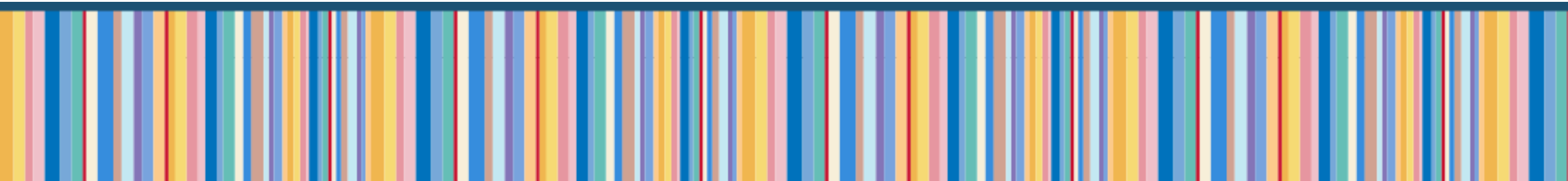


Newborn Skin Health Research

Unique Differences of Infant Skin, its Microbiome, and
How to Support Normal Skin Maturation



Welcome and Introductions

Professor Dame Tina Lavender, PhD

Centre for Childbirth, Women's and Newborn Health (CWNH)

Liverpool School of Tropical Medicine



Agenda

Welcome & Introduction	Tina Lavender, PhD
The Science of Infant Skin	M. Catherine Mack, PhD
Infant Skin Microbiome	Georgios Stamatas, PhD
Panel Discussion	Moderator
Question and Answers Session	Tina Lavender, PhD
Closing Remarks	Tina Lavender, PhD
Session Evaluation and Adjournment	

Learning Objectives - Enhance your Understanding of...

1. The unique differences of infant skin vs. adult skin, its maturation, and how these differences inform infant skincare
2. The skin microbiome, its role, and how it works in combination with the skin as a “first line of defense”
3. Cleansing and moisturizing routines for infant skincare and why they matter, including evidence-based clinical practice guidelines to support a healthy skin barrier and its protective skin microbiome

Disclosures

- The opinions expressed by the speakers are their own and not that of their employers or the program sponsor
- Dr. Mack and Dr. Stamatas work in Research & Development as employees of Johnson & Johnson Consumer Health operating companies
- Dr. Lavender has received research and educational grants from Johnson & Johnson Consumer Inc. in the past
- This presentation and speakers are sponsored by the Research & Development group at Johnson & Johnson Consumer Inc.

Why is Understanding Infant Skin Important to Midwives?

- Newborn skin barrier remains immature for some time following birth; making it susceptible to infections and the penetration of allergens and irritants
- The microbiome works alongside the skin barrier to keep baby skin healthy
 - Newborn babies get their first microbiome from their mother during birth
- Early microbiome development is critical, having long term impact
 - Gut health, mental health, immune health
- How we care for newborn skin can disrupt the skin barrier and microbiome, leading to harm
- Any skin care practices should be based on rigorous evidence

Why is Understanding Infant Skin Important to Midwives?

- Midwives are the primary care givers for women in the immediate postnatal period
- The advice we give parents can have a long-term impact on the health of the baby
- Understanding the skin and the evidence surrounding skin care practices enables us to provide parents with choices based on the best available research

The Science of Infant Skin

How it Develops and Implications for Care

M. Catherine Mack, PhD

Research Manager Translational Science

Johnson & Johnson Consumer Inc., USA



The Human Skin – Our Outside Organ is Our Largest

- Rapid growth in skin surface area over the first years of life¹
- Baby ~ 3-5 square feet¹
- Adult ~ 20 Square feet²



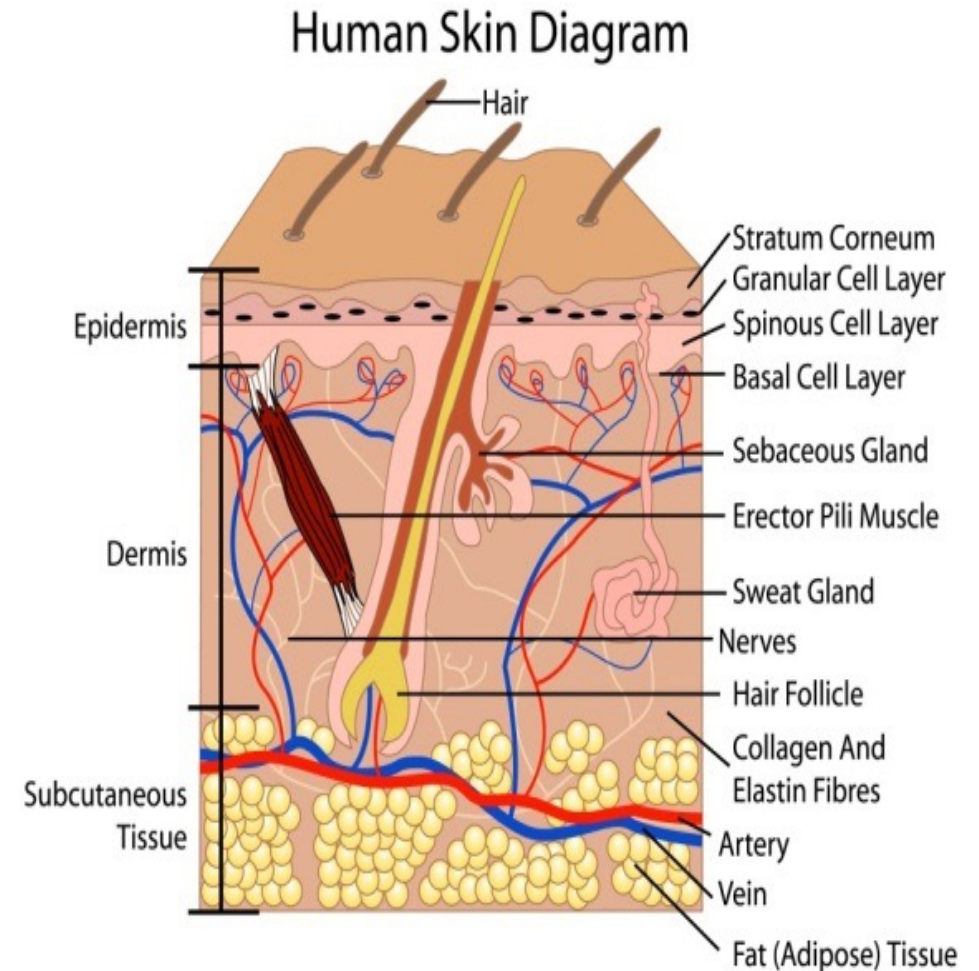
At birth, skin surface area grows at a rate of 75 cm²/week

Surface area growth rate decreases to about 10 cm²/week by 1 year



Skin Function

- Natural **protective barrier** from
 - Physical injury
 - Pathogenic microbes
 - Chemical agents
 - Extreme temperatures
- Starts process for making **Vitamin D** to help body absorb calcium and maintain phosphorous for healthy bones
- **Sensory perception:** temperature, pressure, touch, pain
- **Temperature regulation** of the body
- Helps to **restrict fluid** and water loss



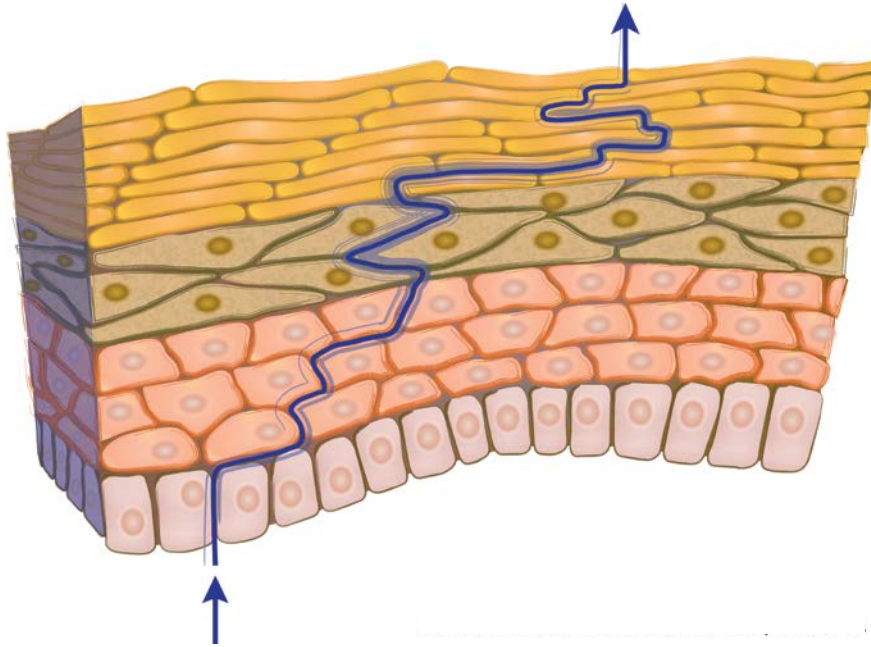
Babies' Skin is Different: Structure, Composition, Function



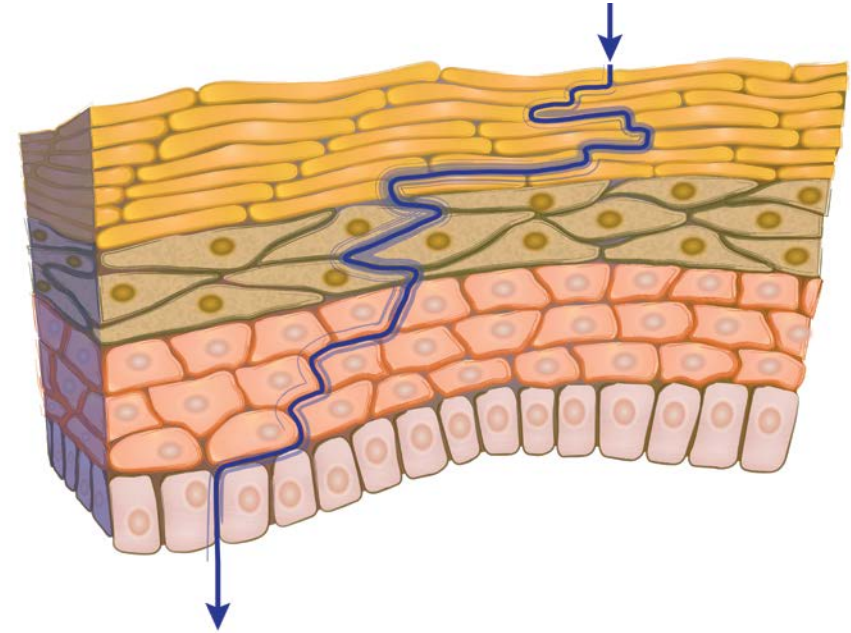
Structure	Composition	Function
<ul style="list-style-type: none">■ Stratum corneum and epidermal thickness¹■ Corneocyte size¹■ Surface roughness■ Elasticity	<ul style="list-style-type: none">■ Water content²■ Natural moisturizing factor (NMF)²■ Melanin³■ Lipid content and organization	<ul style="list-style-type: none">■ Water handling properties²■ Barrier function²■ Skin reactivity■ Cell proliferation¹

HEALTHY SKIN	SKIN PARAMETER		ADULT	INFANT
STRUCTURE	Surface	Microrelief Lines	Less Dense	More Dense ↑water retention
	Thickness	Stratum Corneum (SC)	Thicker ~10 μm	Thinner ~7 μm ↑permeability
		Epidermis	Thicker	Thinner (~20% vs. Adult)
COMPOSITION	Water Content	Stratum Corneum (SC)	Lower	Higher (older infants, drier at birth) ↑skin hydration
	NMF	Natural Moisturizing Factor Concentration	Higher	Lower ↑dryness
	Surface Lipids	Sebum	Higher	Lower (7-10 mo old) ↓hydro-lipid film
FUNCTION	TEWL	Trans-epidermal water loss	Lower	Higher ↑water evaporation
	pH	Surface pH	Lower	More Alkaline (newborn) ↑potential infections

Infant Skin is Thinner than Adult Skin and has Smaller Corneocytes



Although more hydrated than adult skin it can lose water up to 2X as fast

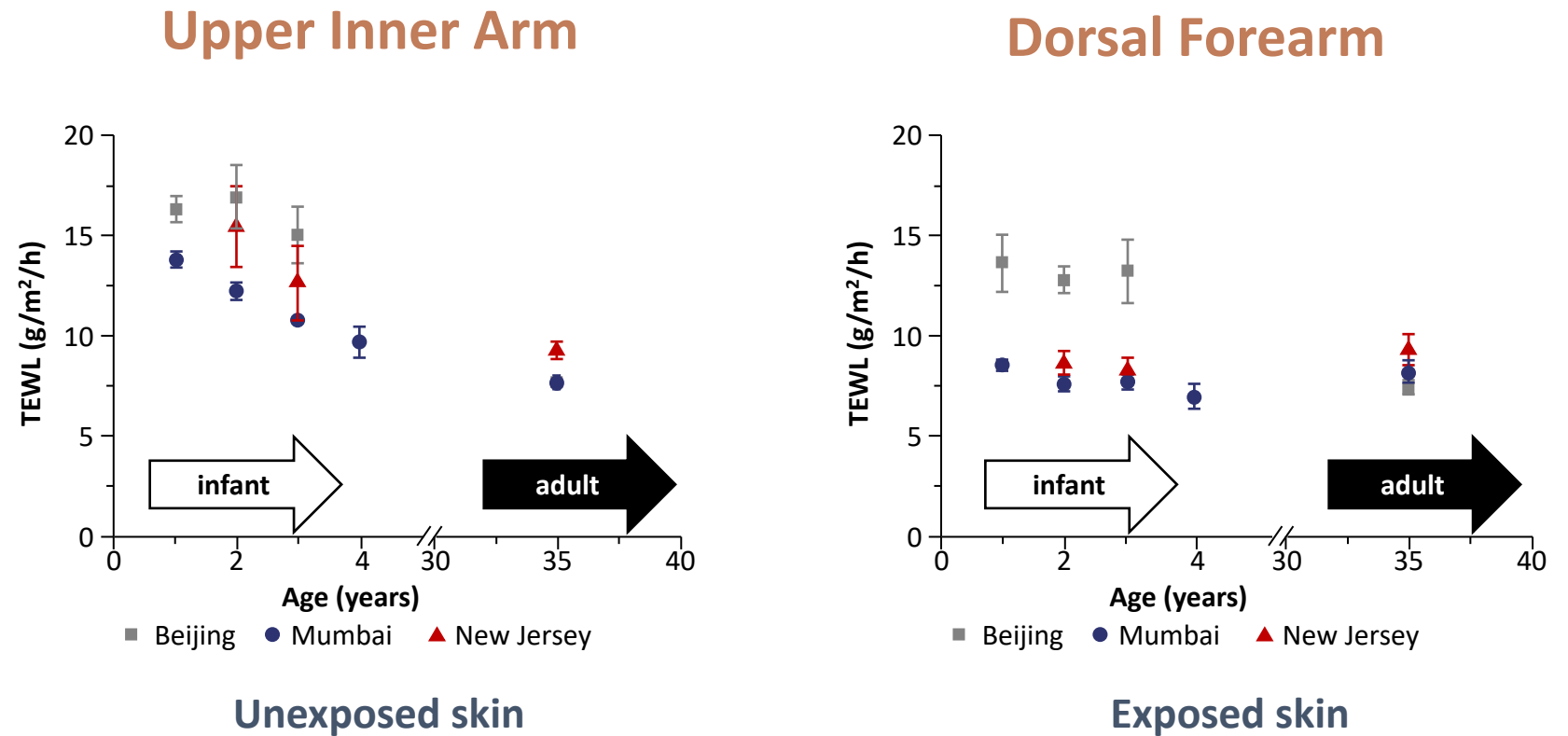


Smaller cells and thinner skin results in shorter pathway from outside to inside

Across Geographic Regions & Skin Type, Infant Skin Barrier Differs from Adult

- Study performed in Beijing, China; Mumbai, India; and New Jersey, USA
- TEWL is higher in infants compared to adults in all three populations studied
- TEWL on exposed skin (dorsal forearm) approaches adult-like values faster than unexposed skin (upper inner arm)

Transepidermal Water Loss

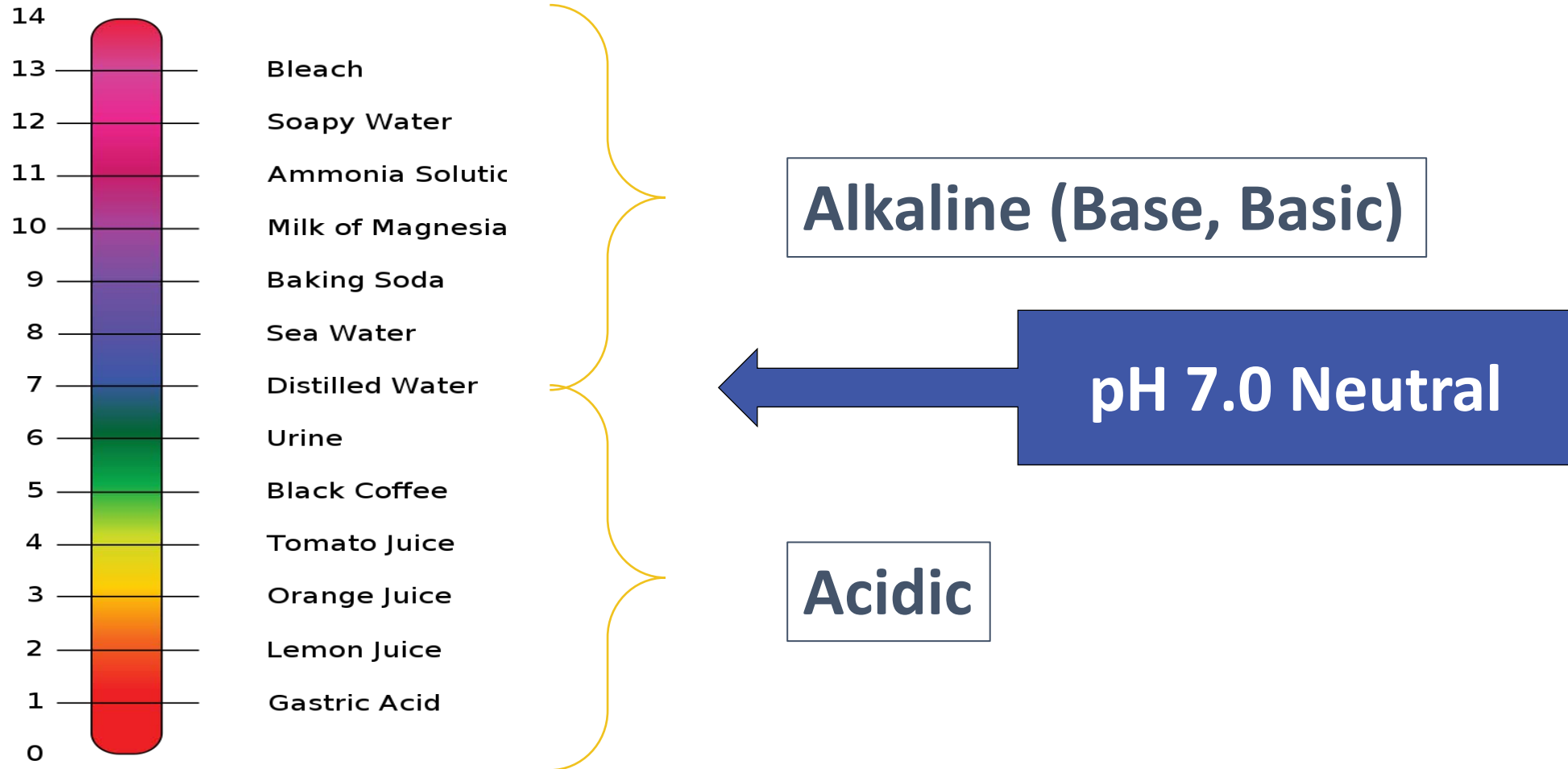


Maintaining Skin Barrier Integrity is Essential

- Can be measured by skin's ability to hold onto water - TEWL*
- Skin hydration of the stratum corneum (SCH) also important (assessed with electrical measures)
- Is influenced by skin pH
- Immaturity, alterations in skin pH, injury or disease can result in impaired skin barrier function

* TEWL, transepidermal water loss

pH - A Measure of Alkalinity or Acidity



The Acid Mantle

Key to Maintaining the Integrity of the Skin Barrier

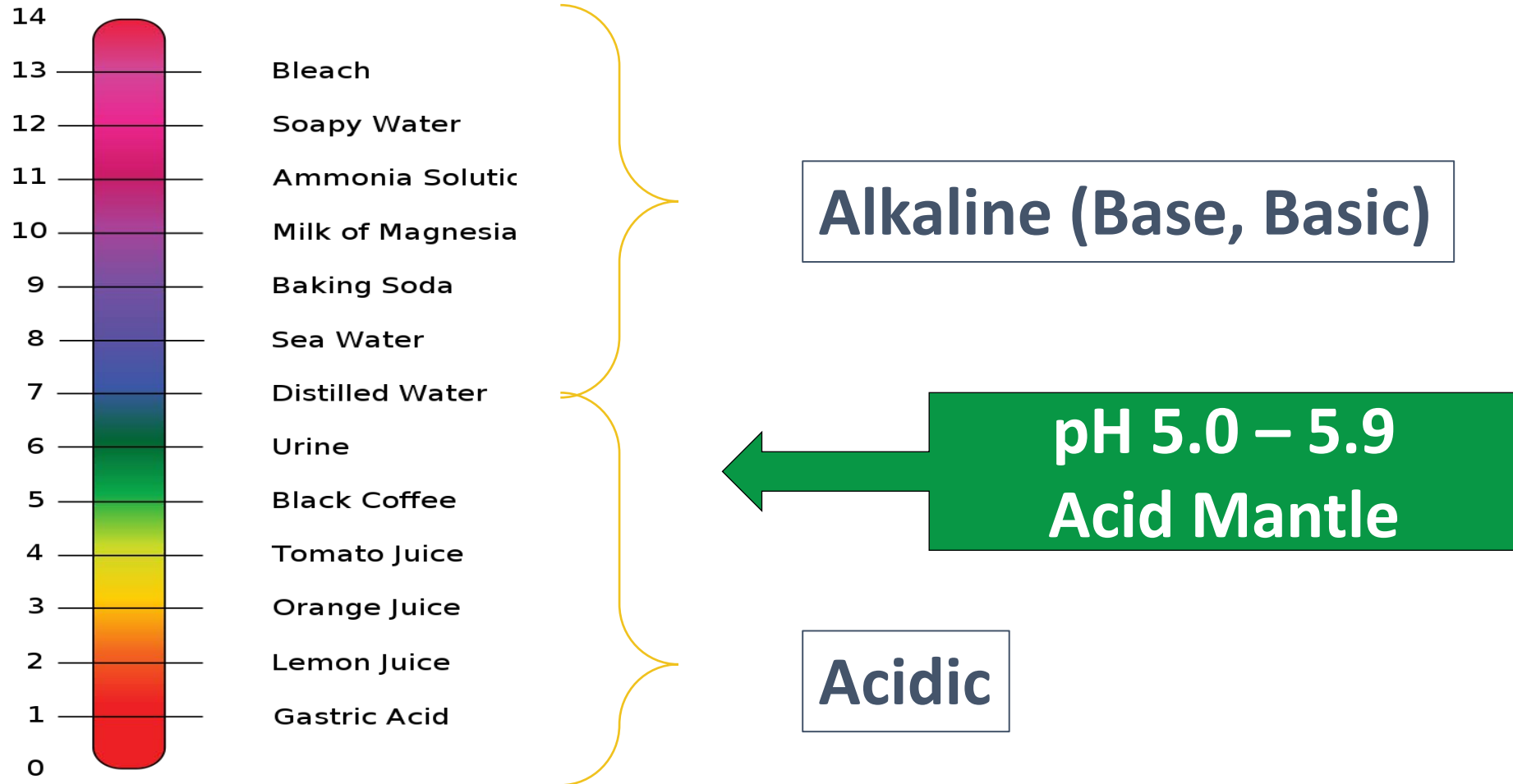
- What is it?
 - Protective, mildly acidic, skin “film” protects overall health of the skin
 - Allows resident skin flora to flourish
 - Inhibits growth of transient flora, such as, gram negative bacteria (E. coli, Pseudomonas); gram positive bacteria (Staphylococcus); fungal (C. albicans)
- What happens if it becomes more alkaline?
 - Interferes with protective barrier
 - Cell separation results in more water loss → dry skin, flaking, irritation, roughness
 - Skin vulnerable to bacterial invasion → infection

Question

What is the pH range of baby's skin?

- A. 2.0 – 3.9
- B. 5.0 – 5.9
- C. 7.0 – 7.9
- D. 10.0 – 10.9

pH - A Measure of Alkalinity or Acidity



Acid Mantle (Skin pH) is Protective - Inhibits Growth of Pathogens and Transient Flora and Favors Growth of Protective Resident Flora

Skin Type	Skin pH (~)
Full Term Healthy ¹	pH > 6.0 @ Birth Falls to pH <5.0 at Day 4
Premature ²	pH 5.5 @ one week pH 5.1 @ one month
Adult ³	pH 5.0 – 5.9
Diapered Skin ⁴	pH > 6.0
Atopic Dermatitis Skin ⁵	pH >6.0
After Alkaline Soap Cleansing ⁶	pH 9.5; increase can last over hours

1. Behrendt & Green, 1971

2. Fox, Nelson, & Wareham 1998

3. Braun et al, 1986

4. Visscher, Chatterjee, Ebel, LaRuffa, & Hoath, 2002

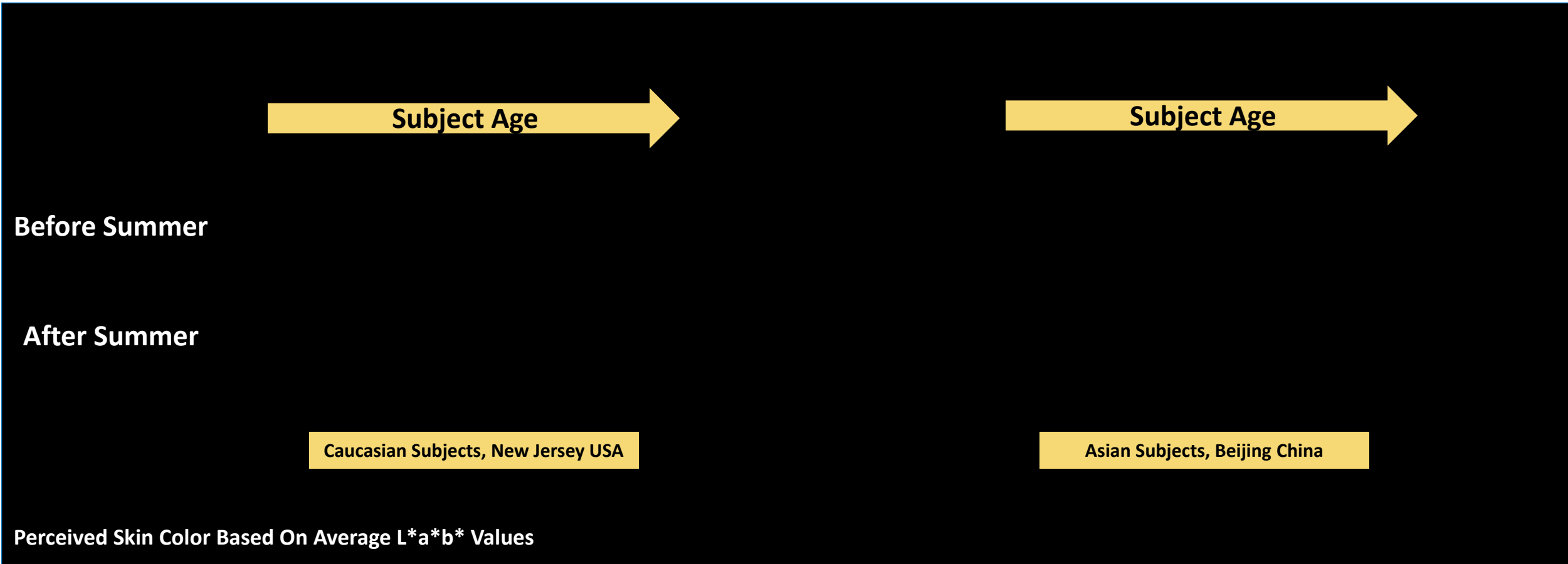
5. Knor, et al, 2011

6. Braun et al, 1986

Infant Skin – Needs Protection from Sun Exposure

- Acute as well as cumulative sun damage can have serious consequences, including risk of skin cancer
- Pigmentation changes are an indicator of skin adaptation to sun exposure, and therefore can be used as a noninvasive surrogate marker for photodamage
- Sun induced pigmentation changes observable as early as the first summer of life
 - Increased melanin content in exposed skin areas
 - Freckling observed on the face

Visible Skin Changes Are Observed In Infants After Summer Season



Visible Skin Changes Are Observed In Infants After Summer Season – Freckles



Recommended UV Protection Strategies

- Protect skin daily
- Use shade, clothing, wide brimmed hats (protect scalp, face, ears, neck)
- Avoid peak daylight hours
- Appropriately formulated UV protection products
 - Read product label for age restrictions
 - Check with baby's healthcare provider
- Note, healthcare professionals additionally recommend appropriate UV blocking sunglasses to protect eyes

Babies' Skin is Uniquely Different; Still Developing

Baby's Skin is Still Developing	Implications for Products
<ul style="list-style-type: none">• Thinner¹• Absorbs and loses water more quickly²• Less natural moisturizing factor• Melanin developing• Developing immune system³	<ul style="list-style-type: none">• Need mild products with less potential to alter skin barrier function; less potential to irritate; lower potential for allergy• Need mild cleansers, moisturizers, and sunscreens designed for baby's developing skin

Key Learnings

1. Infant skin is different from adult skin in structure and composition and *continues to develop* over the first years of life
2. These differences lead to functional differences in skin barrier properties with implications for care and protection
3. Ensure baby skin care routines support infant's developing skin and that products are mild and specially formulated for baby's unique needs (cleansers, moisturizers, etc.)

Infant Skin Microbiome

Research on the Development of Skin's Protective Layer and Connection with Care

Georgios Stamatas, PhD
Research Associate Director & Fellow
Johnson & Johnson Sante Beaute, France



Question

Which answer do you think is correct?

- A. **All** microbes are **harmful** to our health and should be removed from baby skin through rigorous cleansing
- B. **Some** microbes are **harmful**, while some are inoffensive; we should ensure that baby skin remains microbe free
- C. There are **some harmful and some beneficial** microbes, we should strive to enhance the beneficial ones while ensuring protection from the harmful ones

Skin-microbe Relationships

Human skin

Microbe



commensalistic



parasitic



mutualistic

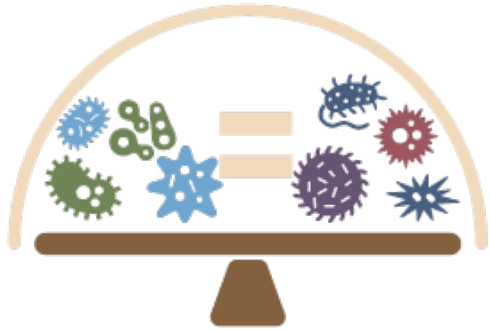
The Skin Microbiome as a First Line of Defense



**Healthy skin is
inhabited by harmless
microbes, which also
help to keep harmful
ones away**

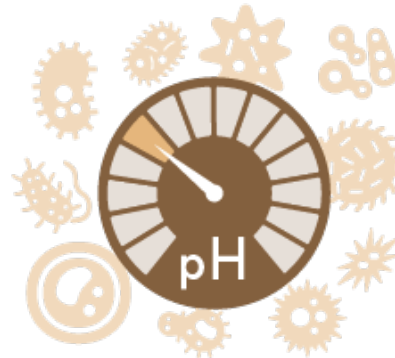
The Skin Microbiome

A diverse community of microorganisms coexisting at the skin surface.¹



A Balanced Microbiome

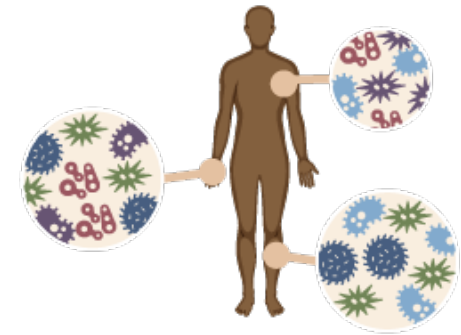
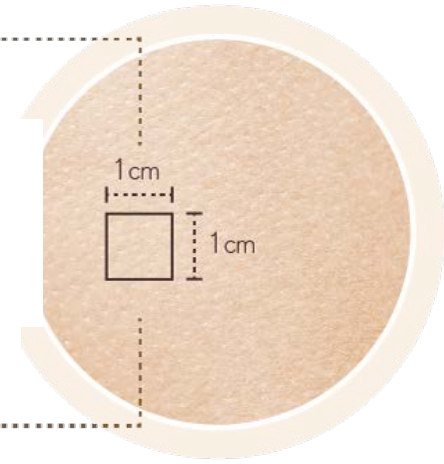
The skin microbiome is a habitat of billions of beneficial and harmful bacteria. An imbalance of these bacteria can lead to a variety of skin conditions including acne, eczema, rosacea and ageing.¹



pH Balance

The skin microbiome prefers a relatively acidic environment (pH around 5.0) which also inhibits growth of pathogens.¹

1 BILLION BACTERIA
inhabit a typical **square centimeter** of skin²



Bacterial Diversity Differs by Body Zone

Differences in skin temperature, texture, thickness, humidity and chemistry help determine which kinds of microbes live where on the skin.¹

1. EA Grice, JA Segre, *Nat Rev Microbiol* 2011: 9(4), 244-53.

2. EA Grice, HH Kong, G Renaud, AC Young, et al. *Genome Res* 2008: 18(7), 1043-50.

Question

Where is diversity important?

- A. In human societies as cultural diversity
- B. In natural ecosystems (lakes, forests, coral reefs, etc.)
- C. In microbial ecosystems (skin microbiome, gut microbiome, etc.)
- D. In long-term investment portfolios
- E. All of the above

Skin Microbiome at Birth

In utero skin is in a sterile environment

The skin of vaginally-born babies is colonized by microbes from the mother's vagina¹

The skin of C-section babies is colonized by microbes from the mother's skin¹

Baby skin microbiome community is dynamic and becomes more diverse as the baby grows²

Skin contacts between mother and child (breast-feeding, kangaroo care, wash, massage, etc.) is an opportunity for exchange of microbiome²

¹ MG Dominguez-Bello, EK Costello, M Contreras, M Nargris, G Hidalgo, N Fierer, R Knight, *PNAS* 107(26), 11971-5, 2010

² KA Capone, SE Dowd, GN Stamatias, J Nikolovski, *J Invest Dermatol* 2011: 131, 2026-2032

³ G Gaitanis, G Tsiouri, P Spyridonos, T Stefanos, GN Stamatias, A Velegraki, ID Bassukas, *Pediatr Dermatol* 36, 460-465, 2019

Mode of Birth Influences Newborn Skin Microbiome Composition

Principal component analysis of microbiome data demonstrates grouping of:

- Vaginally-born babies' skin microbiome with mother's vaginal microbiome, dominated by *Lactobacillus*, *Prevotella*, or *Sneathia* spp.
- C-section babies' skin microbiome with mother's skin, dominated by *Staphylococcus*, *Corynebacterium*, and *Propionibacterium* spp.
- Both are distinct from oral microbiome

Baby Skin Microbiome Differs from Adult and Evolves with Baby Age

**Infant Skin Microbiome differs
from that of Adult**

**Species diversity increases
over the first year of life**

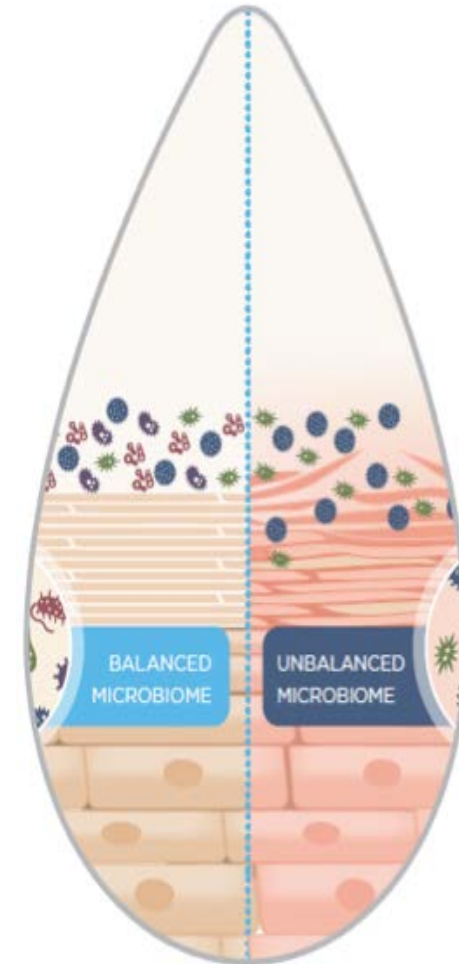
Concordance with Mother's Skin Microbiome

Skin microbe concordance between the mother-infant dyad is particularly high early in life

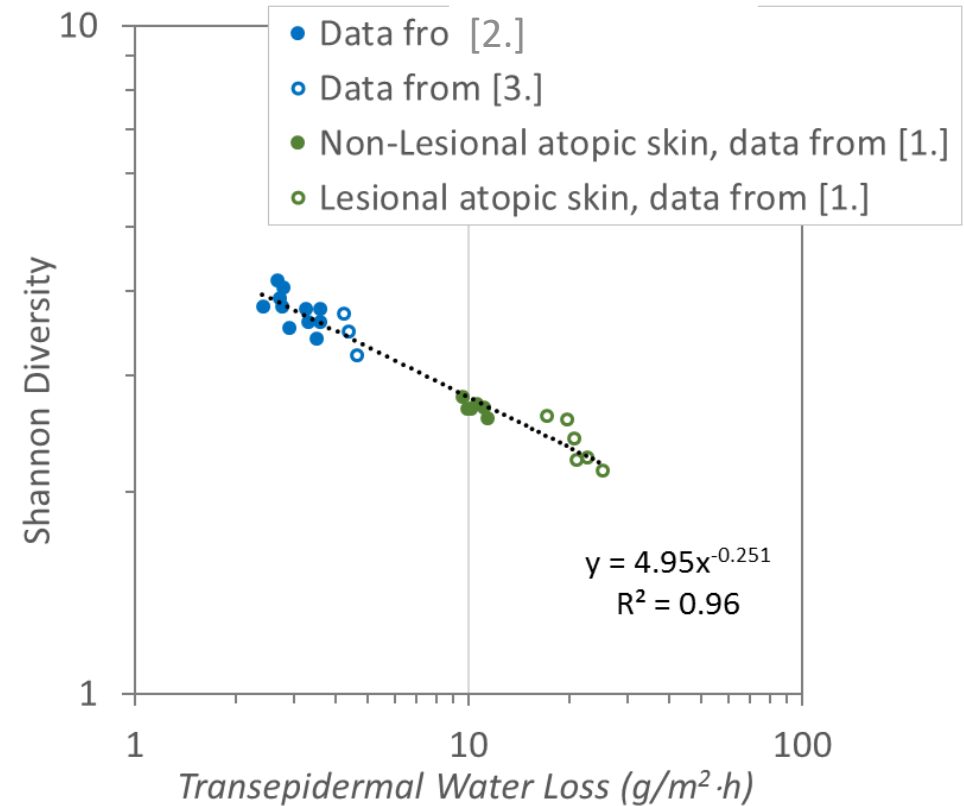
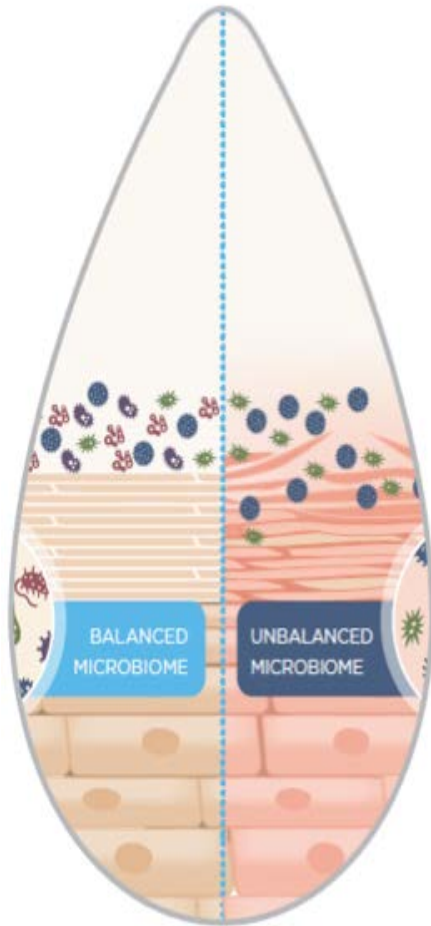


The Skin Microbiome in Disease - Importance of Diversity

- The **diversity** of microbes within a given area of the body can be defined as the number and abundance of distinct types of organisms
- Diversity has been linked to several human diseases
 - *C. difficile* colitis – lack of diversity, monocolonization in colon with *C. difficile*
 - Obesity and inflammatory bowel disease - low diversity in the gut
 - Bacterial vaginosis – high diversity in the vagina
 - Atopic dermatitis (AD) lesions – increase in *S. aureus* and low diversity
 - Lesions of acne vulgaris patients – lower diversity, and certain strains of *Propionibacterium acnes*
 - Changes in relative abundance – lesional areas of psoriasis
- New research suggests that **a diseased state may be achieved by the absence of commensal bacteria** and not simply the presence of a pathogen



The Skin Microbiome Diversity and Skin Barrier Function (meta-analysis of data from 3 studies)

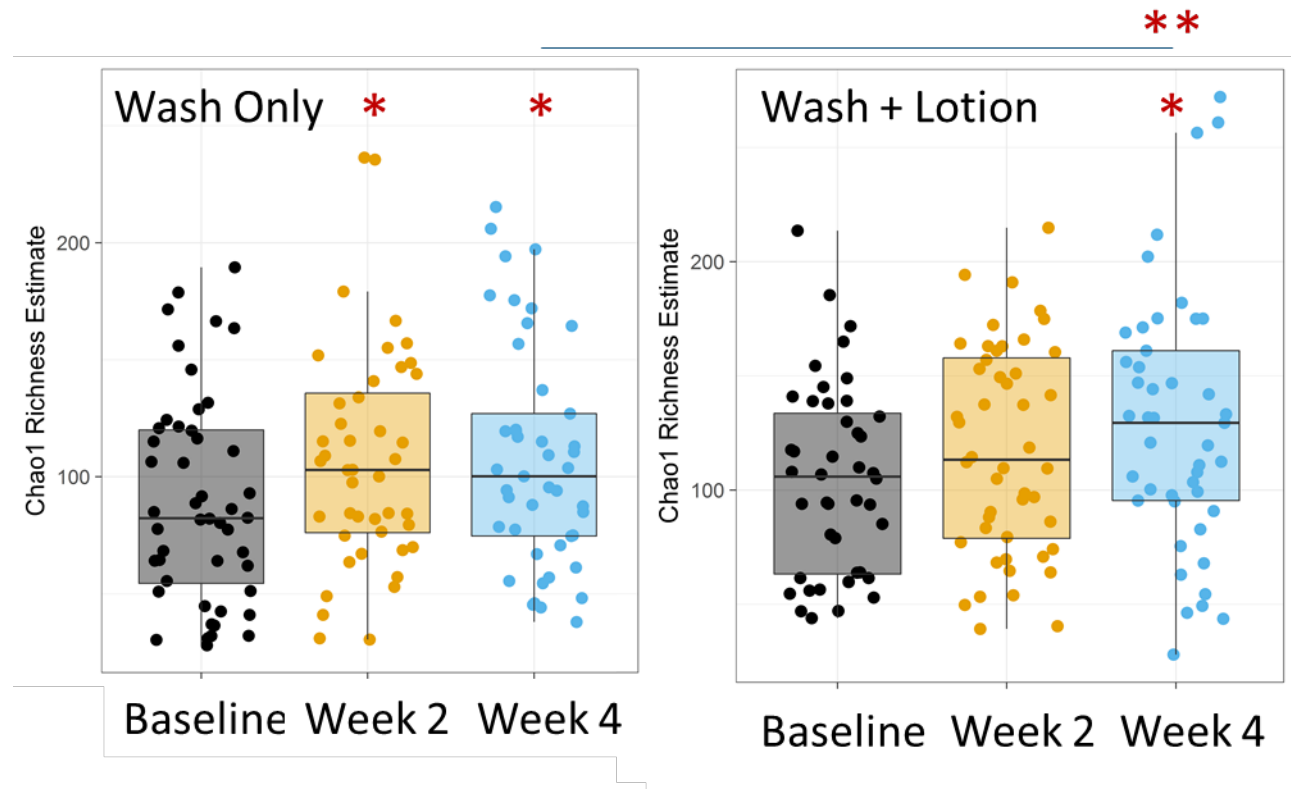


1. Poster at the 76th Annual Society for Investigative Dermatology (SID) Meeting: 26-29 April 2017; Portland, OR, USA.
2. Poster at the American Academy of Dermatology Annual Meeting: 1-5 March, 2018; Washington, DC, USA.
3. Poster at the American Academy of Dermatology Annual Meeting: 16-20 February, 2018; San Diego, CA, USA.

Clinical Study – Wash Only vs. Wash + Lotion



Adding lotion to the daily cleansing routine accelerates increase in skin microbial richness



* $P < 0.05$ from Baseline

** $P < 0.05$ Between treatments

Key Learnings

1. The skin and its microbiome continue to mature and develop long after birth, playing an important role as a first line of defense
2. Skin care routines should strive to maintain the integrity of the skin barrier *and also* to support the skin microbiome
3. In a clinical study, adding an application of lotion after bath, using mild products specifically formulated for baby's skin, was shown to accelerate increase in skin microbial richness

Question

- What is the most interesting thing you just learned about the infant skin microbiome?

Closing Remarks

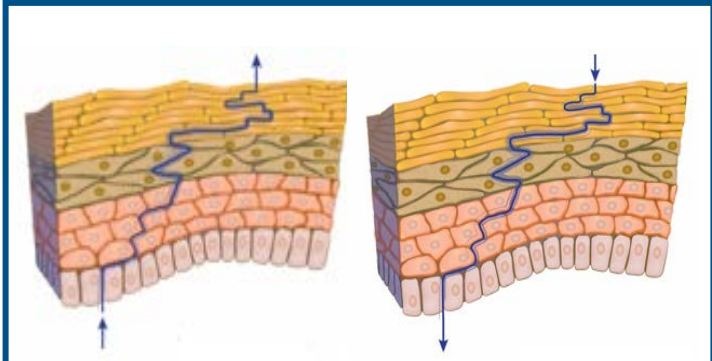
Professor Dame Tina Lavender, PhD

Centre for Childbirth, Women's and Newborn Health (CWNH)

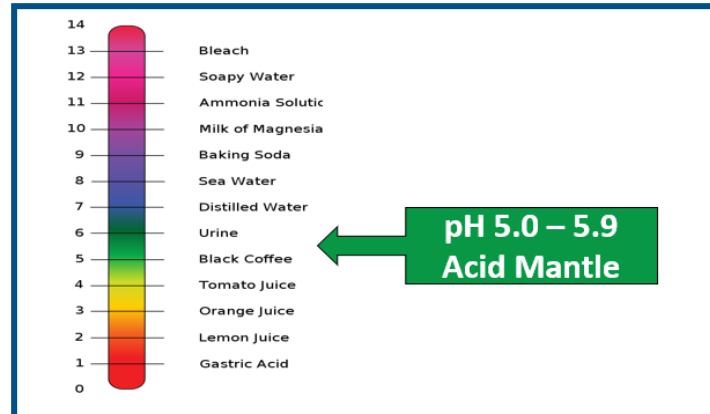
Liverpool School of Tropical Medicine



Evidence-Based Skin Care Routines with Appropriately Formulated Products can Support Developing Skin and its Microbiome









Infant skin can lose water 2x as fast. Smaller cells and thinner skin - shorter pathway outside to inside



14	Bleach
13	Soapy Water
12	Ammonia Solution
11	Milk of Magnesia
10	Baking Soda
9	Sea Water
8	Distilled Water
7	Urine
6	Black Coffee
5	Tomato Juice
4	Orange Juice
3	Lemon Juice
2	Gastric Acid
1	
0	

pH 5.0 - 5.9 Acid Mantle

Acid Mantle (skin pH) Helps provides overall skin protection & support microbiome

Human skin	Microbe	
		commensalistic
		parasitic
		mutualistic

Skin microbiome is protective. Microbial richness & diversity are important

Asante Sana

Ngiyabonga

Takk

Děkuji

Arigato

Obrigada

شُكْرًا

Dankie

Bedankt

Danke

Thank You !

Tack

Gracias

Xie xie

Merci

Ευχαριστώ

e dupe

Terima Kasih

Obrigado