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Evidence-Based Selection of Skin Care Options for Infants and Children CME/CE

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This activity is supported by a grant from
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CME/CE Released: 6/20/2011
Valid for credit through 6/20/2012

Target Audience

This activity was developed for MDs, RNs, NPs, PAs, and other health care professionals.

Goal

Infants are born with a developing epidermal barrier that is more permeable and more reactive to the environment through the first 2 years of their lives.[1] The infant skin barrier does not fully mature until at least 1 year of age, meaning the distribution and transport of water through the superficial layers of the skin creates a need for protection of infant skin.[2]

Health care providers (HCPs), including physicians and (pediatric) nurse practitioners (PNPs), routinely recommend pediatric skin care products. Because the skin of infants and young children is at significant risk for damage, HCPs need current and accurate education to enable them to offer guidance on selection and application of safe skin care products and sunscreen.

Sunburn may occur readily because an infant's skin has less melanin than at any other time in life.[3] One blistering sunburn in childhood or adolescence more than doubles a person's chances of developing melanoma later in life.[4] A study estimated that regular use of sunscreen with an effective SPF of 7.5 for the first 18 years of life could reduce the lifetime incidence of nonmelanoma skin cancers by 78%.[5]

Although skin cancer is frequently considered a disease of older adults, new statistics reveal the startling reality that skin cancer affects children and adolescents. Melanoma accounts for up to 3% of all pediatric cancers.[6] HCPs have an important role in educating parents and caregivers beginning in their child's infancy and later when developmental stages result in new patterns of sun exposure; as well promoting healthy ultraviolet radiation (UVR) avoidance habits.

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Learning Objectives

Upon completion of this activity, participants should be able to:

1. Confidently discuss the unique attributes that place infants and young children at significant risk for skin damage.
2. List the essential components of routine skin care for infants and children.
3. Outline the fundamental principles of the formulation of safe and effective topical sunscreen products.
4. Describe ways that HCPs can effectively communicate to educate parents and caregivers on safe sun practices that incorporate protective clothing, sunscreens, and sun avoidance.
5. Apply current evidence-based recommendations to the selection of efficacious and safe skin care products for infants and children.

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CONTENT:

How Does Infant Skin Differ from Adult Skin? CME/CE

Peter Lio, MD

"Smooth as a baby's bottom" summarizes the popular notion of infant skin: the soft, supple, and practically flawless integument that is the unattainable objective of all cosmetic treatments. Indeed, it can be difficult to imagine what problems a pediatric dermatologist could possibly address given how perfect newborn skin appears to be. And while there are undoubtedly plenty of skin maladies that affect those at the beginning of life, even for the smoothest of bottoms, there are critical differences worth thinking about, both in health and disease. In this article, we review some of the important structural and physiologic differences between infant (defined here as the first few years of life) and adult skin. We also consider some of the clinical and practical ramifications of these distinctions using evidence whenever possible.

The functions of the skin remain essentially the same at all phases of life, including: barrier, photoprotection, thermoregulation, immune surveillance, hormonal synthesis, insensible fluid loss prevention, and sensory perception.[1] However, there are several important structural differences between the skin of babies and adults, differences immediately accentuated as the newborn transitions from the intrauterine environment to the outside world.

Barrier function of the skin is vital for survival for all human beings. With increasing prematurity, there is increasing barrier dysfunction with higher transepidermal water loss (TEWL) and increased percutaneous absorption of chemicals.[2] As a result, there is greatly increased mortality in premature infants with impaired barrier function, generally due to microbial invasion.[3] Remarkably, this can be demonstrated experimentally by application of emollients that enhance barrier function. In a randomized, controlled trial, massaging premature infants with sunflower seed oil 3 times daily resulted in a 41% reduction in sepsis and a 26% reduction in mortality.[4]

Although the TEWL in full-term infants is generally agreed to be close to that of healthy adults,[1] there is recent evidence that the barrier development continues during the first year of life.[5] Infant skin is found to have higher water content and is able to absorb more water and lose excess water faster than adult skin.[6] Other microstructural differences include thinner stratum corneum and papillary dermis in infant skin.[6]

Beyond these structural points, however, several factors converge to make infants more susceptible to percutaneous toxicity. Their high surface area-to-volume ratio, immature drug metabolism systems, and decreased subcutaneous fat stores effectively increase the absorptive area while decreasing the volume of distribution of a drug or toxin.[3,7] This is compounded by the fact that once absorbed, the infants lack fully developed drug carriage and detoxification systems. Furthermore, direct barrier injury can occur because of the increased fragility of infant skin, particularly from the removal of adhesive tapes and monitors, thus increasing local permeability.[3] Finally, given the estimated 20% incidence of atopic dermatitis among children,[8] there are yet other reasons for barrier function to be impaired at baseline. Because of these factors, it seems prudent to advise that only essential products be applied to the skin, particularly in the first several months of life.

Below the skin, in the subcutaneous fat, there are also discrepancies between mature and immature. In newborns, the subcutaneous fat is rich in the saturated oils palmitic and esteric acid. These fats have higher melting point temperatures than the increasingly unsaturated fats of adulthood; as more oleic acid becomes present, the melting point diminishes.[9] The higher melting point means that the fat in infants can freeze more easily: approximately 64°C vs the much lower adult melting point of 14°C.[10] This principle is typified by "popsicle panniculitis," a fairly common form of fat necrosis in the cheeks of infants several hours after eating popsicles or ice, and the closely related equestrian panniculitis, seen after the cold exposure from riding horses, bicycling, or riding motorcycles.[9] Subcutaneous fat necrosis of the newborn, a condition frequently associated with hypothermia, trauma, or other perinatal stressors, is a panniculitis that may also be related to the higher melting point of infant fat.[11] Because of this limitation in infant skin, extra care must be made to avoid temperature extremes.

Bathing an infant provides important psychological benefits between parent and child.[12] However, oddly enough, it can also provide an opportunity to damage the skin. There is evidence to suggest that washing the skin with a washcloth during the first 4 weeks of life is associated with increased TEWL and decreased stratum corneum hydration compared with simply soaking in

water.[13] Another study found that tub bathing an infant was actually associated with an increased risk of cord infection vs no washing at all.[14] Several papers have examined the use of mild liquid cleansers vs using water alone for bathing. The consensus appears to be that a mild liquid cleanser may actually be less drying and less irritating than water alone, and that bathing should be brief (10 minutes or less) and no more than every other day[15] with spot cleaning in between.

Photoprotection is an important function of the skin, though in the process of preventing ultraviolet (UV) sun damage to certain structures, the skin can itself accrue damage, increasing the chances of skin cancer. As for adults, sun protection is important in childhood. This topic takes special importance because the damage from UV radiation is cumulative: children spend more time doing outdoor activities, younger skin is more susceptible to damage, and UV damage in childhood may have particularly profound consequences later.[16,17] It is also important to remember that infants are entirely dependent upon their caregivers to practice sun protection and are generally not able to communicate the symptoms of early sunburn.

In recent years, concerns have emerged over possible hormone-disrupting chemicals in sunscreens, such as oxybenzone. In children, the doubly worrisome scenario of increased percutaneous absorption of chemicals and the enhanced developmental sensitivity to hormone disruption makes this topic extremely contentious. Evidence for such absorption is fairly abundant with 1 study concluding: "...whilst limited absorption across the skin was observed for the majority of the sunscreens tested, [oxybenzone] demonstrated sufficiently high penetration to warrant further investigation of its continued application."[18]

Evidence for hormone disruption is another issue that is well established for benzophenone-3, homosalate, 4-methyl-benzylidene camphor (4-MBC), octyl-methoxycinnamate (OMC), and octyl-dimethyl-para-aminobenzoic acid (PABA). All show estrogenicity,[19] and studies document environmental persistence and widespread presence in the population.[20] Unfortunately, even the mineral sunscreens such as titanium dioxide and zinc oxide are not without risk. There is evidence that the nanoparticles present in many of these mineral sunscreens can cause cellular damage.[21] Although most studies have shown that there is minimal penetration into the skin,[22] no studies have yet tested these particles in fragile or damaged skin. Infant skin is more fragile, and with the incidence of atopic dermatitis approaching 20% in some populations, there is a reasonably high chance that there will be areas of skin damage in some infants.[23] My conclusion strongly reinforces the message conveyed by the American Academy of Pediatrics: minimize the reliance on topical products in infancy by avoiding sun exposure and using sun-protective clothing whenever possible.[24]

Skin diseases in infants and adults can vary as much as the difference in fundamentals of the skin. Even disorders that may sound familiar from experience in older patients may be distinct in infants: acne, skin infections, and nutritional dermatoses, to highlight a few.

Classical teenage acne (acne vulgaris) is well known to all of us; however, there are 2 distinct forms of acne that can affect patients in the first few years of life: neonatal acne and infantile acne. Neonatal acne is perhaps more accurately referred to as neonatal cephalic pustulosis (NCP) and can affect up to 20% of newborns.[25] This papulopustular disorder lacks the comedones of true acne and may actually be related to colonization with Malassezia yeast species on the skin. Generally benign and self-limited, treatment with topical ketoconazole may shorten the duration of the disease.[26]

Infantile acne, on the other hand, is far more rare than neonatal acne, and generally occurs between 3 months and 1 year.[26] Both comedones and inflammatory papules are seen in this disease, and like its teenage counterpart, scarring may be an issue. Sometimes infantile acne will resolve by school age without specific treatment, but it may also be a harbinger for severe forms of acne in adolescence and appears to be more common in families with a strong family history of acne.[25] Here the differences end: treatment can be very similar to that for teenage acne, including a topical retinoid and topical benzoyl peroxide.[25]

Staphylococcal scalded-skin syndrome in infants and children is caused by staphylococcal bacteria that release exfoliative toxin and can also be seen in adults with renal failure. This suggests that it is the inability to clear the toxin that causes the characteristic superficial bullae and widespread sloughing, with crusting and impetiginization at the orifices.[2] Prompt diagnosis and treatment with systemic antibiotics and skin barrier support are necessary to minimize morbidity from this disease.

Infants are also particularly susceptible to nutritional deficiencies, and zinc deficiency may be acquired or inherited. Acrodermatitis enteropathica (AE) is the rare, autosomal-recessive disease of impaired zinc absorption that usually presents upon weaning from breast milk.[27] Acrodermatitis enteropathica-like eruption can be seen in the setting of insufficient dietary zinc, including breast milk deficiency.[28] Symptoms of periorificial dermatitis, diarrhea, and hair loss frequently are mild and incomplete, making this disease a challenge to diagnose at times. Once the diagnosis is made, zinc supplementation is required, which generally results in dramatic reversal of skin lesions within several days.

Infant skin is often thought of as ideal skin, and its characteristics are frequently sought by adults. However, beyond the smooth and supple beauty, there are significant structural and functional differences that make infant skin more susceptible to certain problems. During the first years of life, there are considerable developments of the skin and subcutaneous fat that warrant handling infants differently—and much more gingerly—than adults.

This article is part of a CME/CE certified activity. The complete activity is available at:
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Sun Protection Products CME/CE

Joe A. Schwarcz, PhD

When it comes to health matters, scientists rarely make statements that do not begin with "may." But here is one. Excessive exposure to sunlight causes skin cancer! There's no "may" about it. Neither is there any "may" about sunlight causing "photo-aging," the development of leathery, wrinkled skin with long-term sun exposure. And the damaging effects of sunlight are not restricted to farmers toiling in the fields or to sun-worshipping yuppies in quest of that alluring tan. Children and infants are also vulnerable. Luckily, chemical protection is readily available. Uncertainties do, however, emerge when it comes to deciding on which specific chemicals to use. There is also the question of whether children, because of their more sensitive skin, need special products.

Some activist organizations claim that certain sunscreen ingredients are unsafe and blame regulatory agencies for not looking after the welfare of the public, while manufacturers profess that their products have been thoroughly tested for safety and efficacy. As usual, the public is left confused. Actually, when you blow away the superfluous blather emanating both from the alarmists and from industry, there is some simple advice to offer.

The challenge is clear. Find a chemical or mixture of chemicals that can be applied to the skin to reduce exposure to the full spectrum of UV light. Then make sure these chemicals do not degrade upon exposure to light, have no topical or systemic toxicity, are minimally absorbed into the body, are resistant to water, do not have a greasy feel, are cosmetically acceptable, do not stain clothing, and can be incorporated into a "vehicle" that allows for easy spreading. Secure Food and Drug Administration (FDA) approval, which is required unlike for other cosmetics. Quite a list of demands.

The first commercial "sunscreens" appeared in the 1960s and were designed to filter out "UVB," the shorter wavelengths of UV light (290–320 nm). These are the rays that cause sunburn, which was the main concern at the time. Slightly longer waves, those responsible for tanning, were deemed safe. Finding chemicals that absorb the nasty UVB rays was not particularly difficult, with PABA, octocrylene, phenylbenzimidazole sulfonic acid, and various cinnamates and salicylates being up to the task.

Products with different concentrations of these ingredients were introduced for different skin types, each prominently featuring a "sun protection factor (SPF)," basically a measure of the time it takes for skin to redden compared with having no protection. The SPF value is determined in the laboratory by applying 2 mg/cm^2 of product to the skin of volunteers. Using a product with an SPF of 15 means that a person who normally begins to burn in 10 minutes can in theory stay in the sun for 150 minutes before experiencing any visible effect on the skin.

It didn't take long for this scenario to prove to be too simplistic. As a clear link between skin cancer and UVB emerged, the focus shifted from preventing sunburn to preventing skin cancer, resulting in an industry frenzy of products with higher and higher SPF values. In truth, an SPF of 15 already blocks 94% of UVB, only 3% less than one labeled as SPF 30. In any case, these numbers are only meaningful if the product is applied the same way as in the lab studies, which turns out not to be the case. Most people were applying far less than 2 mg/cm^2 and were not getting the protection they thought they were getting. What many were getting, though, were various skin reactions. And something else became apparent as well. The longer wavelengths of UV light, 320–400 nm, known as UVA, previously thought to be innocuous, were found to be more deeply penetrating than UVB and responsible for premature wrinkling and aging of the skin ("photo-aging"). Unlike UVB, they can even pass through glass. Furthermore, UVA also was found to be potentially carcinogenic.

This created a need for a novel class of products that would protect the skin both from UVB and UVA. Ideally, not one that would just absorb some wavelengths, but one that would reflect all UV light. Titanium dioxide and zinc oxide, both mineral pigments, fit the bill but left a white residue on the skin. That was all right for lifeguards' noses, but not for vain sunbathers. The search was on for cosmetically acceptable molecules capable of absorbing UVA. Oxybenzone and avobenzone (*Parsol 1789*) were up to this task, but as usual, there are some "buts."

When oxybenzone absorbs UV light, it becomes energized and some of this energy is dissipated through the production of free radicals. These are very active molecular species that have been linked to cancer. Oxybenzone also undergoes a reaction in the presence of UV light to form a compound called a semiquinone, which in turn can inactivate some of the naturally occurring antioxidants in the skin such as reduced glutathione. This is not a good thing since antioxidants offer protection against free radicals. And if that weren't enough, it turns out that oxybenzone can also mimic the behavior of estrogens, at least in fish exposed to high doses. It has therefore been labeled a potential "endocrine disruptor." Concern has been raised, mostly by the EWG, an American activist organization, because surveys have shown that oxybenzone can be found in the blood of 97% of the population.

But, and a big "but" it is, there is no evidence reported in the scientific literature of oxybenzone being linked to any human health problem, except for photodermatitis, a skin reaction triggered by exposure to sunlight. There are hundreds and hundreds of compounds, both natural and synthetic that, if scrutinized the same way as oxybenzone, could be linked to problems. Phthalates, bisphenol A, soy extracts, and various pesticides are estrogenic. We live in a world full of hormone-like substances, and a complete analysis of our blood would reveal hundreds of these. All of this goes to say that the risks of oxybenzone as implied by the EWG are overstated.

Avobenzone is cosmetically elegant and nonirritating but becomes unstable after a couple of hours of exposure to UV light. However, its stability is increased when combined with oxybenzone, especially if another stabilizing agent known as diethylhexyl-2,6-napthalene (DEHN) is added. This combination, developed by Neutrogena, is known as *Helioplex*. An important question arises here: what happens to the UV energy that these chemicals absorb? The energy has to go somewhere. Might it not have a damaging effect? The answer: DEHN takes the energy absorbed by avobenzone and transfers it to oxybenzone that then fluoresces it as harmless red light.

Another effective broad-spectrum sunscreen is tetraphalydine dicamphor sulfonic acid, which goes by the trade name *Mexoryl*. It is stable, absorbs UV light, and dissipates the energy as harmless heat. *Mexoryl* isn't absorbed through the skin and so far there are no safety issues. And recently, excellent products using "micronized" titanium dioxide and zinc oxide have been developed, which do not leave a tell-tale white residue. Presently it is difficult to judge exactly how much protection a product affords against UVA, because no SPF-like system has yet been devised. But regulatory agencies are working on it.

Sun protection products also contain ingredients beyond the ones that reduce UV light exposure. However, the EWG has also taken aim at some of these, particularly retinyl palmitate, added to some sunscreens with the aim of reducing "photo-aging," is a potential carcinogen. The criticism is based on an inconclusive study on rodents that has not been published in the peer-reviewed literature. Furthermore, the comparison was not between sunscreens that contained retinyl palmitate and ones that didn't. A cream that contains only retinyl palmitate is not an appropriate model for a sunscreen preparation. And why not mention a recent 2009 study that examined the combined effect of UV light and retinyl palmitate on hamster ovary cells, a protocol that is consistent with the current recommendations for effective testing of photogenotoxicity? This published peer-reviewed study concluded that retinyl palmitate had no photogenotoxic potential! Admittedly, though, the evidence that retinyl palmitate actually prevents skin damage is pretty thin, so there is really no need to include it.

There is 1 more "may" about sunscreens that has been converted to fact. We no longer have to say that sunscreens may prevent skin cancer, we can say with authority that they do. A study in Australia, where skin cancer is a huge concern, involved 1600 subjects who were given sunscreen to use every day for 4.5 years. They developed 40% fewer squamous cell cancers than a control group who just maintained normal skin care without being given specific instructions about the use of sunscreens.

Sunscreens can prevent skin cancer, which is not a rare disease. The World Health Organization estimates 48,000 deaths a year from melanoma (likely sun related but not conclusively proven) and 12,000 from other forms of skin cancer. What's next?

The general recommendation is to look for a product with SPF 30 containing avobenzone, *Mexoryl*, titanium oxide, or zinc oxide. Since titanium dioxide (5%) and zinc oxide (10%) are the least irritating to the skin, products that use only these ingredients are the most appropriate for children. Infants should be protected with clothing, but there is no evidence to suggest that sunscreens cannot be used on exposed parts. Fragrance-free products are also available if there is a concern about allergies and sensitivities.

The sun protection products should be applied about 15 minutes before going out in the sun. As a general guideline, a shot glass full is needed for the body and half a teaspoon for the face. Reapply frequently. Forget terms like "waterproof," "all day protection," and "sweat-proof." They don't mean much. And if you are buying something that is "chemical-free," you are not getting a good deal because you're buying a vacuum. Sunscreens should not be used to prolong sun exposure, but rather to protect the skin when exposure is unavoidable. Above all, it is important to remember that unfortunately there is no such thing as a healthy tan.

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Skin Care for Infants and Young Children: Using New Evidence to Address Common Myths CME/CE

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For a long time, we have considered the barrier function of full-term infants' skin equivalent to adults. However, there also is the perception that baby skin is soft, delicate, sensitive, fragile, and in need of special care. Which perspective is really true?

Both views to some extent are true. The skin of a full-term newborn has remarkable structural and functional competence at birth and does approach adult skin after a period of adjustment to the dry, extra-uterine environment. However, recent closer examination of the skin in healthy infants and young children through noninvasive methods for studying the skin microstructure in vivo has revealed differences from adult skin.

Just like many other organ systems in infants, skin development in children continues during the early years of life, and with certain skin structures such as sebaceous glands, does not reach full adult function until adolescence. Important for pediatric health care providers to understand are the implications that the structural and functional difference in the skin of infants and young children have for skin care recommendations in this population. Important implications of these differences include:

- Infants and young children are at greater risk for disruption of the barrier function, toxicity, and development of contact irritation or allergy because:
  - Water handling properties differ—infant skin has higher water content, and it absorbs and loses water faster
  - Infant skin has significantly lower amounts of natural moisturizing factor (NMF) in the stratum
  - Infant stratum corneum is thinner (on average 30% thinner), and the infant suprapapillary epidermis is on average 20% thinner
  - Infant corneocytes and granular layer keratinocytes are smaller possibly due to high cell turnover rates

- Newborns lack the acid mantle, which is formed during the first month of life. This is important for the barrier function of the stratum corneum by stabilizing intercellular lipids and retaining skin hydration as well as control of microbial colonization on the skin surface. Water, soaps, and some cleansers can disrupt this mantle in infants and young children making it more alkaline and potentially altering skin microflora, increasing TEWL, all resulting in the loss of effective barrier function

- Delayed full functioning of melanocytes, thinner stratum corneum, and smaller skin cells all place infants and young children at enhanced risk of skin damage from UV light exposure. It is believed that the groundwork for later skin cancer is laid in childhood

Babies and young children get dirty, like to be outside, crawl on the ground, wear diapers, and are messy eaters! Adequate skin cleansing and protection is vital for their good health. Skin care in this population must take into consideration the unique properties of their skin. Fortunately, new evidence regarding differences between infant and adult skin can help guide our recommendations to parents regarding skin care for their children.

What is the best way to clean a child's skin? I have often read and heard that bathing in water only is the safest as well as an effective way to cleanse the skin of infants and young children. Is this true?

Washing the skin with water alone provides insufficient cleansing and removal of unwanted material such as fecal enzymes, urine components, and other water-insoluble skin surface impurities. The alkaline pH of water has been demonstrated to increase to skin surface pH for extended periods of time after exposure. Water that has high mineral content can impair skin barrier function while not adequately cleaning the skin. A note of caution here is necessary. Not all methods of cleansing the skin are alike. Soaps, detergents, and some cleansers can also temporarily raise skin pH and be quite irritating and drying. Fortunately, new skin cleanser technology has produced cleansers that have less total surfactant and larger micelles with a pH below 7.0 for less aggressive but effective cleansing. These types of skin cleanser are available as liquids (gels and body wash) and not as solid bars. They also tend to foam less when applied to the skin. Skin cleansers for use in infants and young children with these qualities along with minimal dyes and fragrances will provide safe, mild, gentle, effective cleansing. Application of a moisturizing cream immediately after bathing to areas of the skin that tend to be dry or inflamed may also enhance the skin barrier function.

A study out of Germany that tested the impact of various skin care regimens on the skin barrier function of healthy full-term neonates demonstrated that bathing with a pH 5.5 wash gel followed by skin cream application showed lower transepidermal water loss and greater hydration of the stratum corneum than did bathing with water alone or bathing with wash gel. They also demonstrated that neither the use of the wash gel or the cream delayed the development of the skin acid mantle during the first 8 weeks of life.

Should children be bathed daily?
How often a child should bathe varies a great deal depending on circumstances. The frequency of bathing needs to take into account the child's' age, the weather, and what they are exposed to from the environment. For very young infants, bathing every 2–3 days is quite adequate along with spot cleansing as needed though out the day for the diaper area, face, hands, and neck folds. Older children may need daily bathing if they have been playing outside, wearing sunscreen, or very active in public areas. During winter months, less frequent bathing may help to reduce dry skin from lower humidity from dry indoor heating. Long baths as well as the use of bubble baths or bath additives with dyes and perfumes should be avoided because these increase the skin pH and cause dryness and irritation. The ideal is a 15-minute or less bath in plain bath water using a mild cleanser with a pH of 7 or less. Mild cleansers may be used for spot cleansing as well. Apply skin cream as needed for skin dryness.

I have been receiving questions from parents in my office about the safety of preservatives in skin care products for their children. How do you recommend responding to these types of questions?

Many parents express concern because of things they have read or heard related to possible human health threats from ingredients in skin care products. Claims of inadequate testing for safety and possible risks to consumers are rampant on the Internet and in popular literature. This information alleges that industry practices related to safety testing are flawed, that there is little government oversight, and that cosmetics contain cancer-causing chemicals and other toxic ingredients. As health care providers, we must be able to adequately answer their concerns with sound scientific data where available and to educate parents on how ingredients are tested and regulated.

The absence or inadequate use of preservatives in personal care products that are applied to the skin can yield them highly susceptible to contamination by bacteria and/or fungi. This is especially true for products with high water content. Oil-based products, on the other hand, are at lower risk and therefore tend to contain smaller amounts or no preservatives at all.

The microflora of the skin itself that is easily introduced into the skin care product can contaminate it. Products stored in jars where the hand is repeatedly dipped in to retrieve the contents are the most susceptible to this type of contamination. These organisms thrive and grow in the dark moist environments of skin care products if nothing is present to inhibit this growth. Common contaminating microorganisms include *Pseudomonas aeruginosa, S aureus*, and *Candida albican*s. Skin care products can also become contaminated during the manufacturing process.

Preservatives in personal care products have a safety history that encompasses thousands of products used over decades by millions of consumers. There are no documented reports linking the use of a personal care product preservative and serious human disease. Even contact allergy to these ingredients has been reported in a very small percentage of users (approximately 6% of general population has a cosmetic-related contact allergy). In contrast, the absence of preservatives is clearly associated with contaminated products and the risk of skin infection. Prior to legislation in the United States restricting the sale of contaminated products, the US FDA found that 20% of a sample of personal care products on the market was contaminated.

The cosmetic industry has the primary responsibility to ensure that all ingredients, preservatives, and co-formulants used in skin care products are safe for their intended uses. The FDA has regulatory oversight of and authority over the cosmetic industry, including the banning or restriction of ingredients for safety reasons. In addition, the Cosmetic Ingredient Review (CIR), an independent scientific review board, critically evaluates chemical ingredients used in cosmetics and publishes its findings in the peer-reviewed literature.

As with many medications and other chemicals in our environment, the adage "It is the dose that makes the poison" (Paracelsus, 16th century) is appropriate with preservatives as well. Many of the health-related allegations about cosmetic ingredients are based on the results of high-dose laboratory testing in animals, not human testing. The ideal is to use the lowest concentrations of preservatives that provide the desired result, thereby reducing exposure. The safety and efficacy of multiple preservatives in combination each in low concentration over single preservatives in higher concentrations is well documented. Researchers are continually working to develop even safer preservative systems.

With the current evidence available to us, the benefit of using preservatives appears to outweigh any potential risks. However, we must remember that there are very few certainties in medicine. The cosmetic industry needs to be encouraged to publish more toxicity studies and safety evaluations and use the lowest concentrations of preservatives needed for efficacy. The longer preservatives are used without ill effects, the more confident we can be that preservatives are indeed safe.

Is there such a thing as a healthy tan?

A tan in actuality is a sign of skin damage. When the skin is exposed to UV light, the UV rays affect the DNA of epidermal cells and dermal fibroblasts, resulting in genotoxic and oxidative effects. In response, a protective mechanism in the skin is called into action where the existing melanin in the skin oxidizes and melanocytes produce new melanin, resulting in tan. The level of susceptibility will vary depending on the child's skin type and how quickly they sunburn as well as how easily they tan. Children are even

more susceptible than adults to this DNA-damaging effect due to lower levels of protective melanin present in the skin (melanocytes do not become fully functional until into the 2nd year of life), a thinner stratum corneum, and a higher surface area:body mass ratio.

A recent study out of England looked at healthy Caucasian babies suggesting that UVR-induced skin changes and associated photodamage can begin as early as the first summer of life before melanocytes have become fully functional. Additionally, it is believed that prior to the age of 18 years, children receive much of their lifetime-accumulated sun exposure. Chronic UV light exposure is associated with nonmelanoma skin cancer and head/neck melanomas. Several epidemiologic studies also suggest that the skin of young children may be especially vulnerable to early intense UV light exposure that leads to blistering sunburns and has been associated with trunk melanomas.

Increasingly, the skin is being recognized as playing an important role in the body's immune response. Exposure to UV light can modulate this immune response and result in a level of immunosuppression. Transgenic mice studies have demonstrated that exposure to solar-simulated radiation in the neonatal period can reduce epidermal Langerhans cells and potentially compromise skin immune system development. Whether infants and young children are similarly susceptible is not clear at this point, but further study is definitely needed in this area.

What advice should I be giving parents regarding sun protection for their children?

We have made progress in educating the public about sun exposure risks. However, sun protection practices for children still remain suboptimal. On any summer weekend in the United States, 7% to 13% of American children become sunburned, and the incidence for the summer season ranges from 29% to 83%. Remember that children of any skin type can sunburn if the UV light dose is high enough. Recommendations for sun protection are available from the AAP, American Academy of Dermatology (AAD), and the American Cancer Society (ACS) and they include:

- *Sun avoidance:* Avoiding suntanning and sunburn is especially necessary for infants less than 6 months of age. Keep babies away from direct sun exposure. For older infants and young children, time outdoor activities to avoid periods of peak sun exposure. Use lightweight but tightly woven clothing and hats to cover skin, and provide shaded play areas. Extra caution should also be used around reflective surfaces such as water, snow, and sand that can reflect up to 85% of the UV light

- *Apply and reapply sunscreen:* In infants and young children, use sunscreens that have the lowest possibility for skin penetration, irritation, and allergy. Since babies often rub their eyes and put their hands in their mouths, exposure through this route must also be considered. For children 6 months of age and younger, the AAP recommends sun avoidance but states that sunscreen may be applied to small areas of skin uncovered by clothing and hats

Studies have demonstrated that sunscreens containing only nano-scale titanium dioxide and/or zinc oxide filters do not penetrate beyond the stratum corneum in adult or infant skin. These same sunscreens may also be the mildest to eyes and safest for oral exposure. Oil-based emulsion formulations of these inorganic sun filters seem to be the safest forms for very young children and those with particularly sensitive skin since they tend to contain fewer fillers, fragrances, photostabilizers, and preservatives.
We have made progress spreading the news that sun protection is necessary for children. However, we still have a long way to go in actually implementing these practices and establishing them as health habits.

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