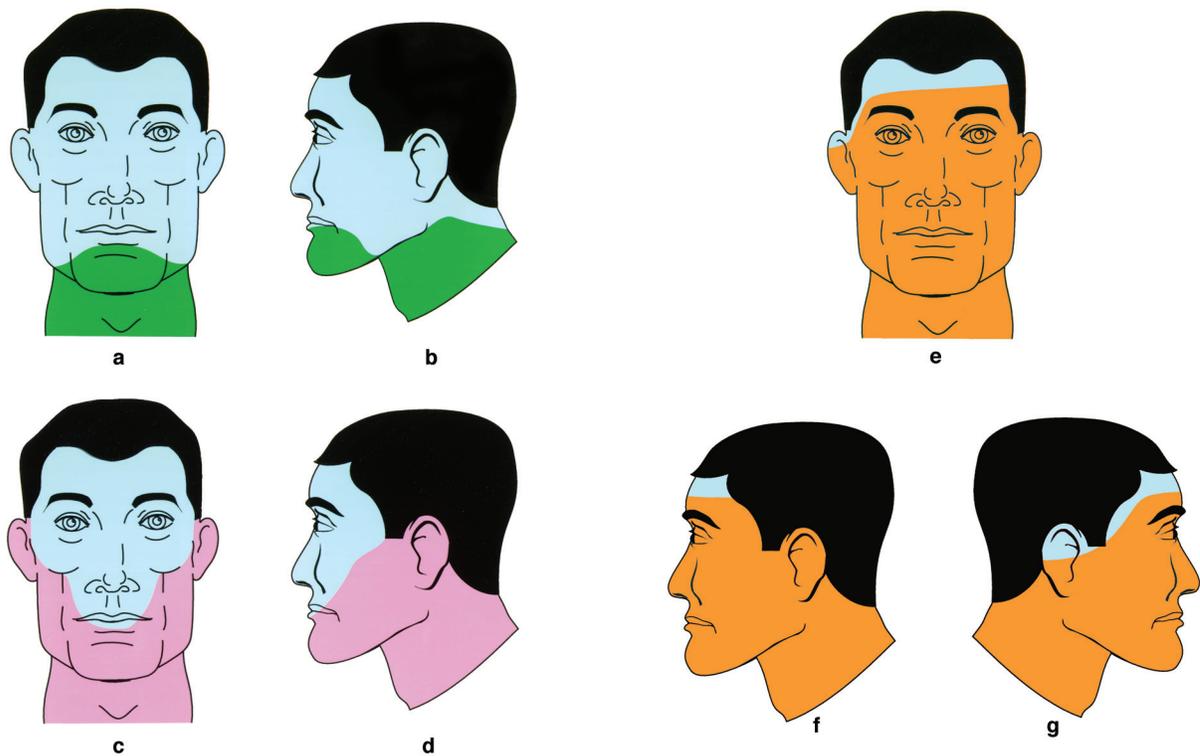
#### Acne

Acne is an inflammatory disease of the pilosebaceous apparatus. Hot-humid environments can

cause the disease to flare up. The eruption can become infected secondarily by *Staphylococcus* or *Streptococcus*. Acne can localize to areas that are chronically rubbed, including the chin, shoulder, waist, and buttocks. These areas can become unresponsive to treatment unless the source of rubbing is removed.

Service members who handle petrochemical products and cutting fluids are susceptible to acne. This chronic oily residue on the skin predisposes it to acne development. It is important that these service members wear protective clothing to keep these compounds off the skin. Line supervisors should ensure that service members wear protective clothing and that soiled clothing is properly laundered rather than worn again.

In the field, cleaning of the skin with soap and water helps control acne. For some people, the addition of an oral antibiotic might be necessary. Service members with acne requiring the use of Accutane (Hoffman-



**Fig. 9-8.** Solar protection of different head covers: jungle hat, BDU baseball hat, and beret. Jungle hat—front view (a) and side view (b). Illustrations show the areas protected by the jungle hat. All areas of the head and neck have at least a 50% reduction in direct radiation exposure. Facial areas have greater than a 80% reduction in direct solar radiation. BDU baseball hat—front view (c) and side view (d). Illustrations show the areas protected by the BDU baseball hat. The ears and posterior neck are not protected by this hat. The cheeks receive minimal protection ( $\leq 40\%$  protection). Only the forehead and nose have greater than a 80% reduction in direct solar radiation. Beret—front view (e) and side views (f and g). The beret was adopted in 2001 for use by all personnel in the US Army. Illustrations show the areas protected by the beret, which provides less than a 13% reduction in solar radiation to the forehead, nose, face, chin, left ear, and posterior neck. The protection is asymmetric because of the beret design, which provides up to a 75% reduction in the covered areas.

BDU: battle dress uniform

Illustrations of jungle hat and BDU baseball hat protection: Adapted with permission from and courtesy of Visual Illustration Service, Brooke Army Medical Center, Fort Sam Houston, Texas. From data reported by Keeling JH, Kraus EW, Pathak M, Sober AJ. Hats: design and protection from ultraviolet radiation. *Mil Med.* 1989;154:250–255.

Illustrations of beret protection: Courtesy of Visual Illustration Service, Brooke Army Medical Center, Fort Sam Houston, Texas. From data reported by Schissel DJ. Operation Shadow Warrior: a quantitative analysis of the ultraviolet radiation protection demonstrated by various headgear. *Mil Med.* 2001;166:783–785.

LaRoche, Basel, Switzerland) should not be deployed until they have completed at least 3 months of drug treatment. This period of time allows the drug to be adjusted to the appropriate dose and any side effects monitored (as well as a response to therapy).

### Hidradenitis Suppurativa

Hidradenitis suppurativa is chronic inflammation of the apocrine sweat gland. Clinical features of this disease include recurring, painful, fluctuant cysts and nodules of the axillae, buttocks, and genital area.

The cysts are usually infected by gram-positive cocci. gram-negative bacteria are isolated with repeated infections. The disease flares up during conditions of high temperature, humidity, and stress. Patients with the disease can have frequent flare-ups that might require surgical intervention.

A similar eruption involves only the scalp and is called dissecting cellulitis. Service members with this condition cannot wear protective headgear. This is a rapidly progressive disease that eventually causes permanent scarring alopecia (hair loss). Dermatology evaluation is essential to treatment.

**EXHIBIT 9-6**

**ULTRAVIOLET INDEX**

The ultraviolet (UV) index (UVI) provides general guidance regarding potential exposure to the risk of sunburn and skin damage due to UV radiation. The UVI can be presented as a forecast or derived from direct UV measurements. Based on the UVI value, different behaviors are recommended, such as applying sunscreen, wearing clothing or sunglasses, or limiting exposure time by seeking shade (Exhibit Table E6-1). A forecast is based on satellite measurements of the ozone layer and a model prediction of the UV portion of solar radiation reaching a given location on the Earth’s surface. The local forecast is adjusted for cloud cover in accordance with a statistical projection of local cloudiness. The methods used by the National Weather Service<sup>(1)</sup> are consistent with international standards sanctioned by the World Health Organization (WHO),<sup>(2)</sup> but they differ because many international sites use ground-based measurements rather than calculations based on satellite data. Ground-based measurements are technically more accurate for the locales near the monitoring site, but UV radiometers are uncommon. Thus, ground-based measurements are very limited, whereas satellite-based estimates are possible for almost any location. The following methodology is based primarily on Long et al.<sup>(1)</sup> As noted by these authors, the methodology continues to be refined and improved. Equivalent methods are used in other countries, such as the methodology reported by Lemus-Deschamps et al<sup>(3)</sup> in Australia.

**TABLE E6-1**

**GENERAL EPA GUIDELINES FOR PROTECTIVE MEASURES AGAINST OVEREXPOSURE TO UVR BASED ON THE UVI**

Exposure Category	UV Index	Protective Actions
Minimal	0–2	SPF 15 sunscreen
Low	3–4	SPF 15 sunscreen and protective clothing (hat)
Moderate	5-6	SPF 15 sunscreen, protective clothing, and UVA /UVB sunglasses
High	7–9	SPF 15 sunscreen, protective clothing, sunglasses, and sun avoidance 10 AM to 6 PM
Very high	10+	SPF 15, protective sunscreen clothing, sunglasses, and sun avoidance 10 AM to 6 PM

EPA: Environmental Protection Agency; SPF: sun protection factor; UV: ultraviolet; UVA: ultraviolet light ray A; UVB: ultraviolet light ray B; UVI: ultraviolet index; UVR: ultraviolet radiation.

Data source: [http://www.cpc.ncep.noaa.gov/products/stratosphere/uv\\_index/uv\\_info.html](http://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uv_info.html). Accessed July 27, 2006.

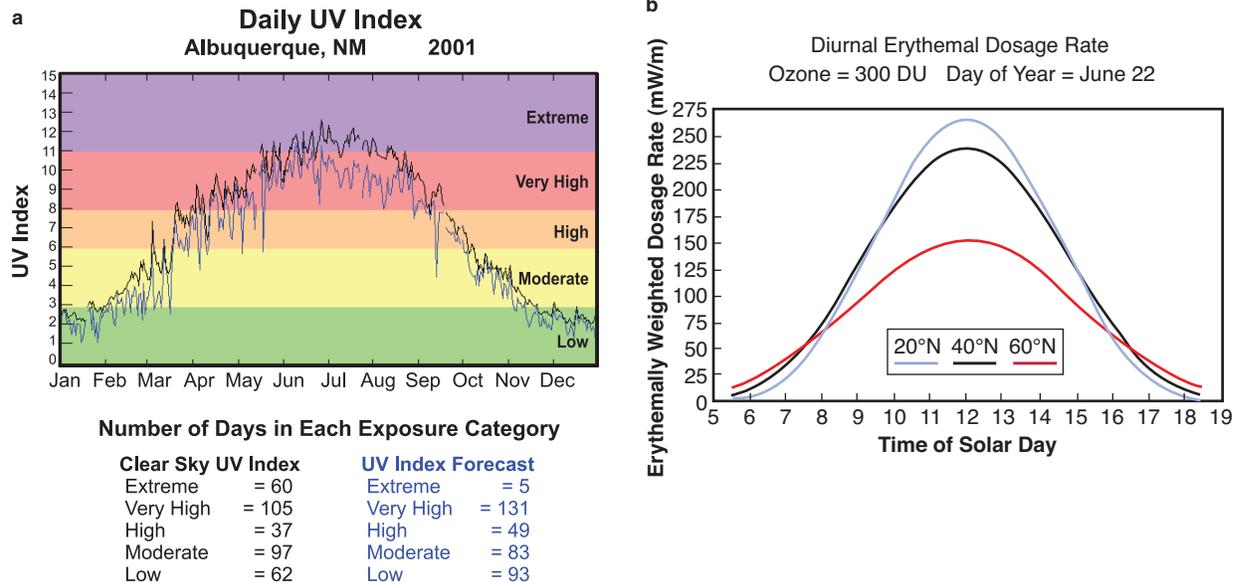
Ozone is not distributed evenly across the Earth’s surface, because it varies by season and hemisphere. A forecast of the ozone layer thickness or column is based on a weighted estimate from satellite observations. Incoming UV radiation is partially absorbed by ozone or scattered by particles in the atmosphere in proportion to the distance the radiation travels through the atmosphere. The shorter the distance or path, the greater the level of irradiance and corresponding risk of skin damage. The path is shortest at solar noon in proximity to the summer solstice and at higher altitudes, and increases relative to sunrise, sunset, the winter solstice, and lower elevations (Exhibit Figure E6-1, a and b). Values will be higher on an annual basis in the tropics and higher when the shadow cast by a standing individual is minimum. During the Hawaiian summer solstice, “no shadow day” is celebrated at solar noon. On that day, when the sun is directly overhead (zenith angle = 0), for a standing individual, there is no shadow. The concept of maximum exposure to UV radiation at solar noon has been expressed as the “shadow rule”—if you cast little or no shadow, you should get out of the sun, because this corresponds to a high zenith angle and maximum solar irradiance. The rule is most applicable in the tropical latitudes and is somewhat confounded by reflected radiation and/or overcast days.

Calculation of UVI is based on a radiation transfer model<sup>(4)</sup> that uses the following as inputs:

- ozone amount,
- latitude,
- longitude,
- date and time of day,
- solar position, and
- cloud cover.

(Exhibit 9-6 continues)

## Exhibit 9-6 continued



**Fig. E6-1.** (a) Seasonal variation in ultraviolet index values for Albuquerque, New Mexico, forecast calculated for clear sky and predicted cloud cover conditions. (b) Erythemal dosage rates vary with time of day and latitude. Ultraviolet index forecast values are usually given for solar noon.

DU: Dobson units; UV: ultraviolet.

Illustrations: (a) Adapted with permission from the National Oceanic and Atmospheric Administration (NOAA), US Department of Commerce, Washington, DC. (b) Adapted with permission from Long CS, Miller AJ, Lee H-T, et al. Ultraviolet index forecasts issued by the National Weather Service. *Bull Am Meteorol Soc.* 1996;77:729–748 (Fig. 3, p. 732). Courtesy of the American Meteorological Society, Boston, Massachusetts.

Other inputs, such as surface reflection (albedo), are set as constants. See Chapter 8 for additional information on solar radiation. The model computes clear sky spectral irradiance as an energy flux ( $W/m^2$ ), which is adjusted for cloud cover or haze. Because only UV radiation in the 280- to 400-nm range are factors in sunburn—and the relative importance varies in accordance with the CIE (Commission Internationale de l'Éclairage) action spectrum<sup>(5)</sup>—the raw irradiances are weighted to compute an erythemal irradiance or dose rate. The original National Weather Service UV product was expressed as a 1-hour dosage in  $mJ/m^2$ , but is currently expressed as a true nondimensional scale in accordance with the World Meteorological Organization standard of  $25 mW/m^2 = 1$  UVI unit. The WHO equation for UVI is:

$$I_{uv} = k_{er} \times \int_{250}^{400} E_{\lambda} \times s_{er}(\lambda) d\lambda \text{ [ND]},$$

where  $E_{\lambda}$  solar spectral irradiance in  $W/(m^2 \times nm)^{-1}$  for a given wavelength ( $\lambda$ ) over  $d\lambda$ , the wavelength interval, and  $s_{er}(\lambda)$  erythema action spectrum,<sup>(5)</sup>  $k_{er}$  is a constant ( $40 m^2/W^{-1}$ ).  $E_{\lambda}$  can be obtained from ground-based sensors or satellite-adjusted calculations.

#### UVI Varies with Location

The United Kingdom's Web page indicates that UVI values in the United Kingdom never exceed 8, whereas the example in the WHO guide (2002) indicates a value of 13 in Darwin, Australia. Exhibit Figure E6-2 shows the National Oceanic and Atmospheric Administration/Environmental Protection Agency report format for UVI values for 58 cities in the United States.

#### Value of the UVI

The Environmental Protection Agency (EPA) established five categories for interpreting the UVI, which differ slightly from the WHO exposure categories, because a small adjustment was made to conform to the international standard. As noted previously, based on the UVI value, different protective measures are recommended, although it might be

(Exhibit 9-6 continues)

**Exhibit 9-6** *continued*

FOR HEALTH RELATED ISSUES...CONTACT EPA AT 1-800-296-1996  
 FOR TECHNICAL INFORMATION ABOUT THE UV INDEX....  
 GO TO THE NATIONAL WEATHER SERVICE UV INDEX WEB PAGE:  
 WWW.CPC.NCEP.NOAA.GOV/PRODUCTS/STRATOSPHERE/UV\_INDEX

CITY	STATE	UVI	CITY	STATE	UVI
ALBUQUERQUE	NM	12	LITTLE ROCK	AR	10
ANCHORAGE	AK	5	LOS ANGELES	CA	11
ATLANTIC CITY	NJ	2	LOUISVILLE	KY	9
ATLANTA	GA	10	MEMPHIS	TN	10
BALTIMORE	MD	6	MIAMI	FL	11
BILLINGS	MT	8	MILWAUKEE	WI	8
BISMARCK	ND	8	MINNEAPOLIS	MN	8
BOISE	ID	2	MOBILE	AL	11
BOSTON	MA	9	NEW ORLEANS	LA	11
BUFFALO	NY	8	NEW YORK	NY	3
BURLINGTON	VT	4	NORFOLK	VA	8
CHARLESTON	WV	9	OKLAHOMA CITY	OK	11
CHARLESTON	SC	5	OMAHA	NE	8
CHEYENNE	WY	10	PHILADELPHIA	PA	5
CHICAGO	IL	8	PHOENIX	AZ	10
CLEVELAND	OH	8	PITTSBURGH	PA	8
CONCORD	NH	8	PORTLAND	ME	8
DALLAS	TX	10	PORTLAND	OR	2
DENVER	CO	10	PROVIDENCE	RI	8
DES MOINES	IA	9	RALEIGH	NC	8
DETROIT	MI	8	SALT LAKE CITY	UT	10
DOVER	DE	7	SAN FRANCISCO	CA	9
HARTFORD	CT	7	SAN JUAN	PU	12
HONOLULU	HI	11	SEATTLE	WA	4
HOUSTON	TX	11	SIOUX FALLS	SD	8
INDIANAPOLIS	IN	9	ST. LOUIS	MO	9
JACKSON	MS	11	TAMPA	FL	11
JACKSONVILLE	FL	11	WASHINGTON	DC	5
LAS VEGAS	NV	10	WICHITA	KS	10

**Fig. E6-2.** Sample data sheet of the National Oceanic and Atmospheric Administration (NOAA)/Environmental Protection Agency (EPA) Ultraviolet Index (UVI) forecast for US cities. [http://www.cpc.ncep.noaa.gov/products/stratosphere/uv\\_index](http://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index). Accessed July 27, 2006.

UV: ultraviolet

Data sheet: Courtesy of the National Oceanic and Atmospheric Administration, US Department of Commerce, Washington, DC.

more practical to make the applicable EPA recommendation into standard operating procedures for military populations. Long<sup>(6)</sup> carefully pointed out the following limitations of UVI calculations:

- statistical adjustment for cloud cover,
- assumptions on the use of satellite data to estimate ozone,
- use of constants to represent albedo, and
- emphasis in the forecast on the maximum value at solar noon.

In addition, the UVI is expressed on an artificial, nondimensional scale. Whereas users should be aware of these limitations required to develop a manageable forecast, the UVI provides both awareness and general guidance relative to the risks of exposure to solar radiation.

(Exhibit 9-6 *continues*)

**Exhibit 9-6** *continued*

Data sources: (1) Long CS, Miller AJ, Lee HT, Wild JD, Przywarty RC, Hufford D. Ultraviolet index forecasts issued by the National Weather Service. *Bull Am Meteorol Soc.* 1996;77:729–748. (2) World Health Organization, 2002. *Global Solar UV Index: A Practical Guide.* WHO/SDE/OEH/02.2. <http://www.who.int/uv/>. Accessed July 27, 2006. (3) Lemus-Deschamps L, Grainger S, Rikus L, Atkinson R, Steinle P, Gies P. *Australian UV and Ozone Forecasting System.* <http://www.bom.gov.au/bmrc/mdev/expt/uvindex/uvi.shtml>. Accessed September 16, 2005. (4) Frederick JE, Lubin D. The budget of biologically active radiation on the earth-atmosphere. *J Geophys Res.* 1988;93:3825–3832. (5) *Erythema Reference Action Spectrum and Standard Erythema Dose.* Vienna, Austria: CIE Central Bureau; 1999. ISO 17166: 1999/CIE Standard ISO 17166/CIE S007-1998. (6) Long CS. *Presentation to OFCM JAG/TI 2003.* <http://www.ofcm.gov/jagti/jagti-start.html>. Accessed July 27, 2006.

Patients with active disease should not be deployed. Those individuals in remission (under treatment with Accutane) might experience flare-ups when deployed. Service members are eligible for deployment if the disease has been in remission for at least 6 months.

**Psoriasis**

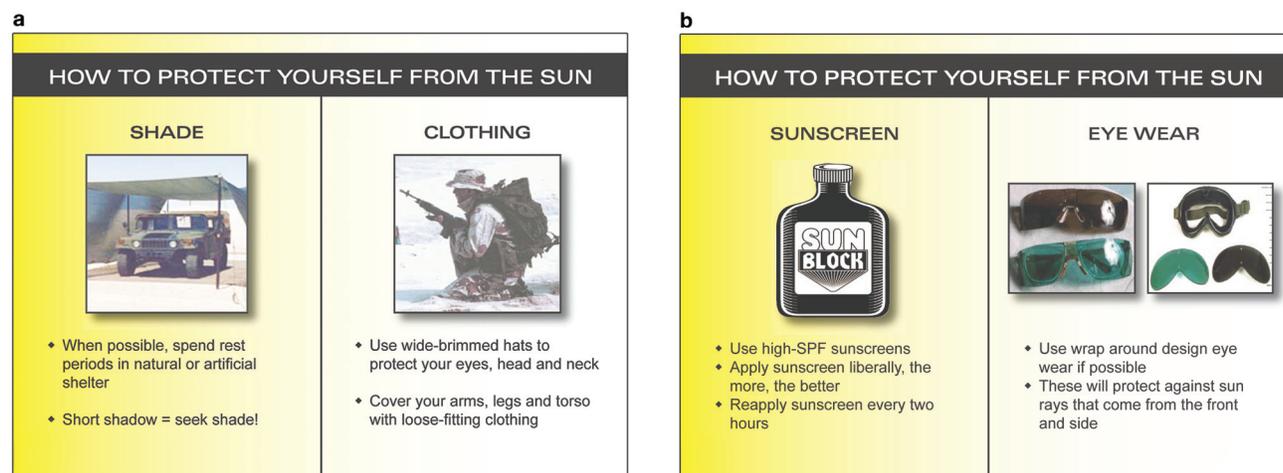
Psoriasis is a chronic, inflammatory skin disease that presents as scaly papules and plaques (Figure 9-10). At times, the disease can have an unpredictable course. Any combination of factors (eg, stress, low humidity, minimal sunshine, or cold weather) can affect the progression of psoriasis in the Army garrison. Chloroquine and antimalarial chemoprophylaxis can also exacerbate psoriasis.<sup>33–35</sup>

The abundance of skin scale and odor produced by psoriasis complicates living in the field. Service members with psoriasis often have itching. Thus, daily bathing is essential to reduce the skin scale build-up.

Lesions from psoriasis are often colonized by *S aureus*, and such bacterial infections can cause progression of the cutaneous lesions.

Treatment during deployment focuses on improving skin hygiene and lubrication, applying topical steroids, and taking oral antihistamines. Army Regulation 40-501 (“Standards of Medical Fitness” [February 1, 2005]), and Department of Defense Directive 6130.3 (“Physical Standards for Appointment, Enlistment, and Induction” [December 15, 2000]), both bar people from entering the military if they have active, residual lesions or a history of atopic dermatitis after 8 years of age. Individuals with only mild psoriasis (without nail pitting) that does not interfere with the wearing of military equipment might enter military service. Military service personnel can be treated with the following:

- etritinate,
- isotretinoin,
- bexarotene,



**Fig. 9-9.** Sun Smart Cards TA-012-0403. (a) Shade and clothing. (b) Sunscreen and eye wear. Available at: [http://chppm-www.apgea.army.mil/doem/pgm34/HIPP/sun\\_smart\\_card.pdf](http://chppm-www.apgea.army.mil/doem/pgm34/HIPP/sun_smart_card.pdf). Accessed July 27, 2006.

SPF: sun protection factor

Photograph: Reproduced from the Center for Health Promotion and Preventive Medicine (CHPPM), now US Army Public Health Command (PHC).



**Fig. 9-10.** Psoriasis in a military contractor serving in Afghanistan. Normally, this individual's condition is well controlled without medication in a more humid stateside environment. One recommendation from the teleconsultation was a few minutes per day sun exposure three times/week to help control the condition until redeployment.

Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0003110103.

- cyclosporine,
- methotrexate,
- mycophenolate mofetil,
- hydroxyurea,
- systemic biological agents for psoriasis (alefacept [Amevive], infliximab [Remicade], etanercept [Enbrel], and others), and
- psoralen with UVA.

Patients on narrow-beam UVB should be evaluated by a dermatologist prior to deployment to be switched to another treatment regimen. Most of these treatments are not available to deployed military personnel, nor can they interfere with a person's immune system.

### Atopic Dermatitis

Atopic dermatitis is a chronic skin disease that results from an intense pruritus of the skin. It is characterized by symmetrical, eczematous lesions of the face or antecubital or popliteal fossa. These lesions can be weepy, scaly, or lichenified papules and plaques (Figure 9-11). The skin is colonized by *S aureus*. Atopic dermatitis is triggered by airborne irritants, stress, foods, dry weather, cold weather, and hot weather.

Presentation of atopic dermatitis varies per indi-

vidual. Patients with this condition rub their skin regularly, with pruritus as the main complaint. They do not tolerate wearing wool or scratchy fabrics. These patients are susceptible to heat injuries because of an impaired sweat mechanism. They have impaired cellular immunity of the skin. Infections caused by varicella, herpes simplex, vaccinia, and dermatophytes can easily involve all skin surfaces. Prophylaxis with an oral antiviral agent is indicated when these patients are exposed to herpes simplex. Service members with this condition usually do poorly in the field.

### Lichen Planus

Lichen planus is an inflammatory skin disease characterized by the presence of flat-topped polygonal papules of the skin. The eruption can involve any cutaneous surface. These lesions are pruritic and are exacerbated by stress. Sunshine intensifies the eruption. Lichen planus can cause painful oral ulcerations. The eruption clears with the use of corticosteroids, but returns when the drug is stopped. In the field, health-care workers have limited therapies for management of this disease.

### Discoid Lupus Erythematosus

Discoid lupus erythematosus is a cutaneous collagen vascular disease that has the propensity to become generalized. Service members with this disease have hypopigmented, atrophic skin scars. Active lesions



**Fig. 9-11.** Atopic dermatitis (chronic eczema) with a nummular (coin-shaped) eruption on hands with itching and burning. This soldier was managed by teleconsultation from Afghanistan. Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0006110104.

usually present as pink-to-red papules and plaques. This eruption can be a source of permanent hair loss. In addition, affected areas tend to be sun-exposed. Both UVA and light can trigger flare-ups of discoid lupus erythematosus.

Treatment focuses on limiting stress and sun exposure. Service members should wear the hot weather hat in lieu of the BDU cap or beret. The hot weather hat protects the cheeks, ears, nose, and neck. Frequent application of a broad-spectrum sunscreen with a solar (sun) protection factor (SPF) of 30 should be used. Commanders might need to limit activities that increase sun exposure. Service members might need job reclassification.

### Darier's Disease

Darier's disease is an autosomal, dominant skin disease that is triggered by sunshine, heat, and humidity. When the disease is in remission, the only cutaneous findings appear in the fingernails. Red streaks and notching of the free edge of the nail present in one or more nails. Flaring of the disease is characterized by generalized intensely pruritic, weepy, and scaly papules that initially involve sun-exposed areas. Secondary bacterial infections are common. Treatment is aimed at placing the individual in an air-conditioned environment and administering oral antihistamines to control pruritus.

### Hand Dermatitis

Hand dermatitis can be caused by atopic dermatitis, psoriasis, contact dermatitis, and chronic irritation. Similar conditions can affect the feet in occupational exposures such as in Figure 9-12. These factors play a major role in hand dermatitis and



**Fig. 9-12.** Contact dermatitis on the foot of a 29-year-old seaman aboard ship. Teleconsultation resulted in a recommendation of topical steroids and evaluation for dermatitis triggers, such as laundry soap and petroleum products, as well as antibiotic treatment for possible cellulitis. Photograph: Courtesy of Chuck Lappan, AKO teleconsultation, case 0116110331.

commonly result from frequent washing of the hands with soap and water or with water-free cleaning solvents. Depletion of the protective skin lipids of the stratum corneum is the result, with the stratum corneum drying out, losing pliability, and cracking. Stiffening of the stratum corneum is inversely related to the level of hydration. Thus, painful cracks and fissures can develop, with fissures extending down to the dermis. Treatment focuses on limiting exposure to an allergen/irritant and rehydrating the skin (Exhibit 9-7).

## EFFECT OF SKIN DISEASE ON OPERATIONS DURING DEPLOYMENT

### Ship Operations

Little information exists on the prevalence of skin disease during ship deployments. Some information is provided in a study by Vidmar et al,<sup>27</sup> who prospectively examined all sick call visits during a 3-month, cool weather deployment of an aircraft carrier. He found that skin disease accounted for 40% of all sick call visits. Skin disease and sexually transmitted diseases accounted for 24.5% of all lost man-days (916/3,737) during the deployment. Based on the reported values, pyoderma and eczema accounted for 72% of the dermatology/sexually transmitted disease lost man-days, and pyoderma

caused 48% of those lost man-days. Skin infections were highest among personnel doing dirty work in damp surroundings.<sup>28</sup>

### Tropical Operations

Skin disease not treated adequately can result in hospitalization. This was noted especially during the Vietnam War: from 1965 to 1971,<sup>36</sup> skin diseases, infectious diseases, and ill-defined symptoms were the most common causes for admission of US Marines to hospitals. In that report, Palinkas and Coben<sup>36</sup> gave a rate of hospitalization per 1,000 person-years for "diseases of the skin and subcutaneous tissue"

## EXHIBIT 9-7

### PREVENTION OF HAND DERMATITIS IN DEPLOYED SERVICE MEMBERS

Hand dermatitis is common in professionals who do wet work, or who handle raw foods, detergents, or solvents. To prevent these problems, individuals should do the following:

- Protect hands from soaps, detergents, and wet work by wearing waterproof, heavy-duty gloves. Vinyl gloves work better than rubber gloves. Allergies to rubber can occur. An alternative option is to wear cotton or vinyl liners inside the rubber gloves. Gloves should be kept in work areas, their use encouraged, and they should not contain any holes.
- Wear work gloves when doing dirty work. Clean hands are less likely to spread infections.
- Wear vinyl or nitrile gloves (with a liner) when working with solvents (eg, turpentine, gasoline, paints, polishes, or paint thinner).
- Use cool water and a small amount of mild soap to wash hands. (Ivory soap is not recommended.) Dry hands gently. Lipid-free skin cleansers (such as Cetaphil or Aquanil) can be applied to the skin and wiped off. Hands will feel greasy if too much cleanser is used. Cold cream can also remove grease and oil from the hands instead of the waterless hand cleaners.\*
- Wear cotton or leather gloves during cold weather to reduce skin water loss and chapping. Treat skin chapping of the hands with frequent applications of a skin lubricant (eg, Lubriderm or Moisturel), especially after wetting the hands. Very dry hands can be managed during cold weather deployment by wetting the hands; applying Vaseline, white petrolatum, or Crisco at night; and covering them with a pair of gloves or socks. During the day, frequent applications of a skin lubricant should follow for normal maintenance.

\*Brand names: Ivory (soap), Procter & Gamble Company (Cincinnati, Ohio); Cetaphil, Galderma Laboratories (Fort Worth, Tex); Aquanil, Person & Covey, Inc (Glendale, Calif); Lubriderm, Johnson & Johnson Consumer Companies, Inc (New Brunswick, NJ); Moisturel Therapeutic Lotion, Dillon Distributors (Kenilworth, NJ); Vaseline, Unilever House (London, United Kingdom); Crisco, J. M. Smucker Company (Orrville, Ohio).

Data source: Adapted with permission from a patient care handout used by the Dermatology Service, Wilford Hall Medical Center, Fort Sam Houston, Texas.

as 47.2 for Marines in Vietnam versus 15.6 for non-Vietnam status. That striking difference, and an overall increase in disease and nonbattle injury, was probably the result of a combination of combat and exposure to climate and other environmental factors. During this time,<sup>37,38</sup> malaria and skin disease were the leading causes of hospital admissions among military personnel in Vietnam. During a 1-month experience in jungle operations in Panama, English and Fano-Schultz<sup>39</sup> reported that more than 50% of sick calls were because of skin disease. Bacterial and fungal infections accounted for more than half of the reported skin diseases.<sup>39</sup>

#### Desert Operations

Available reports do not identify skin disease as a major cause of lost man-hours during Operation Desert Shield (the *deployment phase* of the Persian Gulf War) and Operation Desert Storm (the *combat phase* of the Persian Gulf War). Wasserman and colleagues<sup>40</sup> reported sick call visits for the 3rd Armored Cavalry Regiment for a 19-week period during Operation Desert Shield. The greatest percentage of visits was listed

under the category of "other." Skin disease accounted for 7% of all first-time sick call visits at the battalion aid station and clearing company. The authors did not identify the number of follow-up visits or patients referred for specialty care.<sup>40</sup> Most dermatologists were assigned as general medical officers to hospitals or clearing stations during this conflict. While assigned to a clearing station, Pehr and Kornfield<sup>41</sup> reported seeing 81 patients for skin disease. Eczematous dermatitis was the major reason service members sought healthcare in the field. Hepburn<sup>42</sup> reported on the British dermatology experience in the Persian Gulf War. During a 6-month period, he evaluated 95 patients for dermatology complaints: 34 required admission, and 5 were evacuated permanently from theater. Infections were the most common reason for referral. In addition to protection from solar radiation, clothing can protect against cuts, abrasions, and bites, which might become infected. Eczema accounted for nearly one third of the dermatology consultations.<sup>42</sup> The brief duration of the war, low humidity, and combat operations during the winter months (and, as noted previously, possibly with less insect activity than in the summer months) minimized the number of skin

## PROTECT YOURSELF AT NIGHT

- **Ensure your bed net is in good repair.**
- **Use your bed net when sleeping.**
- **Tuck net under sleeping pad or sleeping bag so there are no openings.**



Fig. 9-13. During World War II, troops slept under mosquito netting. Painting: Courtesy of the Army Art Collection, US Army Center of Military History, Washington, DC.

infections among military personnel. Skin conditions sensitive to an environment of high solar radiation and low humidity accounted for a larger number of dermatology consultations. In the April 2005 issue of *Medical Surveillance Monthly Report*,<sup>43</sup> covering 2000 to 2004—which includes the early stages of Operation Enduring Freedom—the relative diagnosis of hospitalization for dermatological diseases increased from 12th in 2000 to 10th in 2004 for US armed forces. During deployment to Iraq, a higher number of cases of cutaneous leishmaniasis was seen in personnel returning from Iraq than was seen after the Persian Gulf War (1990–1991). This might result from the longer time these military units spend in theater and problems with the availability of protective mosquito nets (Figure 9-13). Thus, a portion of this increase might be caused by changes in reporting procedures.<sup>22</sup> However, as noted previously,<sup>22</sup> a rapid increase began for US Army personnel in 2002. The reported rates were nearly flat from 1999 to 2002, with rapid increases for US Army personnel and much smaller increases for other service members (Figure 9-14).

### Cold Weather Operations

Corbett and Benson<sup>44</sup> presented an overview of cold weather dermatology issues. Two reports de-

scribed skin disease during cold weather operations in Bosnia. Croft and colleagues<sup>3</sup> reported a 100% survey of two company-size units that operated there. One of the companies stationed at a dam site reported an outbreak of skin rashes allegedly from exposure to water contaminated with human remains. Members of both units were living in fixed facilities with running water. Skin diseases were reported in 14% of the study unit and in 21% of the control unit, with the most common diseases being infections, eczema, and acne. During a health survey of British troops in Bosnia, from December 1995 to April 1996, Smith and Croft<sup>45</sup> noted that skin diseases accounted for 12.7% of all primary care consultations. Dry skin and chapped lips were common cold weather problems.<sup>45</sup> Habek et al<sup>46</sup> reported the sick call activities of the 105th Croatian Army Medical Brigade from 1991 to 1992. Of 4,220 reported patient visits:

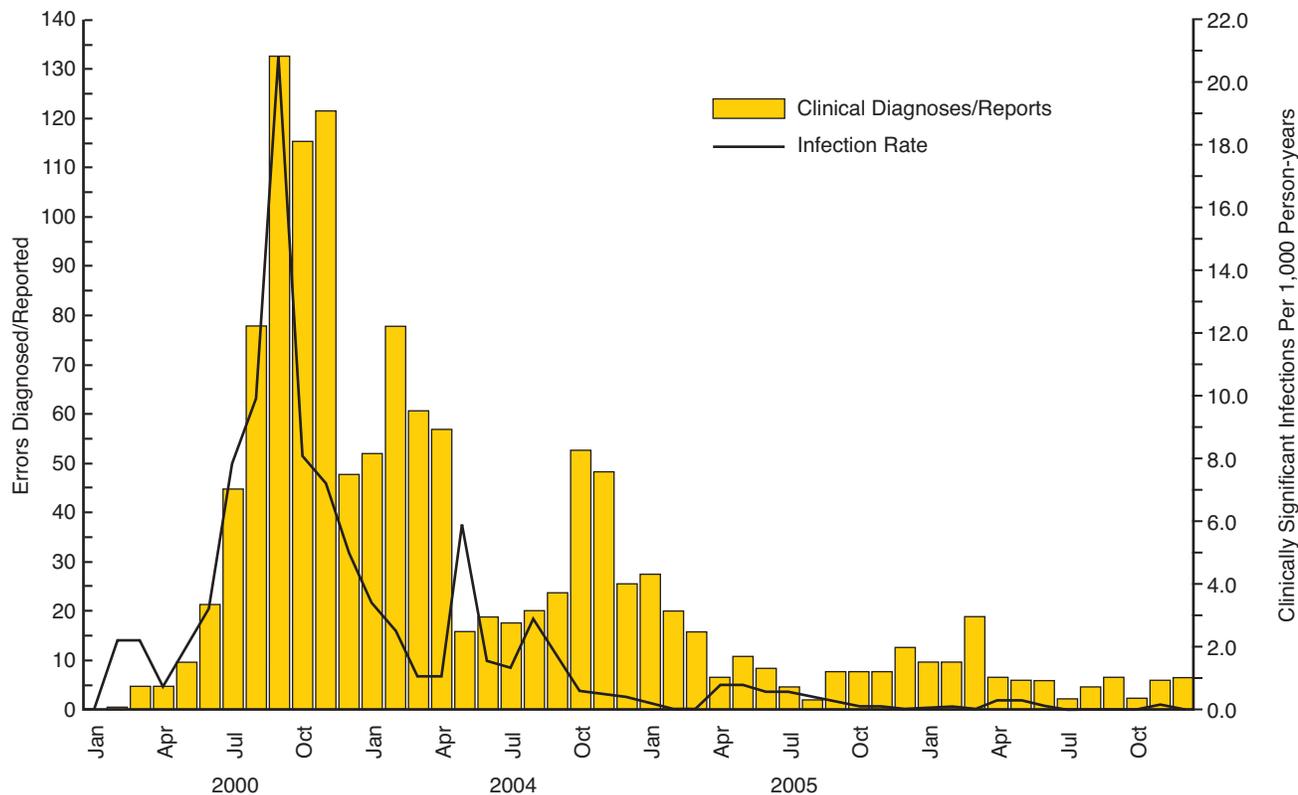
- skin disease was the fourth leading cause of these visits,
- skin infections and dermatitis were the major causes of the sick call visits, and
- scabies accounted for 1% of the total visits.

In addition, this unit provided care to the refugees, as well as to its army.

## SKIN DISEASE AND MEDICAL PLANNING

The effect of skin disease on military personnel/military deployment is largely unappreciated by medical operational planners. Yet, skin diseases occur quite frequently, and—as in other minor, nonbattle injuries—military personnel can become rapidly disabled. Compounding the effects from skin disease is

the inability of healthcare providers without specialty training to recognize and manage skin disease. A large expenditure of patient and healthcare provider time and medical supplies is often used in search of the correct diagnosis.<sup>47</sup> With proper care, affected personnel are a source of valuable, recycled manpower during



**Fig. 9-14.** Clinical diagnoses/reports of leishmaniasis at US military medical treatment facilities and estimated leishmaniasis infection incidence rates among US service members in Operation Enduring Freedom/Operation Iraqi Freedom, by month, January 2003–December 2006. After an initial increase, the incidence of leishmaniasis has decreased significantly. Illustration: Adapted with permission from Lay JC. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. *Med Surv Monthly Rep.* 2004;10:1–5 (Fig. 1, p. 3). Courtesy of the US Army Center for Health Promotion and Preventive Medicine (CHPPM), Aberdeen Proving Ground, Maryland (now the US Army Public Health Command [PHC]).

deployment. Skin disease can also cause morale problems in affected individuals and in other personnel in the unit. With sufficient operational planning for proper care and protection of the skin, the cost of treating skin disease in deployed personnel can be reduced.

Schissel and Wilde<sup>48</sup> reviewed past deployments and the cost savings of intratheater dermatology support to deployed units. They reported savings in preventing lost workdays and in reducing funds from having had 12 periodic dermatology missions to Bosnia. In addition, they demonstrated the advantages of having a dermatologist in theater. If, however, a dermatologist is not available in theater, a “teledermatology” consultation is an alternate method of delivering this

needed healthcare. (The Internet has become more available to all deployed units and healthcare personnel, even in austere environments.) Teledermatology consulting involves a formal setup—arranged through the unit’s information management officers and the Army Medical Department (AMEDD)—that allows personal data and images to be transmitted over a secure system. These consultations are normally handled by a group of military dermatologists from the Army’s teledermatology project. Another method involves a healthcare worker e-mailing a dermatologist with a description of the skin disease. However, this type of consultation might take longer to answer and is usually not over a secure system.

### SUMMARY

The skin is a complex organ and is affected by internal and external factors. Awareness of external factors that degrade the integrity and function of the skin is

important for commanders and medical staff, because they can modify working and living environments that promote skin disease. It is imperative that medical

officers become familiar with the recognition and treatment of common skin diseases. Before deployment, medical staff need to evaluate and seek consultation for personnel with any long-standing skin disease. These actions can reduce the number of medical evacuations from the theater and the expense of deploying replacement personnel. In addition, knowledge of drug and skin disease interaction is important for the deploying medical officer. Commanders must ensure that personnel keep their skin clean, dry, and well

lubricated. Through the guidance of their medical staff, commanders should promote the effort to limit UVR exposure. With these efforts, acute and long-term skin disease can be reduced in service members during training, deployment, and beyond. The Internet provides valuable dermatology support to deploying healthcare workers. In the future, this tool will be of increasing value to healthcare workers and service members in promoting a more active partnership in the overall health of the military force.

### Acknowledgment

This chapter was authored by Dr Keller more than a decade ago and has since undergone several extensive revisions to fit the focus of this book.

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