MORE THAN
SKIN DEEP

STANFORD DERMATOLOGY CATALYZES
BIO MEDICAL INNOVATION & DISCOVERY

Stanford MEDICINE
A Marvel-and-Model System: Skin Offers a Window to Health

There’s more to skin than you think. We can see it on the surface, but the lessons we can learn from it run so much deeper.

The cells that make up our skin are the most prolific cell type in the body. That’s right: We’re all covered—inside and out—with epithelial cells (pictured above). These cells not only create our outer layer, but they line our internal organs and are involved in everything we do. What’s more, the same principles that mediate health and disease in the skin—regeneration, homeostasis, immunity, and inflammation—drive health and disease in other parts of the body.

“Skin is the most accessible epithelial tissue and is where disease visibly affects patients the most,” says Paul Khavari, MD, PhD, chair of the Department of Dermatology and the Carl J. Herzog Professor of Dermatology in the School of Medicine. “Concentrating our energy from all these diverse disciplines into research of the skin will hopefully benefit all patients with skin disease and many other medical conditions.”

What we learn about epithelial cells offers insight for other areas of medicine. That’s why we created Stanford’s Program in Epithelial Biology, which brings together more than 75 leading researchers with expertise in more than 26 subspecialties. These scientists are working together to shed light on the basic biology of these cells and how to maintain our overall health and predict and prevent disease.

The Field of Dermatology Is a Proving Ground of Medical Innovation

By operating at all scales—from the visible impacts of disease on the surface of the skin to the genetic, cellular, and molecular drivers of disease within individual cells—dermatologic research can speed scientific discovery and accelerate the development of new treatments. The Department of Dermatology at Stanford Medicine has been at the forefront of the biomedical revolution for decades, pioneering advances in RNA medicine, genomics, stem cell biology, rare diseases, cancer, artificial intelligence, and more. The discoveries made by our physician-scientists represent fundamental leaps in our understanding of basic science and offer profound insights for human health.

Our vision is to alleviate suffering, advance scientific discovery, and lay the groundwork for a new paradigm of precision therapies while training and empowering the next generation of biomedical scientists and preeminent clinicians. With skin as a platform, we’re developing new tools that will allow us not only to heal disease, but to predict and prevent it.

Cutting-Edge Advances from Our Research Labs

Fundamental discoveries made in our basic science research labs have led to the development of new therapies, offering hope and healing for many.

RARE DISEASES: Stanford Dermatology faculty helped to uncover the genetic basis of epidermolysis bullosa (EB), a rare condition that causes painful blistering and tearing of the skin and, often, esophageal complications. Our faculty were also the first to be granted FDA approval for a drug to treat EB directly, rather than merely minimizing symptoms; before this landmark approval, palliative care was the only option. Today, department faculty deploy the latest stem cell biology and tissue engineering techniques to potentially offer patients even more curative therapies, such as repairing and replacing blistered, torn skin and esophageal tissue with healthy tissue.

In addition, the department’s world-leading Multidisciplinary Cutaneous and T-cell Lymphoma Program is responsible for bringing the four most recent FDA-approved drugs to patients. The team is now pursuing novel immunotherapies in hopes of providing a cure using patients’ own immune systems and a hyper-personalized approach to attack their individual cancers.

AUTOIMMUNE CONDITIONS: Stanford Dermatology established the first-ever multidisciplinary rheumatic skin disease clinic, where dermatologists and rheumatologists work together to manage and support patients with complex autoimmune conditions. Using the largest biorepository of patient samples, department faculty have uncovered new links between different autoimmune diseases, classified new disease subtypes, and identified new drug targets. They are now leading clinical trials to apply CAR T-cell and other novel therapies to improve patients’ lives.

CANCER: Our faculty created human cancer from normal human cells in the laboratory—the first in the world to do so. Faculty researchers then used this powerful model to understand the hedgehog signaling pathway (proteins that work together to send signals from the cell membrane to the cell nucleus) and to generate the first pathway inhibitor to treat inoperable basal cell carcinoma—
Advances made in dermatology won’t just lead to progress in skin disease, but to progress and advancements in other diseases as well. Skin research as a force multiplier can open the door to 95% of diseases that plague humanity, and our department is dedicated to doing all that we can to alleviate suffering.

—Paul Khavari, MD, PhD
Chair of the Department of Dermatology

the most effective drug for treating the most common skin cancer. Today, department faculty are uncovering more novel cancer pathways and working to map all of them in an effort to treat the full landscape of cancers and stop them in their tracks.

In addition, department leaders have launched a comprehensive public health effort to help eradicate preventable melanoma fatalities, especially in high-risk, vulnerable populations. The statewide, Stanford Dermatology-led Wipe Out Melanoma–California initiative aims to change the way communities address melamoma through outreach, education, and research.

AGING: Following the identification of a set of genes involved in skin aging, dermatology faculty conducted research on broadband light therapy, which revealed a pro-inflammatory factor that may be responsible for at least some of the therapy’s restorative effect. Ongoing efforts include assessing skin frailty, cell autophagy, and hair follicle stem cell function to investigate the impacts of aging and preserve the highest possible quality of life for an increasingly aged population. Our faculty are also researching hair and hair-loss disorders to understand aging.

RNA MEDICINE: Long before messenger RNA (mRNA) became a linchpin of medicine, Stanford Dermatology faculty discovered a class of long noncoding RNAs, developed novel genomic technologies, and improved the ability to map active DNA and RNA elements by 1 million-fold in sensitivity and by 100-fold in speed. These technologies have been adopted by investigators in thousands of labs worldwide, revolutionizing the field of RNA medicine. It took 60 years from the discovery of mRNA to the development of the first drug using mRNA as a therapeutic (the COVID-19 vaccine); through Stanford's RNA Medicine Program (RAMP), we are building a ramp to accelerate the transition from discovery to therapy.

ARTIFICIAL INTELLIGENCE: Stanford Dermatology faculty were the first to create an AI algorithm to detect skin cancer, and through a new Translational AI in Dermatology (TRAINd) initiative, they continue to lead the AI, big data, and machine learning revolution in medicine. Multiple imaging modalities are being refined to develop technologies capable of diagnosing skin disease accurately to expand access to care in remote areas and serve vulnerable populations—from full-body imaging and mole mapping to virtual, noninvasive biopsy techniques. Our faculty are also at the forefront of efforts to unearth unintended consequences of these powerful new technologies to prevent harm and ensure that AI advances health benefits for all.

GENOMICS: Stanford Dermatology faculty were awarded a grant from the National Human Genome Research Institute to map the single letter changes and identify loci of genetic risk, not just for skin disease but for the top cancers, neuropsychiatric conditions, and other causes of human mortality. Under the aegis of the Atlas of Regulatory Variants in Diseases (ARVID) Project, which is housed within Stanford Dermatology, researchers are unlocking new insights into the common skin and systemic diseases that cause more than 70% of human mortality, with a goal of enabling new prevention strategies and accelerating the development of new drugs against novel pathogenic targets.
Additional Notable Achievements

Beyond the incomparable research and clinical advances taking place in the Department of Dermatology, many achievements deserve mention.

EXPOSENTIAL GROWTH: Since 2010, the number of faculty in the Department of Dermatology has tripled, now with experts in all dermatologic subspecialties, including emerging growth areas such as AI, global health, and supportive dermato-oncology (specialized inpatient dermatologic care for patients undergoing cancer treatment). In the same period, our clinical volume has quadrupled, with new clinics now available across the greater Bay Area. And our leadership at the forefront of telehealth expands access to dermatologic care for all.

WORLD-RENOVISED RESEARCH: With more published ultra-high-impact papers than the top 10 peer institutions combined, Stanford Dermatology discoveries directly influence the way we understand, diagnose, and treat disease. Scientists across the globe often cite and build on research that began at Stanford.

NEW THERAPEUTIC APPROACHES: World-leading scientific, translational, and clinical faculty in the department have developed tissue modeling systems that offer new insights for novel drug development and other first-in-class therapies where before there were none. Our Skin Innovation and Interventional Research Group (SIIRG) is aimed at bringing new therapies to patients.

TRAINING FUTURE LEADERS: Stanford Dermatology has established the largest residency training program in the United States and is also known for training more graduate students per capita than our peers. More importantly, our trainees often go on to successful careers in academia, many pursuing PhDs and joining our ranks here at Stanford. The department has attracted the largest-in-the-world cohort of the most talented young research and clinical trainees, who represent a driving force for the future.

Please Join Us

Over the past two decades, biomedical knowledge has grown exponentially. There’s never been a more exciting time to be involved in such progress, and we invite you to join us. Everyone here at Stanford Dermatology is passionate about our work and committed to doing everything in our power to alleviate human suffering. Our community of brilliant physician-scientists are eager to spend energy, effort, and time to advance human health. With philanthropic patrons who share our passion, we will realize our vision of using skin as a platform to achieve the promise of precision health—to predict, prevent, and cure disease precisely for all.

For a personal conversation about how philanthropy can make a difference, please contact:

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Cover image: light micrograph of the skin’s external layers, the epidermis (brown) and dermis (pink)