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Abstract

Careful observation while problem solving an individual case of pediatric eczema using the engineering method led to a framework by which others could carry out similar environmental problem solving to alleviate their own individual cases of eczema and related allergy problems. The resulting heuristic, published on a web site in 2004, has been updated with community- and web-based user experiences to form a reliable resource. Understanding the effect of modern syndets on skin-barrier function under normal household conditions was crucial to developing the heuristic and may explain the increasing prevalence of eczema in the industrialized world.



Abnormal Amplification? Observations from Applying the Engineering Method to Solving Eczema and Atopic Disease

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INTRODUCTION

Since Strachan's 1989 "hygiene hypothesis" letter in the BMJ [1], much subsequent research has supported and refined the notion that continually increasing prevalence of eczema, atopy, and associated allergic diseases suggests "widespread environmental factors originating from the industrialized world are operating in genetically susceptible persons" [2]. Yet a unifying explanation and solution remain elusive. While some aspect of cleanliness seemed potentially related, trends in the use of domestic cleaning products themselves lacked correlation with atopic diseases over the last 100 years, especially given widespread adoption of mass-produced personal hygiene products in the early 20th century that resulted in major public health benefits without a commensurate rise in allergic diseases [3].

Practical studies of personal care products highlight the need to "mirror the use conditions of the product as closely as possible" since even direct testing doesn't predict the result of actual, long-term usage [4]. The history of surfactant use in the last 200 years is varied but can be roughly summed in the industrialized world as: rare use of often harsh surfactants mostly made at home under poorly-controlled conditions gave way to widely used mass-produced traditional alkaline soaps in the early part of the 20th century [5][6], gave way to increasingly hydrophilic syndets in step with the rise in allergic disease. When modern cleaning products are differentiated by molecular properties and associated impact on membrane barrier function, in addition to novel patterns and increasing ubiquity of domestic exposures, a correlation, both ecological and practical, emerges.

METHODS

Based on rigorous personal, empirical problem-solving in an individual case, and generalizing over time through incorporating additional cases and open source information, we developed a "citizen

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science” website heuristic for environmental problem-solving of eczema [7][8]. Both authors have training as engineers so we chose to apply the engineering method [9]. A major aspect of the solution is managing household exposure to overly hydrophilic modern surfactants, which appear to abnormally increase membrane permeability. From experiential feedback, the website is structured to best engage site users to overcome common misconceptions, avoid common practical pitfalls, and to understand and most effectively solve the problem in their own environments.

The underlying basis for the heuristic represents a potentially unifying revision of previous explanations proposed by Strachan [10], Rook [11], and others, incorporating and reconciling relevant and otherwise seemingly contradictory research related to birth order, microbial exposures, probiotic usage, antibiotic usage, infections, washing habits, rural versus urban environments, GNP, prevalence of parental allergic diseases, increasing prevalence of eczema and allergy in pets, household pet exposures (to humans), water hardness, breastfeeding, skin dryness, food-related outbreaks (especially to certain protein foods), and even traditional “triggers” like weather. It also suggests a new view of the role of allergy in human evolution.

RESULTS OF APPLYING HEURISTIC

Website-user-reported results are consistent with pre-launch community-based results and are anecdotal but still useful. Historical medical writings about atopic dermatitis are equally non-optimal but some patterns of information are distinct and unmistakable [12]. So, too, can some site user experiences help validate and refine the heuristic. The majority of site traffic arrives by bookmark or direct link rather than search engine, and appears to be predominantly by word of mouth. Statistics from 2014: 73,765 unique users, with 234,058 page views.

Typical results of users understanding and properly applying heuristic:

- Alleviated eczema.
- Not a mere removal of triggers. Cause and effect become clear. Breakouts no longer seem random, even before the problem is solved.
- Control - possible to prevent or reverse subsequent breakouts quickly without treatment.
- Healthy, normal skin without treatment or moisturizing. Repaired skin barrier approximately 2 months after alleviated eczema if environmental improvements are maintained.
- Reduced allergic diseases, including asthma, among all members of a household.
- Normal life with heightened environmental awareness by site users.

ANALYSIS AND OBSERVATIONS

- * Eczema outbreaks seemed reliably proportional to exogenous and endogenous impacts on skin permeability. Most modern syndets and many personal care products enhance the permeability and penetration of skin in unprecedented ways.
- * Small amounts of water (such as sweat in flexural areas, but external sources of wetting as well) in combination with detergents and other penetration enhancers appear to substantially increase permeability at those locations during wetting.
- * Tiny traces of detergents remaining on the skin have an appreciable impact on the permeability and skin quality over time, especially in the presence of later wetting. Even substantial rinsing efforts with water are not enough to remove traces to a low-enough level to avoid abnormal water loss over time.
- * The major mechanism of skin dryness in atopic and non-atopic individuals related to washing appears to be the result of residues of extremely hydrophilic substances like detergents and moisturizers on the skin, and the resultant increase in skin permeability, water loss over time, and

impairment of the dynamic process of skin repair. Residues on the skin can come from contact with surfaces, dusts, and other household washing, in addition to direct exposure from the washing of the skin, detergents in fabrics, or the application of products (e.g. certain types of moisturizers). Ingested syndets appear also to affect skin.

* The membranes of all living beings, not just those with eczema, appear subject to these environmental influences. Over time, impairment of the dynamic skin repair process results in thinner, dryer, less supple skin and other membranes than in the absence of such influences. Removing these new environmental influences entirely reverses not only eczematous symptoms and dry skin, but also in ensuing months, largely attenuates atopy, allergies, and asthma, and improves and normalizes skin quality. The atopic person or the person with chronic, seemingly inherited dry skin, can go on to be entirely normal with no intervention at all. A cause-and-effect relationship can be observed by reintroduction of these environmental influences.

* Removal of very hydrophilic surfactants and other skin penetration enhancers using less hydrophilic surfactants for washing is a far more effective strategy for reversing these environmental influences than refraining from surfactant use altogether or using only water for washing.

DISCUSSION

By this interpretation, the modern eczema and allergy epidemic appears to be the result of abnormal amplification of what we propose is a normal biological signal, allergy. Eczema is more readily expressed in the presence of unhealthy but normal environmental exposures such as increased indoor dampness and mold, for example, and atopic individuals are more susceptible under the circumstances [13][14]. Both eczema and atopy are described in medical literature prior to the 20th century, at fairly low prevalence [12]. Additionally, in less-industrialized nations with very low rates of eczema today, atopy rates are similarly low [15]. Viewing allergy and eczema as feedback or signals to the conscious brain by the immune system, conceptually similar to pain for the nervous system, and the modern allergy epidemic as an abnormal environmental amplification of those signals, among other things, reconciles the precipitous worldwide increase and significant modern prevalence of atopy with basic biological principles.

When underlying environmental influences cause disease, heuristics that allow each individual in their unique circumstances to best solve the problem can result in the most optimal outcome overall and must be validated along with a proposed solution. Such a validation study might be appropriately achieved through a large-scale, open-source, citizen science effort.

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