NCC Pediatrics Continuity Clinic Curriculum: **Atopic Dermatitis**

Pre-Meeting Preparation:

Please read/review the following:

- "Atopic Dermatitis Visual Guide" (*National Eczema Organization)*
- "Atopic Dermatitis" *(PIR 2018)*
- "Mechanisms of Atopic Disease" *(cartoons from NEJM 2011)*
- "Treatment of Atopic Dermatitis":
  - Atopic Dermatitis Action Plans
  - Prescribing Tips: Steroids & Moisturizers on Formulary, FTUs
  - Home Remedies: ("Management of Atopic Dermatitis" Pediatrics, 2008)

Conference Agenda:

- *Review* Atopic Dermatitis Quiz
- Complete Atopic Dermatitis Cases
- Round table: Compare moisturizers and topical corticosteroids on formulary. **Discuss potential benefits and drawbacks.** **Samples will be provided**

Post-Conference: *Board Review Q&A*

Extra-Credit:

- "Atopic Dermatitis" (NEJM, 2021)
- "Atopic Dermatitis: an expanding therapeutic pipeline for a complex disease" (Nature Reviews, 2022)
- "Emollient enhancement of the skin barrier from birth offers effective atopic dermatitis prevention" (2014)
- "Petroleum Jelly for Neonates?" (JAMA Pediatrics, 2016)
- "Management of Atopic Dermatitis in the Pediatric Population" (Pediatrics, 2008)
- "Effects of Early Nutritional Interventions on the Development of Atopic Disease . . ." (2008)
- "Complementary, Holistic, and Integrative Medicine: Atopic Dermatitis" (PIR, 2007)
- New Atopic Dermatitis Treatments (Medscape, 2017)
- "Advances in Pediatric Eczema Highlight 2022" (podcast, HCP Live, Dec 2022)
- **Resources for Patients/Parents:**
  - http://www.nationaleczema.org (educational videos, support group, etc.)
  - Eczema Action Plans

Atopic Dermatitis

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Education Gap

Clinicians are often challenged in the primary care setting with children who present with moderate-severe recalcitrant atopic dermatitis. Many patients present at the subspecialist level grossly undertreated with topical medications and emollients. Recently, numerous clinical investigations have evolved our understanding of the pathogenesis of atopic dermatitis, and the American Academy of Dermatology released new atopic dermatitis guidelines in 2014. Understanding the groundbreaking discoveries in disease pathogenesis and implementing up-to-date management guidelines in clinical practice are critical for pediatricians.

Objectives

After completing this article, readers should be able to:

1. List the age-specific clinical features of atopic dermatitis (AD).
2. Understand the essential, important, and associated diagnostic criteria of AD.
3. Recognize the atopic and nonatopic clinical comorbidities associated with AD.
4. Understand the cutaneous infectious complications associated with AD.
5. Understand the disease pathogenesis and its relationship to therapeutic management.
6. Understand the state-of-the-art treatment guidelines, including the recent "proactive" maintenance therapy recommendations.
7. Recognize the importance of multidisciplinary management and clinical indications for subspecialty referral.
8. Understand effective strategies of therapeutic patient education and implement them into clinical practice.

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ABBREVIATIONS

AD	atopic dermatitis
ADHD	attention-deficit/hyperactivity disorder
AE	adverse effect
FDA	Food and Drug Administration
FLG	filaggrin
IgE	immunoglobulin E
IL	interleukin
TCI	topical calcineurin inhibitor
TCS	topical corticosteroid
Th	T helper
WWT	wet wrap therapy

INTRODUCTION

Atopic dermatitis (AD) is a chronic pruritic inflammatory skin disease with a frequently remitting and relapsing course. It is postulated as the first manifestation of the "atopic march"—often preceding the later development of food allergies, allergic rhinitis, and asthma. The terms *atopic dermatitis* and *eczema* are

commonly used interchangeably to describe eczematous dermatitis, although technically there are eczemas other than AD, including allergic contact dermatitis and irritant dermatitis. The cardinal features of AD include xerosis, pruritus, eczematous lesions in the typical morphology and distribution, and a personal or family history of atopy.

The personal, social, emotional, and financial resources of patients, their caregivers, and the health-care system are largely burdened by AD. Not including the lost opportunity costs and productivity, such as missed work or school days, or the loss of individual quality of life, annual US economic burdens are conservatively estimated to be approximately $5 billion. (1) An estimated two-thirds of patients with AD initially present with mild disease and may be managed by their primary medical care provider. (2) Pediatricians are nearly always a child's first line of management, and the purpose of this review is to provide up-to-date information regarding AD pathophysiology, clinical presentation, and state-of-the-art treatment guidelines.

EPIDEMIOLOGY

Atopic dermatitis is the most common chronic inflammatory dermatologic disorder in children, affecting an estimated 12.5% of children in the United States. (3) Sixty percent of children with AD present in the first year after birth, and 90% present by 5 years of age. (3) Numerous studies suggest that AD affects both sexes nearly equally. (4) Most children with AD present with mild disease (67%), and the remaining 33% present with moderate-to-severe AD. (3)

Multiple investigations have analyzed the demographic and geographic associations with AD. A study published in 2011 by Shaw et al (5) using National Survey of Children's Health data reported an increased disease prevalence in individuals of African American race. In addition, higher educational level (greater than high school) is associated with higher rates of AD. (5)(6) Domestically, the regions with highest disease prevalence in the United States include numerous northeastern states as well as Idaho, Nevada, and Utah. (5) The prevalence of AD has risen dramatically during the past 50 years in developed countries, especially in the United States, Europe, and Japan. (6) In addition, the incidence of pediatric AD in developing countries seems to be rising, with a maximum prevalence of nearly 30% in some populations. (7) The causes of the increasing prevalence of pediatric AD are unknown, but several systematic large-scale studies point to numerous genetic and environmental factors as potential contributors. (7)

PATHOGENESIS

A major debate has existed as to whether AD is primarily driven by immune abnormalities (inside-out theory) or epidermal barrier dysfunction (outside-in theory). It is clear that AD pathogenesis is multifactorial, resulting from a complex interplay among epidermal barrier dysfunction, immune dysregulation, and environment. Numerous studies have suggested genetic susceptibilities for AD. (8) Preceding classification of the human genome, concordance in monozygotic twin studies and case reports detailing transfer of AD after bone marrow transplant supported a genetic basis for the disorder. (9) Most recently, groundbreaking research worldwide has positively associated 46 genes with AD. (8) Of these investigations, the most steadily replicated findings involve variations in genes encoding filaggrin (FLG), which is also implicated in the etiology of ichthyosis vulgaris. Ichthyosis vulgaris presents with xerotic skin, especially on the extensor surfaces of the legs, is associated with hyperlinear creases on the palms and feet and is due to homozygous or heterozygous deficiencies in the *FLG* genes.

In the superficial epidermis, FLG influences epidermal differentiation, affects barrier function (preventing water loss and blocking the entry of foreign substances), promotes skin hydration, and modulates immune function. (10) It may be that more porous skin is more easily sensitized by skin contactants. Studies have shown that *FLG* gene mutations are associated with higher rates of AD development, more common in certain populations than others, and that variation in *FLG* gene copy numbers (influencing FLG protein expression) influence the development of AD.

Environmental factors undoubtedly interact with genetic susceptibilities, resulting in the clinical expression of AD. Mechanical injury, allergens, and microbes activate the skin's innate immune system, leading to increased expression of specific cytokines that incite inflammation, notably thymic stromal lipoprotein, interleukin (IL)-25, and IL-33. These cytokines trigger type 2 innate lymphoid cells to activate T helper (Th) 2 cells. Increased Th2 cell activity promotes specific cytokine-associated inflammation, eosinophilia, and immunoglobulin E (IgE) production while suppressing epidermal barrier proteins and antimicrobial peptides (IL-4, IL-5, IL-13). The Th2 response also contributes to pruritus by promoting IL-31 production along with several other mediators, including thymic stromal lipoprotein, histamine, tryptase, and neuropeptides. Interleukin-17, a cytokine implicated in the etiology of psoriasis, is also increased in AD, but this association is poorly understood. In addition, barrier function is markedly impaired due to a decline in expression of the structural proteins and lipids

that play a role in water retention and barrier protection. Also of importance, Th1 and Th22 cytokines are significantly increased in chronic AD, in addition to Th2 cytokines. The novel Th22 cytokine IL-22 has recently been linked to lichenification through impairing epidermal differentiation and promoting epidermal hyperplasia. These factors contribute to the acute and chronic clinical presentation of AD. (3)(11)(12)

RISK FACTORS FOR DISEASE DEVELOPMENT

Of the numerous risk factors linked with AD, 2 are greatly associated—*FLG* gene mutations and a family history of atopic disease. More than two-thirds of children with AD have an immediate family member with atopic disease. The chances of developing AD increase exponentially with parental atopy. The risk of developing AD is 2 to 3 times more likely with 1 atopic parent and 3 to 5 times more likely with 2 atopic parents. (13) Furthermore, a robust quantity of literature has acknowledged the association between *FLG* mutations and AD. Sixty percent of individuals with *FLG* mutations ultimately develop AD—more than 3-fold higher than the occurrence in the general population. (10) This association is reinforced by numerous studies showing a positive correlation between *FLG* mutations and severe AD. Further investigations highlighted the higher incidence of eczema herpeticum and asthma in patients with AD with *FLG* mutations (10)(14). Conversely, 40% of children with *FLG* mutations do not develop AD, and these mutations are uncommon in specific populations. A recent genomic study of 100 South African children with severe AD and ichthyosis vulgaris showed no *FLG* mutations in this population, and an analogous study of 75 Ethiopian children revealed an *FLG* mutation incidence of 1.3%, much lower than the 10% prevalence documented in individuals of European ancestry. (15)(16) Loss-of-function mutations are also uncommon in African American individuals. (17)

Other environmental exposures in genetically susceptible children may increase the risk of AD, but this is highly controversial. Two clinical investigations of independent birth cohorts revealed a correlation between cat ownership at birth and the development of AD in individuals with *FLG* loss-of-function mutations. (18)(19) Another investigation suggested that dog ownership from birth may reduce the incidence of AD. (20)

Multiple studies suggest a positive correlation between urban environment and atopic disease prevalence. (21) These findings support the hygiene hypothesis, which speculates that early exposure to pathogens may serve as protective in the development of atopy, and in the absence of such exposure, atopic conditions become more prevalent. Several different rural pathogens have been proposed to safeguard individuals from the development of atopic disease, including farm animals, unpasteurized milk, and helminthes. (22)

CLINICAL FINDINGS

Hallmark clinical findings of AD include xerosis (dry skin), pruritus, and eczematous lesions in an age-specific distribution. Morphologically, erythema, lichenification, crusting, exudation, and excoriation characterize the lesions. Skin involvement varies from mild and localized to severe and widespread. The skin of AD is termed by some to be sensitive, with lower thresholds for irritation and pruritus. Pruritus is the most bothersome symptom to children and caregivers, which often significantly worsens quality of life. The resulting "itch-scratch" cycle is a major root of morbidity leading to complications such as secondary infection and poor sleep quality. Pruritus may be exacerbated by factors such as xerosis, coarse clothing (eg, wool), environmental irritants (temperature extremes, harsh soaps or detergents), and allergens.

Classically, AD lesions are characterized as poorly demarcated eczematous plaques; however, the presentation often varies according to age and race. Three distinct age-associated phases—infantile, childhood, and adult—define the usual distribution of AD lesions. The infantile phase typically evolves in the first few years of life, and the childhood and adult phases are distinguished by the initiation of puberty. Noteworthy, the symptoms of individuals occasionally fall outside their age-specific phase.

Characteristic infantile eczema is typically on the scalp, cheeks, and forehead. Lesions progressively extend to involve the trunk and extensor surfaces of extremities. The diaper region is typically shielded from involvement as a result of protection from transepidermal water loss and external irritation. Flexural surface involvement is common in childhood AD. Most frequently, lesions arise in the antecubital and popliteal fossa. Other well-established sites of involvement include the perioral region, wrists/ankles, and neck. Parents often voice concerns about the pigmentary changes, although these typically resolve without long-term scarring. From puberty forward, major areas of involvement consist of the face (periorbital and perioral regions), dorsal feet, hands, and upper back.

The expressed phenotype of AD may vary according to race. African American children often present with more papular or follicular AD. Furthermore, increased pigmentary changes, both hypopigmentation and hyperpigmentation, may be noted in darker skin–type patients, especially in lichenified or resolving areas. Other classic

cutaneous conditions associated with AD include keratosis pilaris, ichthyosis vulgaris, and pityriasis alba. Keratosis pilaris is characterized by follicular hyperkeratosis of the extensor surfaces of the upper arms and legs and the face. These rough-feeling keratotic papules are highly associated with ichthyosis vulgaris, an autosomal dominant disorder defined by generalized xerosis and hyperkeratosis. Pityriasis alba is a common concurrent condition, often presenting with blotchy hypopigmentation of the face. More common in patients with AD, it is thought to be due to the hyperkeratosis of the epidermis, which decreases UV penetration. Pityriasis alba and postinflammatory hypopigmentation may overlap, although pityriasis alba can be seen in individuals without underlying AD. Parents may be reassured that these hypopigmented patches gradually improve with time and sun protection.

CLINICAL COMORBIDITIES

Numerous investigations have supported the relationship between AD and other atopic disorders, including asthma, allergic rhinitis, and food allergies. (23) Noteworthy, patients with AD with *FLG* mutations have an additional risk of developing other atopic disorders, especially asthma and peanut allergy. (24)

Additional associations between AD and nonatopic comorbidities have recently been highlighted in the literature. Sleep disruption is the most prevalent comorbidity, affecting up to 60% of children with AD. (25) Pruritus during AD exacerbations causes increases in sleep disturbance, which may lead to neurocognitive impairment, affecting school performance, peer relations, and familial interactions. (25) Studies have also linked neurobehavioral disorders with AD. Several studies of children with AD found a significantly increased prevalence of concomitant attention-deficit/hyperactivity disorder (ADHD) and additional psychiatric disorders, including anxiety, conduct disorder, and depression. (26)

Finally, emerging evidence for comorbidities, including cancer, hypertension, and obesity, is controversial, requiring further investigation. (27) The prospect of these associated comorbidities highlights the importance of obtaining a complete review of systems when evaluating patients with AD and implementing a multidisciplinary approach in their management.

MAKING THE DIAGNOSIS

The diagnosis of AD is primarily clinical, based on a constellation of essential, important, and associated features listed in Table 1. A task force of AD experts updated diagnostic guidelines at a 2013 consensus conference organized by the American Academy of Dermatology. Essential features in the diagnosis of AD include pruritus, chronic relapsing eczematous dermatitis, and age-specific distribution. Other compelling associations include personal or family history of atopy and IgE reactivity; however, these are not essential for diagnosis. Table 1 lists additional clinical findings that are commonly associated. Finally, a diagnosis of AD is contingent on ruling out a variety of additional conditions, including seborrheic dermatitis, scabies, contact dermatitis, psoriasis, and others, as well as other less common conditions that may present with eczematous-appearing rashes (Table 1). (23)

The severity of AD may be delineated through several methods. Numerous scoring systems have been used for clinical trials, such as the Eczema Area and Severity Index, the Investigator Global Assessment, and the Scoring Atopic Dermatitis, but they are not generally used in clinical practice. Generally, milder disease will involve less body surface area and have skin lesions with less erythema, papules, edema, excoriations, lichenification, and intensity of itch. Disease persistence, frequency of flares, effect on quality of life, and comorbidities may influence severity classification. More severe disease may require more aggressive treatment and consideration for referral to a specialist. (23)

DIFFERENTIAL DIAGNOSIS

Table 2 lists the core differential diagnosis of AD. Less common diagnoses are also listed in Table 2, which should be considered in individuals presenting with atypical rash, poor response to therapy, unusual infections, and/or failure to thrive. This differential diagnosis includes infectious, neoplastic, genetic, immunodeficiency, and inflammatory etiologies. When considering a diagnosis of AD, these clinical disorders must first be excluded. (23)

INFECTIOUS COMPLICATIONS

It is commonly recognized that individuals with AD have a high frequency of infectious complications. This stems largely from the increased occurrence of *Staphylococcus aureus* colonization in the AD population. (28) Recent studies involving patients with AD document *S aureus* colonization in up to 90% of actively affected skin and 76% of nonaffected skin. (29)(30) This sharply contrasts with the 2% to 25% prevalence of colonization in controls. (29)(30) The increased adherence of *S aureus* to superficial skin cells, impaired epidermal barrier function, and insufficient production of antimicrobial peptides promote

TABLE 1. **Essential, Important, and Associated Features Used for the Clinical Diagnosis of Atopic Dermatitis**

ESSENTIAL FEATURES	IMPORTANT FEATURES	ASSOCIATED FEATURES
Both must be present:	Add support to the diagnosis, observed in most cases of AD:	Suggestive of AD, but too nonspecific to be used for defining or detecting AD in research or epidemiologic studies:
1. Pruritus	1. Early age at onset	1. Atypical vascular responses (eg, facial pallor, white dermographism, delayed blanch response)
2. Eczema (acute, subacute, chronic)	2. Atopy	2. Keratosis pilaris/pityriasis alba/hyperlinear palms/ichthyosis
A. Typical morphology and age-specific patterns:	A. Personal and/or family history	3. Ocular/periorbital changes
a. Infants/children: facial, neck, and extensor involvement	B. Immunoglobulin E reactivity	4. Other regional findings (eg, perioral changes/periauricular lesions)
b. Any age group: current or previous flexural lesions	3. Xerosis	5. Perifollicular accentuation/lichenification/prurigo lesions
c. Sparing of the groin and axillary regions		
B. Chronic or relapsing history		

AD=atopic dermatitis.
Adapted with permission from Eichenfield LF, Boguniewicz M, Simpson EL, et al. Translating atopic dermatitis management guidelines into practice for primary care providers. Pediatrics. *2015;136(3):554–565.*

colonization and, ultimately, cutaneous and/or systemic infection. (31)(32) The cutaneous manifestations of *S aureus* superinfection are characterized by honey-colored crusting, weeping, and pyoderma. Several case reports document severe systemic complications likely resulting from *S aureus* colonization in patients with AD, including bacteremia, sepsis, endocarditis, and osteomyelitis. (33)(34)

Group A *Streptococcus* also accounts for a significant number of AD superinfections. A retrospective review of children with AD with skin cultures revealed colonization with group A *Streptococcus* in 16%. (35) Furthermore, children with group A *Streptococcus* superinfection had a greater frequency of fever, facial involvement, and hospitalization than patients with staphylococcal etiology. (35)

Patients with AD may have an increased risk of developing disseminated viral infections. Eczema herpeticum may present as umbilicated vesicopustules resulting from herpes simplex virus. The hallmark of this condition is grouped vesicles in a "cluster of grapes" appearance overlying diffuse eczematous papules and plaques. Patients can manifest with severe pruritus, pain, and systemic illness, often requiring hospitalization. Molluscum contagiosum, a common ailment of childhood, tends to be more prevalent and can be more severe in children with AD, in addition to inducing eczematous rashes. Molluscum is characterized as a dome-shaped papule with a central white core and/or umbilication. Recently defined in the literature, eczema coxsackium characterizes the atypical clinical presentation of coxsackie virus (CVA6) in children with AD. Mathes et al (36) first described a vesicular pattern with erosions, morphologically similar to eczema herpeticum, localized to areas previously or currently affected by AD. This published constellation of findings suggests that eczema coxsackium should be considered in the differential diagnosis of patients with AD presenting with vesicular lesions. (36)

MANAGEMENT

Figure 1 summarizes the American Academy of Dermatology recommendations for AD therapeutic management for pediatric providers. These guidelines are further detailed throughout this section.

Basic Management

The cornerstone of successful AD management is the implementation of basic management strategies, including good bathing practices and adequate skin hydration. Individuals with AD have baseline xerosis due to barrier function deficits and an unfavorable balance of transepidermal water loss and water retention. Bathing may hydrate skin

TABLE 2. **Core Differential Diagnosis and Less Common Diagnoses of Atopic Dermatitis**

CORE DIFFERENTIAL DIAGNOSIS		
• Scabies		
• Psoriasis		
• Ichthyoses		
• Seborrheic dermatitis		
• Contact dermatitis (irritant or allergic)		
• Cutaneous T-cell lymphoma		
• Photosensitivity dermatoses		
• Immunodeficiency diseases		
• Erythroderma of other causes		
OTHER DIAGNOSES TO CONSIDER		
Nutritional and Metabolic Disorders	**Primary Immunodeficiency Disorders**	**Other Disorders**
• Acrodermatitis enteropathica	• Agammaglobulinemia	• Ataxia-telangiectasia
• Biotin deficiency	• Hyperimmunoglobulin E syndrome	• Langerhans cell histiocytosis
• Celiac disease • Essential fatty acid deficiency • Hartnup disease • Hurler syndrome • Phenylketonuria • Prolidase deficiency • Zinc deficiency	• Omenn syndrome • Severe combined immunodeficiency disorder • Wiskott-Aldrich syndrome	• Netherton syndrome

and reduce irritants, bacteria, and crusts. Expert consensus recommends bathing in lukewarm water followed by application of moisturizer or topical prescription medications. The use of mild or nonsoap cleansers is preferred to avoid irritation and detrimental barrier effects. Transepidermal water loss may result from water evaporation after bathing if moisturizer is not applied. Thus, application of emollients after bathing is encouraged to retard evaporation of water. Applying emollients generously at least twice daily is additionally recommended to boost cutaneous hydration and provide symptomatic relief. (37) Emollient choice is highly dependent on provider and patient predilection. Thicker occlusive agents, such as ointments, may be more effective, but moisturizers vary in formulation and water content and can include ointments, creams, oils, gels, and lotions. Recently, several studies documented anti-inflammatory benefits and enhanced efficacy of emollients with physiologic concentrations of lipids and ceramides. (38)(39)(40) These formulations are more expensive, and the cost-benefit ratio is yet to be established. A variety of studies exploring the efficacy and microbiome effects of specific oils have emphasized that oils are not substitutable. Coconut oil was superior to olive oil in several head-to-head studies in decreasing *S aureus* colonization and AD severity. (41)(42)

Acute Treatment of Exacerbations

Topical corticosteroids (TCSs) have long been established as the first-line therapy for acute flares due to their remarkable anti-inflammatory properties. During the past 60 years, efficacy has been demonstrated in more than 100 clinical investigations. (37) Topical corticosteroids are formulated in a variety of strengths, ranging from lowest potency (group VII) to highest potency (group I). Examples of alternatives in each class are shown in Table 3. Often, TCSs are prescribed

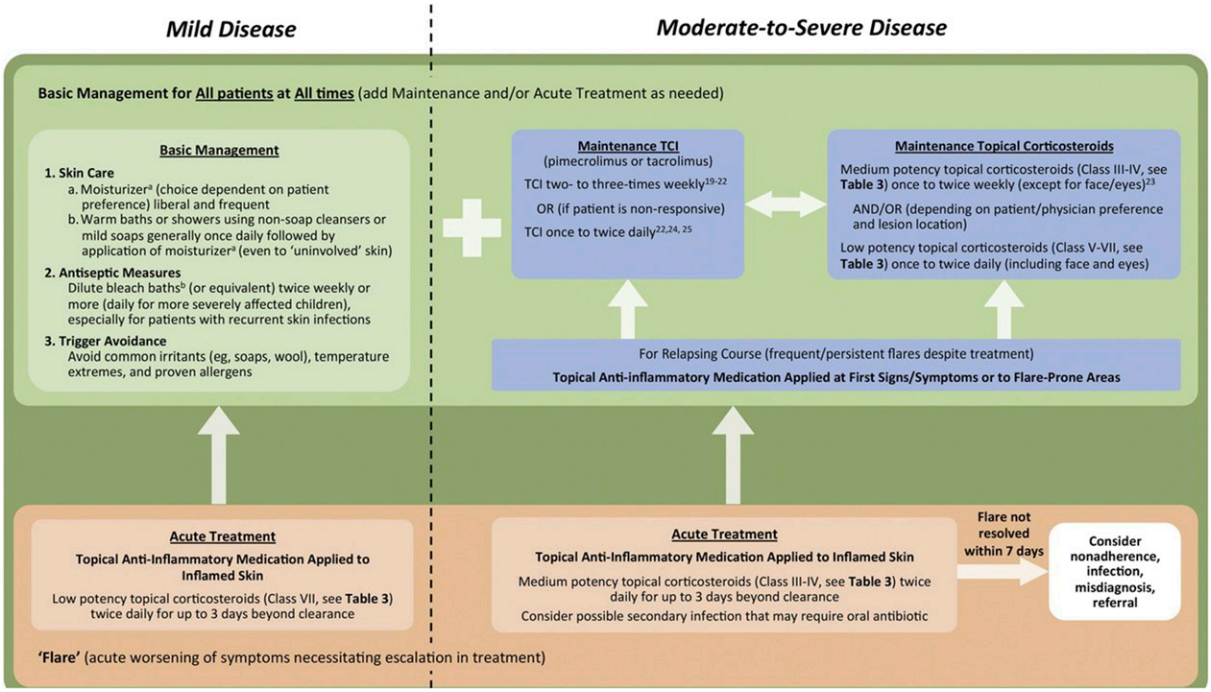


Figure 1. Proposed treatment model/eczema action plan for pediatricians and other primary care providers. (2) TCI=topical calcineurin inhibitor. [a]As tolerated during flare; direct use of moisturizers on inflamed skin may be poorly tolerated; however, bland petrolatum is often tolerated when skin is inflamed. Note: Topical phosphodiesterase-4s were not approved at the time of algorithm development. (Reprinted with permission from Eichenfield LF, Boguniewicz M, Simpson EL, et al. Translating atopic dermatitis management guidelines into practice for primary care providers. *Pediatrics*. 2015;136 (3):558.)

for varying durations of a few days to several weeks to manage AD refractory to basic good skin care and emollient use alone. Low-potency (ie, 1%–2.5% hydrocortisone) and medium-potency (ie, 0.1% triamcinolone) TCSs are recommended as first-line management for flares of mild and moderate-to-severe AD, respectively, especially in infants and young children. (37) Facial and intertriginous areas are very penetrable and should be treated with low-potency corticosteroids to avoid adverse reactions. Recommendations for TCS therapy duration are numerous and largely based on expert consensus. Recently published guidelines for primary care providers endorse continued application of TCS twice daily for up to 3 days beyond flare resolution, (43) but there are data to support sufficient therapeutic response with once daily application. (44) Adequate quantities of mild- to moderate-strength TCS should be described proportionate to age and body surface area involvement. For instance, acute treatment of a 4-year-old with 50% body surface area involvement with a topical corticosteroid ointment applied twice daily should use 62 to 125 g of TCS per week based on "fingertip unit dosing." (45) Patient noncompliance, cutaneous superinfection, and/or misdiagnosis must be considered if the exacerbation fails to improve within 10 to 14 days of therapy. Referral to a dermatologic specialist is recommended for unresponsive dermatitis with appropriate medication use. (43)

To enhance TCS therapy efficacy, wet wrap therapy (WWT) is often used in the management of refractory moderate-severe AD. (46) Health-care providers in the clinical setting may demonstrate this technique to patients with AD and caregivers. The WWT involves the application of TCSs or emollients followed by 2 successive layers of cotton pajamas, gauze, or tubular bandages (first layer wetted with warm water; second layer dry). The occlusive properties of WWT enhance penetration of the topical agent(s), improving treatment success. (46) Wet wrap application for up to 24 hours is acceptable and may be repeated for several days to 2 weeks, permitting patient tolerance. Cautious use of mid-higher potency TCSs in WWT is advised because greater absorption may cause adverse effects (AEs) and/or infection. The WWT should be performed as directed by a practitioner trained in its use. (47)

Rarely, AD worsened by TCSs or other topical therapy may result from allergic sensitization to specific components in topical formulations, including preservatives, vehicle, or active ingredients. (48) Specialist referral for patch testing is recommended if contact dermatitis is suspected. (43)

TABLE 3. **Topical Corticosteroids Ranked by Potency (from Most Potent to Least Potent)**

GROUP	GENERIC NAME (BRAND NAME)	VEHICLE	CONCENTRATION, %
I	• Betamethasone dipropionate (Diprolene)	Ointment	0.05
	• Clobetasol proprionate (Temovate)	Cream, ointment, lotion	0.05
	• Diflorasone diacetate (Psorcon)	Ointment	0.05
	• Halobetasol propionate (Ultravate)	Cream, ointment	0.05
II	• Amcinonide (Cyclocort)	Ointment	0.1
	• Betamethasone diproprionate (Diprosone/Maxivate)	Ointment	0.05
	• Desoximetasone (Topicort)	Cream, ointment	0.25
		Gel	0.5
	• Fluocinonide (Lidex)	Cream, ointment, gel, solution	0.05
	• Mometasone furoate (Elocon)	Ointment	0.1
	• Triamcinolone (Aristocort)	Cream	0.5
III	• Amcinonide (Cyclocort)	Cream, lotion	0.1
	• Betamethasone diproprionate (Diprosone)	Cream	0.05
	• Betamethasone valerate (Valisone)	Ointment	0.1
	• Diflorasone diacetate (Psorcon)	Cream	0.05
	• Fluticasone propionate (Cultivate)	Ointment	0.005
	• Triamcinolone acetonide (Aristocort)	Ointment	0.1
IV	• Flucinolone acetonide (Synalar)	Ointment	0.025
	• Hydrocortisone valerate (Westcort)	Ointment	0.2
	• Mometasone fuorate (Elecon)	Cream, lotion	0.1
	• Triamcinolone acetonide (Kenalog, Aristocort)	Cream	0.1
V	• Betamethasone dipropionate	Lotion	0.05
	• Betamethasone valerate (Valisone)	Cream	0.1
	• Fluticasone acetonide (Synalar)	Cream	0.025
	• Fluticasone propionate (Cutivate)	Cream	0.05
	• Hydrocortisone butyrate (Locoid)	Cream, ointment, lotion	0.2
	• Hydrocortisone valerate (Westcor)	Cream	0.2
	• Prednicarbate (Dermatop)	Cream	0.1
VI	• Alclometasone dipropionate (Aclovate)	Cream, ointment	0.05
	• Betamethasone valerare	Lotion	0.1
	• Desonide (DesOwen/Tridesilon)	Cream, ointment	0.05
	• Fluocinolone acetonide		
	(Derma-Smoothe/FS)	Oil	0.01
	(Synalar)	Solution	0.01
	• Triamcinolone acetonide (Aristocort, Kenalog)	Cream	0.025
VII	• Hydrocortisone acetate	Cream	1
	• Methylprednisolone acetate	Cream	0.25
	• Dexamethasone sodium phosphate	Cream	0.05

Adapted with permission from Eichenfield LF, Boguniewicz M, Simpson EL, et al. Translating atopic dermatitis management guidelines into practice for primary care providers. Pediatrics. *2015;136(3):554–565.*

The AEs reported from TCS utilization are infrequent and primarily cutaneous, but disproportionate fears of their use are many, with corticosteroid phobia being common. Much "recalcitrant" AD is due to insufficient use of prescribed topical therapy. Therapy noncompliance may result from parental fear of AEs. The true frequency of AEs is unknown, but they are rare in studies and clinical practice. Counseling patients and caregivers on clinical signs and reversibility of AEs, including skin atrophy, telangiectasias, acneiform lesions, and hypertrichosis, is critical to treatment adherence. Systemic AE incidence is extremely rare but increases with prolonged duration of therapy. Rare reports of hypothalamic-pituitary axis suppression, hyperglycemia, and hypertension are documented in the literature. (49) Predisposing factors to systemic AEs include long-term utilization, large body surface area, and high-potency formulation. Providers should be aware of TCS AEs and monitor for associated clinical signs. Specific laboratory

monitoring for systemic AEs is not routinely suggested. (37) Pediatricians should feel comfortable prescribing specific quantities of TCS to be used over time, counseling about safe TCS use rather than fueling inappropriate corticosteroid phobia that may contribute to inadequate disease control.

The topical calcineurin inhibitors (TCIs) 0.1% pimecrolimus cream and 0.03% tacrolimus ointment are Food and Drug Administration (FDA) approved for children older than 2 and 15 years, respectively. These topical medications are indicated as "second line therapy for the short term and noncontinuous chronic treatment of moderate to severe atopic dermatitis in nonimmunocompromised children who have failed to respond adequately to other topical prescription treatments for atopic dermatitis or when those treatments are not advisable." (50)

Contrasting with TCS therapy, TCI therapy has fewer cutaneous risks and may be more suitable for thin-skinned areas, such as the face and intertriginous regions. Caregivers and providers often have concerns about TCI treatment in light of the FDA-issued black box warning in 2006. (50) A lack of long-term safety data at the time and concerns of hypothetical risk of skin malignancy and lymphoma led to the issuance of this warning. Since that time, numerous studies involving more than 17,000 infants and children have displayed drug safety with minimal evidence of immunocompromise or malignancies with their use. (51)

Recently, topical phosphodiesterase-4 inhibitors have been studied, and crisaborole 2% topical ointment is FDA approved for AD in children 2 years and older. A nonsteroidal anti-inflammatory agent, it is not associated with skin atrophy. Although it may be incorporated into regimens of care similar to other topical anti-inflammatory medications, it was studied as monotherapy in mild-to-moderate AD applied 2 times a day for 28 days. (52)

"Proactive" Maintenance Therapy

After resolution of disease flare, maintenance therapy largely depends on AD persistence and severity. Control with basic management is typically sufficient for patients with mild disease that is intermittent. Basic management principles include appropriate skin care (detailed previously herein) and irritant avoidance. Emollients constitute an integral part of maintenance and preventive therapy given their cost-effectiveness and capacity to enhance skin hydration. Noteworthy, a recent randomized controlled trial of 124 neonates at risk for atopic disease suggested an inverse correlation between emollient application from birth and subsequent AD development by 6 months of age. (53) Larger-scale investigations are necessary to confirm these encouraging results.

Multiple specialty group guidelines have recommended the use of TCIs and TCSs in proactive maintenance regimens of care. A proactive approach for maintenance therapy is advised to use regularly scheduled topical application of anti-inflammatory medications to frequently flaring skin areas, as contrasted to reactive flare management. Both TCSs and TCIs may be useful on disease-prone areas, applied on a routine periodic basis. Multiple clinical investigations reveal significant flare reduction with proactive consistent application of moderate or lower-potency TCSs, and/or TCIs, with varying application frequencies. (51)(54) Current recommendations allow flexibility, endorsing TCI application 2 to 3 times weekly, or once to twice daily in recalcitrant cases. (55) Similarly, TCSs are recommended once to twice weekly (medium potency; excluding face and intertriginous regions) and/or once to twice daily (low potency; including face and intertriginous regions). (55)

OTHER THERAPEUTIC CONSIDERATIONS

Irritants, Allergy, and Environmental Modifications

Irritants include chemicals, course fabrics (ie, wool), lanolin, soaps/detergents, fragrances, acidic foods, tobacco smoke, and temperature extremes. Avoidance of irritants and known allergens may lessen disease severity and lead to more disease-free days.

Children with AD have higher rates of IgE sensitization, which may be evaluated through specific IgE or skin prick testing. However, IgE sensitization is not the same as clinical food allergy, which is defined as "an adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food." (56) The incidence of IgE-mediated food allergy development in 2 large US-based investigations of infants with mild-to-moderate AD, 1 retrospective and 1 prospective, was approximately 15%. (57) Food allergy rates increased to approximately 30% to 40% in patients with moderate-to-severe disease. (57) The most common food allergens in patients with AD include egg, milk, peanut, soy, and wheat. Food allergens may be a more significant issue in younger children with AD. However, both skin prick and specific IgE tests have high false-positive rates and are not necessarily predictive of clinically relevant reactions. (56)

Food allergy reactions in patients with AD can include elicitation of eczematous changes or urticarial skin findings or systemic symptoms such as wheezing, vomiting, diarrhea, and/or proctocolitis. Suspected food allergy may need to be evaluated with oral food challenges. It is not recommended for children without documented or proven food allergy to avoid potentially allergenic foods as a means of

managing AD. An expert panel recommended that children younger than 5 years with moderate-severe AD should undergo food allergy testing if "1) the child has persistent atopic dermatitis in spite of optimized management and topical therapy; and/or 2) the child has reliable history of an immediate reaction after ingesting specific foods." (56) If they do have documented food allergy and AD it is reasonable to avoid the specific food allergens. Regular growth monitoring and nutritional management may be an important part of intervention.

Recently, young children with AD have been identified as a group that may benefit from the early introduction of specific foods, decreasing subsequent development of food allergy. The novel "Learning Early about Peanut Allergy" (LEAP) trial, published in 2015, was the first large-scale randomized trial investigating allergy prevention by early allergen introduction. Children with severe eczema and/or egg allergy were shown to have a decreased rate of development of peanut allergy with early peanut consumption, beginning at 4 to 11 months of age and continuing until 5 years of age. (57) Prevention was shown in children with negative skin prick test results for peanut, as well as those with positive skin prick test results, although individuals with larger wheal size (5 mm) were excluded from the trial. Expert recommendations are advising the identification of children with severe AD in the first year of life as a cohort that should be evaluated with specific IgE to peanut, with early feeding with a negative serum test result and referral to allergy for skin prick testing for positive specific IgE peanut blood test results, or direct referral before serum screening, for skin prick evaluation for determination of the safety of early peanut feeding. (58)(59)

Reactivity to aeroallergens predominates over food allergen sensitization in older children and adolescents with AD. Sensitization to aeroallergens occurs more frequently in patients with moderate-to-severe AD. Common aeroallergens include animal dander, dust mites, fungi, and pollen. Similar to food allergen sensitization, clinical relevance of aeroallergen sensitization is variable, worsening eczema severity in some individuals but not others. Eczematous dermatitis predominantly on exposed cutaneous surfaces, including the arms, face, neck, and V area of the chest, may be a clue to aeroallergen involvement. Avoidance of aeroallergens through environmental modifications has not consistently decreased cutaneous involvement. Numerous investigations have focused on minimizing house dust mite exposure to improve AD severity. Although cleaning measures and mattress covers may reduce house dust mite sensitization, investigations, although few, have shown clinical improvement in patients with AD who undergo these interventions. Current American Academy of Dermatology guidelines advise that pillow and mattress covers may be considered in children with house dust mite sensitization and refractory AD, on the basis of limited evidence. (55)

Microbial Management

Antimicrobial therapy should be reserved for the management of patients with clinical signs of infection. Localized impetigo may be treated topically with antistaphylococcal antibiotics (ie, mupirocin), whereas widespread involvement often requires more aggressive therapy with systemic antibiotics. First-generation cephalosporins provide broad antibacterial coverage against staphylococcal and streptococcal agents except methicillin-resistant *S aureus*. Poor clinical response should prompt culture of affected skin to assess for methicillin-resistant *S aureus* and to guide antibiotic selection based on sensitivity and resistance patterns. Topical or systemic antibiotic treatment of AD that is not clinically infected is not advised. (60)

Hospitalization and intravenous antimicrobials are occasionally required for extensive infections, especially eczema herpeticum. Once a dermatologic emergency, mortality from this potentially lethal condition is virtually prevented with prompt intravenous systemic acyclovir administration. A multicenter retrospective cohort study recently showed an inverse correlation between hospital length of stay and delay in acyclovir initiation, providing further evidence for the efficacy of therapy. (61) Outpatient oral antiviral management is often sufficient for localized outbreaks and should be considered in mild cases.

In children prone to cutaneous bacterial infections, proactive antiseptic bleach baths may reduce AD severity by decreasing inflammation and cutaneous microbial colonization. (62) One randomized placebo-controlled investigation revealed a significant decrease in eczema severity in children 6 to 17 years of age with clinical signs of bacterial infection who received daily 0.005% sodium hypochlorite (bleach) baths for 3 months. (29) The American Academy of Dermatology currently recommends bleach baths (0.005% sodium hypochlorite) twice weekly to daily in patients prone to bacterial superinfections on the basis of this evidence. Instructions for appropriately mixing a therapeutic bleach bath are listed in Table 4.

Pruritus and Sleep Disturbance

The use of topical antihistamines for the symptomatic relief of pruritus in patients with AD is not recommended due to the risk of cutaneous absorption. (37) Short-term treatment with sedating systemic antihistamines is often used to improve sleep quality during flares, although the evidence supporting this is limited. The first-generation

antihistamines (ie, diphenhydramine and hydroxyzine) with sedative properties are favorable. Nonsedating antihistamines are not suggested in the absence of other atopic disorders but may be useful for concurrent atopic conditions (ie, allergic rhinitis). (60)

REFRACTORY THERAPEUTICS

Immunosuppressive agents or narrow-band UV-B phototherapy is frequently used at the specialist level for moderate-severe refractory AD that is persistent or frequently flaring despite the use of topical medications. UV radiation is postulated to have immunosuppressive, antibacterial, and barrier-enhancing properties beneficial in AD management. (63) Systemic immunomodulatory agents (ie, cyclosporine, methotrexate, azathioprine, mycophenolate mofetil) are sparingly recommended for children recalcitrant to first-line therapies and/or phototherapy. (60) Oral corticosteroids are occasionally used for severe AD flares but are not recommended due to only transient effects and a poor AE profile. Newly established understanding of the immunologic dynamics underlying AD has triggered recent investigations into novel therapeutics, including biological agents and small molecules (eg, IL-4 receptor alpha antibodies (dupilumab), JAK inhibitors, and others. Initial results are encouraging, and further investigations are currently underway.

TABLE 4. **Bleach Bath Instructions for Caregivers**

1. Add common 6% household bleach to a bathtub full of water (8.75% bleach is one-third more concentrated; use one-third more water or one-third less bleach)
2. Measure the amount of bleach before adding it to the bathwater
3. For a full tub of water, use ½ cup; for a half-full tub of water, add ¼ cup of bleach
4. While the tub is filling, pour the bleach into the water
5. Wait until the bath is fully drawn before placing the child in the tub
6. Never apply bleach directly on a child's skin
7. Soak for 10 min
8. Pat the child's skin dry after the bath
9. If the child uses eczema medication, apply it immediately after the bath, then moisturize the child's skin
10. As an alternative to bleach baths, comparable dilute bleach solutions can be made using 1 tsp of bleach per gallon of water. This may be useful in spray bottles for use in showers (eg, for adolescents) or for smaller baby bathtubs. Alternatively, commercial sodium hypochlorite products that seem to have similar effects as bleach baths are available.

THERAPEUTIC PATIENT EDUCATION

Educating caregivers and patients on disease course, prognosis, and effective implementation of therapeutic interventions is critical to AD management success. Comprehensive education may improve treatment compliance and minimize caregiver misunderstandings and reservations. Teaching should begin with implementation of an initial management plan and continue through each subsequent visit, ensuring continued patient understanding as therapy is continued and/or adapted. Educational methods vary significantly and can be conveyed individually or through group sessions. Numerous different educational interventions have been investigated during the past decade. Evidence strongly supports intensive formal training programs, showing significant improvements in patient disease severity and quality of life. These interventions are often less feasible in clinical practice due to substantial physician and personnel time constraints. (64) Other more practicable educational strategies include written action plans, PowerPoint or video instruction modules, and nurse instructional sessions.

Written action plans have been successful in improving treatment compliance in asthmatic and diabetic children. (64) Numerous clinical providers have used an analogous action plan for patients with AD detailing proper skin care and specific indications for systemic and topical medications. (64) Further studies must be performed on their educational effectiveness, but these written action plans are promising. (64)(65)

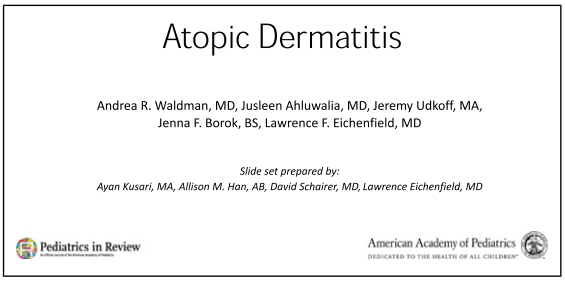
Physicians should be cognizant of additional management resources for patients with AD, including information provided by the American Academy of Dermatology (http://www.aad.org), the National Eczema Association (http://nationaleczema.org), and The Eczema Center at UCSD/Rady Children's Hospital, San Diego (http://www.eczemacenter.org).

Summary

- On the basis of recent epidemiologic evidence, atopic dermatitis (AD) is the most common chronic inflammatory dermatologic disorder, affecting approximately 12.5% of children in the United States (60% by age 1 year and 90% by age 5 years).
- On the basis of recent epidemiologic evidence, disease prevalence is highest in African American children and increases in direct association with parental educational level.
- On the basis of strong evidence, loss-of-function mutations in the *FLG* gene and familial atopy increase the genetic susceptibility to AD development.

- On the basis of expert consensus, AD may be diagnosed clinically based on a constellation of essential, important, and associated features (Table 1).
- On the basis of expert consensus and some research evidence, physicians should be conscious of and evaluate for AD comorbidities, including allergic rhinitis, asthma, food allergies, sleep disturbance, attention-deficit/hyperactivity disorder, anxiety, and depression.
- On the basis of strong evidence, individuals with AD have baseline xerosis for which emollient use is a critical component of management.
- On the basis of some evidence and expert consensus, bathing in lukewarm water for a limited duration using a mild or nonsoap cleanser is recommended to hydrate skin and eliminate residual irritants, bacteria, and crusting.
- On the basis of strong evidence, lowest- to moderate-potency topical corticosteroid (TCS) application for up to 3 days beyond flare resolution is recommended.
- On the basis of some evidence and expert consensus, wet wrap therapy enhances the penetration of topical agents, improving treatment success.
- On the basis of some evidence and expert consensus, antiseptic 0.005% bleach baths may help AD in those with frequent infection.
- On the basis of strong evidence, "proactive" maintenance therapy with TCSs once or twice weekly or topical calcineurin inhibitors (TCIs) twice weekly to daily is efficacious in decreasing flare frequency.
- On the basis of strong evidence, TCIs may be safely used off label in children younger than 2 years.
- On the basis of some evidence and expert consensus, educating caregivers and patients on disease course, prognosis, and effective implementation of therapeutic interventions is critical to AD management success.

To view teaching slides that accompany this article, visit http://pedsinreview.aappublications.org/content/39/4/180.supplemental.



References for this article are at http://pedsinreview.aappublications.org/content/39/4/180.

Mechanisms for Atopic Disease

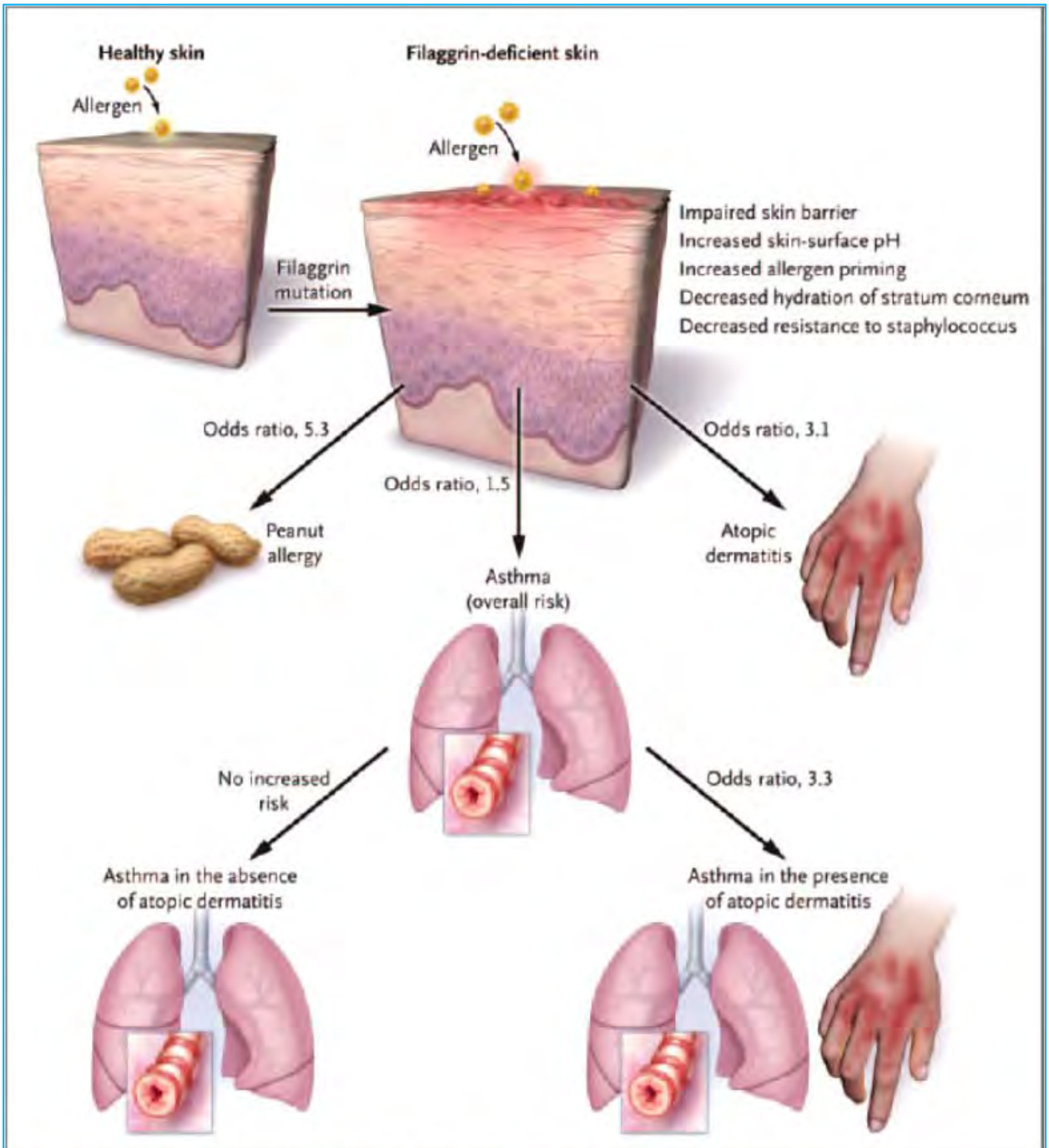


Figure 4. Filaggrin Haploinsufficiency and Increased Risk of Several Complex Traits.

Filaggrin haploinsufficiency is defined as a 50% reduction in the expression of the filaggrin protein. The odds ratios are for the risk of peanut allergy, asthma, or atopic dermatitis as compared with the risk in the absence of filaggrin mutation. The odds ratios listed for atopic dermatitis and asthma are from meta-analyses involving several thousand patients. *FLG* mutations confer an overall risk of asthma of 1.5, but this risk is restricted to patients with atopic dermatitis. The odds ratio for the complex phenotype of asthma plus atopic dermatitis is 3.3. The odds ratio for peanut allergy is based on the only available data, from a single study.

Statistics Review: *Odds ratio:* *Odds of Atopic Disease with Filaggrin MUTATION (Disease/No Disease)*
Odds of Atopic Disease with NORMAL Filaggrin (Disease/No Disease)

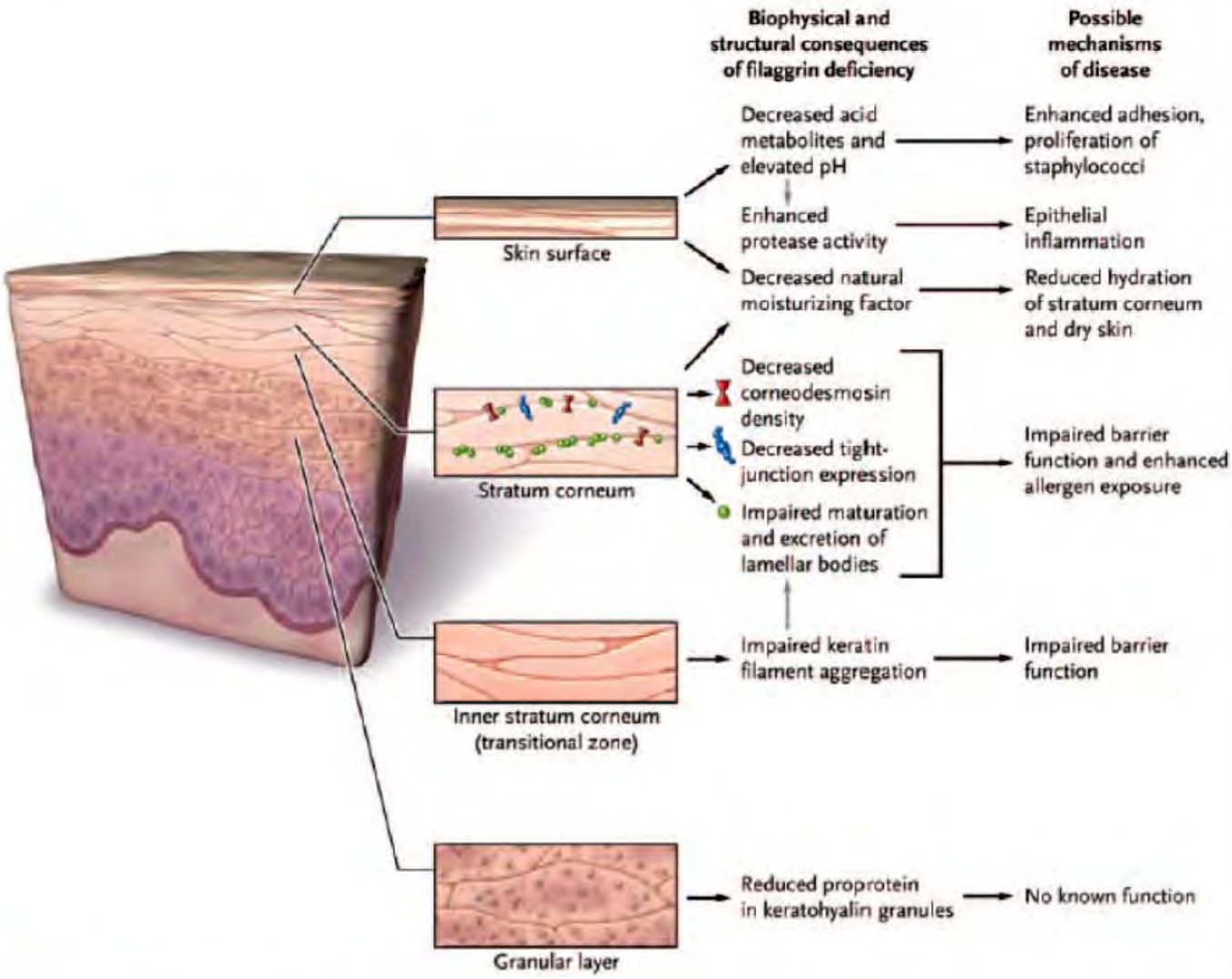


Figure 5. Filaggrin Deficiency and Possible Mechanisms of Disease.

Filaggrin haploinsufficiency results in a number of differentiation-specific structural, biophysical, and functional changes within the stratum corneum that are likely to be directly related to disease pathogenesis in ichthyosis vulgaris and atopic dermatitis. In the granular layer, the proprotein profilaggrin is stored within the keratohyalin granules, where it is thought to be functionally inert. At the interface of the inner stratum corneum and the stratum granulosum, impaired aggregation of keratin filaments causes impaired excretion of lamellar bodies, with resultant impairment in barrier function. In the stratum corneum, filaggrin deficiency is associated with multiple structural changes, including decreased corneodesmosome density, decreased expression of tight-junction proteins, and — most important — impaired maturation and secretion of lamellar bodies. These changes may be mediated by increased pH within the residual cytoplasm of squames due to a lower concentration of acidic filaggrin breakdown products. All these changes contribute to impaired barrier function and increased ease of allergen presentation to epidermal dendritic cells. Finally, on the skin surface, decreased levels of natural moisturizing factor cause the skin to lose hydration and feel dry; reduced levels of urocanic acid and pyrrolidone carboxylic acid on the skin surface impair *Staphylococcus aureus* adhesion and proliferation through pH-dependent and possibly pH-independent mechanisms. Elevated skin-surface pH increases the activity of several proteases that cleave proforms of interleukin-1, possibly contributing to epithelial inflammation and further barrier destruction.

Filaggrin Mutations Associated with Skin and Allergic Diseases

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Steroids on Formulary at WR-B

Potency Group	Generic Name	Percentage Strength	Brand Name (Alt Brand Name)	Size
Class I	Augmented Betamethasone Dipropionate	0.05% lotion	Diprolene	30 ml
	Clobetasol Proprionate	0.05% ointment	Temovate (Cormax)	15 g, 30 g
	Clobetasol Proprionate	0.05% cream	Temovate-E (Cormax)	15 ml, 30 ml, 45 ml
	Clobetasol Proprionate	0.05% solution	Temovate Scalp (Cormax)	25 ml, 30 ml
	Flurandrenolide	4mcg/cm tape	Cordran	200 cm
Class II	Augmented Betamethasone Dipropionate	0.05% cream	Diprolene AF	15 g
	Betamethasone Dipropionate	0.05% ointment	Diprosone	15 g
	Fluocinonide	0.05% cream	Lidex	15 g, 60 g
	Fluocinonide	0.05% gel	Lidex	15 g, 60 g
	Fluocinonide	0.05% ointment	Lidex	15 g, 60 g
	Fluocinonide	0.05% solution	Lidex	60 ml
Class III	Amcinonide	0.1% cream	Cyclocort	15 g, 60 g
	Betamethasone Dipropionate	0.05% lotion	Diprosone	60 ml
	Fluocinonide Emollient	0.05% cream	Lidex-E	15 g, 60 g
Class IV	Hydrocortisone Valerate	0.2% ointment	Westcort	15 g, 60 g
	Triamcinolone Acetonide	0.1% ointment	Kenalog	15 g, 80 g, 454 g
	Triamcinolone Acetonide	0.2% aerosol	Kenalog	63 g
Class V	Betamethasone Valerate	0.1% cream	Valisone	15 g
	Betamethasone Valerate	0.1% lotion	Valisone	60 ml
	Desonide	0.05% ointment	Tridesilon (DesOwen)	15 g, 60 g
	Flurandrenolide	0.05% lotion	Cordran	60 ml
	Hydrocortisone Valerate	0.2% cream	Westcort	15 g, 60 g
	Triamcinolone Acetonide	0.1% cream	Kenalog (Aristocort EQ)	15 g, 80 g, 454 g
	Triamcinolone Acetonide	0.025% ointment	Kenalog	15 g
Class VI	Desonide ☺	0.05% cream	Tridesilon (DesOwen)	15 g, 60 g
	Fluocinolone Acetonide	0.01% oil	Dermasmooth (Capex)	120 ml
	Triamcinolone Acetonide	0.025% cream	Kenalog	15 g, 80 g
Class VII	Hydrocortisone	2.5% cream	(Hytone)	28 g
	Hydrocortisone (OTC) ☺	1% cream		30 g
		0.5% cream		30 g
		1% lotion		118 ml
		1% ointment		30 g

☺ Safe for facial use

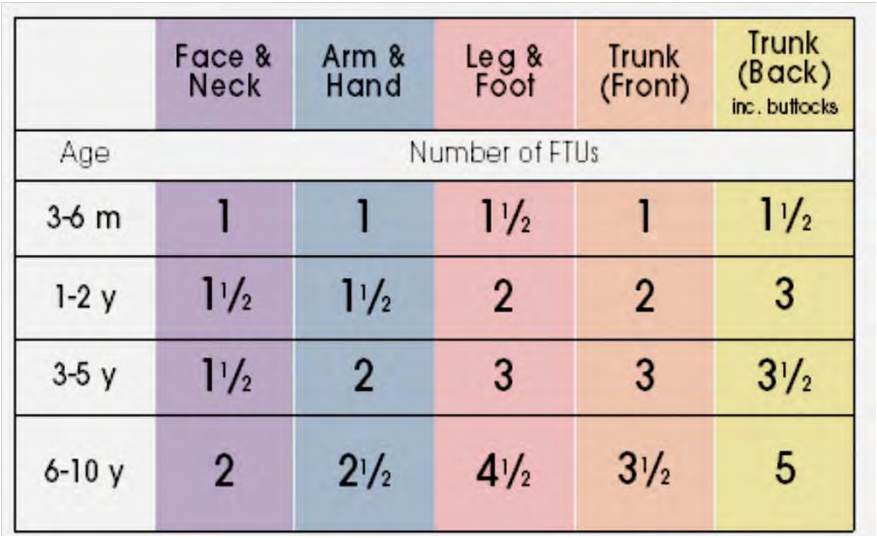
Moisturizers on Formulary at WR-B

Aquaphor (mineral oil/petroleum)	454 g jar
Cetaphil cream	454 g jar
Hydrocerin lotion	480 ml
Vanicream	454 g jar

Finger Tip Units (FTUs)

- Amount of ointment/cream product that extends from the tip of an adult finger to the first flexural crease of the DIP, when dispensed from a tube with the standard 5mm nozzle.
- Used to gauge the amount of topical steroid to use on a given area of affected skin.
- Provides guide to the appropriate size of tube that should be prescribed for a patient.

- **1 FTU = 0.5 g = treats an area 2x the size of an adult's hand with fingers together,**
- **2 FTUs = 1g = treats an area equivalent to 4 adult handprints (10 x 10cm), etc.**
- *30 g of product is necessary to fully cover an adult patient.*



	Face & Neck	Arm & Hand	Leg & Foot	Trunk (Front)	Trunk (Back) inc. buttocks
Age	Number of FTUs				
3-6 m	1	1	1½	1	1½
1-2 y	1½	1½	2	2	3
3-5 y	1½	2	3	3	3½
6-10 y	2	2½	4½	3½	5

"Home Remedies"

TABLE 6 A Bleach Bath Primer

Explain to patients that their skin may benefit from "swimming in pool water." Then, give them these instructions for making a pool right in their very own bathroom.

- Add lukewarm water to fill the tub completely (about 40 gallons of water).
- Depending on the size of the tub/amount of water used, add ¼ to ½ cup of common bleach solution to the bath water. Any sodium hypochlorite 6% solution will do (for example, Chlorox liquid bleach); the goal is to make a modified Dakin's solution with a final concentration of about 0.005%.
- Stir the mixture to ensure that the bleach is completely diluted in the bath water.
- Have patients soak in the chlorinated water for 5 to 10 minutes.
- Thoroughly rinse skin clear with lukewarm, fresh water at the end of the bleach bath to prevent dryness and irritation.
- As soon as the bath is over, pat the patient dry. Do not rub dry, as this is the same as scratching.
- Immediately apply any prescribed medications/emollients.
- Repeat bleach baths 2–3 times a week or as prescribed by the physician.

The following restrictions apply

- Do not use undiluted bleach directly on the skin. Even diluted bleach baths can potentially cause dryness and/or irritation.
- Do not use bleach baths if there are many breaks or open areas in the skin (for fear of intense stinging and burning).
- Do not use bleach baths in patients with a known contact allergy to chlorine.

Additional Types of Baths (www.nationaleczema.org)

Vinegar Baths: Referred to as the "pickle the patient" treatment. Add one cup to one pint of vinegar to the bath. Can be used as a wet dressing too as it kills bacteria.
Bath Oil Baths: Oils in the bath are a favorite of some providers and patients. Bath oils can leave the tub slippery – be careful. They can also leave a hard-to-clean film. See if they work for you.
Salt Baths: When there is a significant flare the bath water may sting or be uncomfortable. Add one cup of table salt to the bath water to decrease this side effect.
Baking Soda Baths: Added to a bath or made into a paste it can be used to relieve the itching.
Tar Baths: Tar baths can sooth inflammation and itch. Tar bath oil or tar shampoo can be used. Warning: if the skin is open or excoriated the tar baths can sting.
Oatmeal baths: Added to a bath or made into a paste it can be used to relieve the itching.

TABLE 7 Keeping Eczema Under Wraps: Recommendations for Applying Wet Wraps

Gather your supplies.

- Topical steroid ointment and/or emollient prescribed by your physician.
- The wraps themselves consist of a bottom (wet) and top (dry) layer. Gauze wrap (eg, Kerlex) or cotton sleepers, pajamas, or long johns may be used. It will be necessary to have two of the material chosen. Alternatively, it is possible to use the "daddy sock" method for wrapping extremities. Simply cut a small hole in the toes of any adult-sized pair of 100% cotton socks to create a pair of tubular cotton bandages that fit easily over an extremity, can be moved up or down as needed, and can be washed and reused.
- Warm water in a sink or a basin.

Apply the steroid ointment directly to the patient's inflamed skin using tongue depressors or popsicle sticks (similar to how a spatula is used in cooking). Using a "spatula" helps to avoid direct contamination of the medication supply, allows large areas to be covered quickly and evenly, and prevents the caregiver from being unnecessarily exposed to topical corticosteroids.

Apply emollient to the rest of the patient's skin.

Take a layer of the wrap (e.g., gauze or one sock) and soak it in warm water.

Wring out any excess water until this bottom wet layer is only very slightly damp.

Wrap the affected area with the wet layer material. Make sure the wet layer is not too tight.

Immediately put the dry layer over the wet layer. Do not use plastic as the dry layer (it is too occlusive and may be a choking hazard).

Make sure the wrapped patient remains in a warm environment, which helps to promote a higher degree of humidity and ensures that the child does not get too cold as the evaporation process occurs.

Wet wraps are generally left in place overnight and may be applied for 5 to 7 days in a row. As always, follow the advice of the physician for frequency of change and duration of use.

Maintain close contact with the physician while undergoing the use of wet wraps. Report any suspected adverse effects immediately.

Atopic Dermatitis Quiz

1. The atopic triad includes: _____. Children with one atopic disease are _____ more likely to develop a second atopic disease.

2. Describe the **underlying etiology** of atopic dermatitis.

3. List the **sites** *typically* affected by atopic dermatitis depending on age:

Infants	
Children	
Teenagers	

4. **True** or **False**: Atopic dermatitis can develop on *any* part of the body regardless of age.

5. Place the following topical corticosteroids in or order of **decreasing potency**:

Desonide 0.05% ointment
Fluocinonide 0.05% cream
Fluocinonide 0.05% ointment
Flurandrenoloide Tape
Hydrocortisone 2.5% cream
Triamcinolone Acetonide 0.1% ointment
Desonide 0.05% cream
Fluocinonide 0.05% emollient cream
Fluoocinolone Acetonide 0.01% oil
Hydrocortisone Valerate 0.2% ointment
Triamcinolone Acetonide 0.025% ointment
Triamcinolone Acetonide 0.1% cream

6. List **adverse effects** of topical corticosteroids. Consider local and systemic.

Atopic Dermatitis Cases

Case 1:

Colton is a 15 month old male infant who presents for a routine well visit. He is the only child of well-educated parents who live in the suburbs. His height and weight have been stable at the 50th percentile. He was breastfed for the first year of his life and continues to breastfeed at night. He was introduced to solid foods at 6 months of age and has fully transitioned to table foods. His mother boasts that he has "never had a runny nose in his life" and that she uses hand sanitizer "all the time, of course". Her only concern is for a red, dry, itchy rash that keeps recurring on his cheeks, arms, and legs. She has not noticed any triggers.

Based on history, what are protective and predisposing factors for Colton developing AD?

On exam, Colton's rash appears consistent with a mild-to-moderate eczema flare, with large dry erythematous plaques covering his cheeks and chin. His arms and legs have multiple papules and vesicles in the flexural surfaces with scratch marks.

What treatment would you recommend?

His mother is wary of starting topical steroids and asks about alternatives or homeopathic treatments that are available. **What would you recommend or advise against?**

Prior to leaving, you obtain additional family history to better delineate his risk for additional atopic disease. His mother notes that she and all her sisters struggled with asthma as kids. His father is adopted so family history is unknown, but he does have a h/o anaphylaxis to peanuts.

How would you counsel Colton's mother regarding his risk, particularly for food allergies?

Case 2

Sarah is a 9 year old female brought in by her mother with the complaint of worsening eczema. The family just moved to the DC area from Arizona after her father was injured in Afghanistan. She is currently living in the Fisher House with her parents and two younger sisters. She has had eczema since infancy that has been controlled with periodic use of moisturizers and topical steroids. Her eczema today is the worse it has ever been, completely involving her arms, legs, and neck with patches on her trunk. She has been unable to sleep because of the pruritis and has little interest in going outside to play because of discomfort with walking.

What further history would you like to know?

Her mother, accustomed to these visits, brings in multiple half used 15 g tubes of steroids that were prescribed or purchased from the drugstore. She says she has tried all of them for 1-2 days with no relief. The only one that has helped was a new script for Desonide 0.05% cream, that is now half-full. She has been using it once a day for the past week on all of Sarah's affected areas.

Has the Desonide been used appropriately? What clues can you use to answer this question, other than Sarah's clinical symptoms?

On exam, you notice that some of Sarah's lesions appear impetiginous. You also learn she has a history of abscesses and that her father is receiving home IV antibiotics for MRSA osteomyelitis.

How does this history and exam affect the treatment for Sarah's eczema flare?

What are additional types of super-infections that can occur in patients with AD?

You ultimately decide to treat Sarah with an oral antibiotic for secondary bacterial infection, decolonize her with daily bleach baths for a week and nasal mupirocin, decrease inflammation with a low potency corticosteroid for her face and a medium potency corticosteroid for her extremities, and start her on a regular bathing and moisturizing regimen.

She returns in one week with no further signs of infection. History and medication tubes support compliance. She continues, however, to complain of pruritis and pain and there has been only moderate improvement. There is no concern for secondary viral or fungal infection.

What would else could you recommend?

Atopic Dermatitis Board Review

1. A 7-year-old girl presents in September with an intensely itchy rash of several weeks' duration. During the summer she had many mosquito bites and one area of ringworm, but otherwise she has had no prior skin conditions. She has had no fever, joint pain, myalgias, fatigue, or change in appetite or activity. Antihistamines helped when she had the insect bites, but now they have little effect. No other family members have a rash. On physical examination, the rash is apparent on exposed areas and consists of papules, vesicles, and wheals, some in a linear array or in triangular clusters. There are also numerous hyperpigmented macules. The scalp is involved, but the palms and soles are spared.

Of the following, the MOST likely cause of this rash is:
A. Atopic dermatitis
B. Id reaction to recent fungal infection
C. Hypersensitivity reaction to insect bites
D. Recurrent impetigo with post-inflammatory changes
E. Scabies

2. A 6-year-old boy presents with a 2-year history of frequent pruritic, erythematous eruptions on his arms and legs. The rash usually worsens during winter but occurs intermittently throughout the year. His mother has tried various moisturizers, but they have not been effective in controlling the rash. On physical examination, you note erythematous patches on his antecubital and popliteal regions bilaterally.

Of the following the MOST appropriate initial step in management for this patient is:
A. food allergy skin testing
B. oral antibiotic therapy
C. oral antihistamine therapy
D. topical calcineurin inhibitor therapy
E. topical corticosteroid therapy

3. A 12-month-old girl presents with a 3-month history of a pruritic rash that involves her cheeks, neck, anterior trunk, and antecubital and popliteal areas. The rash improves after use of an over-the- counter topical steroid cream but still is present most days, and the infant often wakes up at night scratching. On physical examination, you observe a raised erythematous rash that has areas of lichenification.

Of the following, the MOST helpful intervention is to:
A. eliminate fruit and acidic juices from the diet
B. eliminate milk, eggs, soy, and wheat from the diet
C. perform aeroallergen allergy testing
D. perform food allergy testing
E. recommend a skin biopsy

4. A 2-year-old boy presents for evaluation of a chronic pruritic eruption. His medical history is remarkable for recurrent epistaxis, otitis media, and pneumonia. Physical examination reveals erythematous, slightly scaling patches on the trunk and in the antecubital and popliteal fossae. Petechiae are present profusely.

Of the following, these findings are MOST suggestive of:
A. Acrodermatitis enteropathica
B. Ataxia telangiectasia
C. Atopic dermatitis
D. Langerhans cell histiocytosis
E. Wiskott-Aldrich syndrome