Skin & Digital: The 2023 Startups/Innovators

Dominique du Crest[1], Philipp Wustrow[2], Oliver Worsley[3], Barbara Geusens[4], Omar Badri[5], Monisha Madhumita[6,7], Art Papier[8], Alexander Zink[9], Merete Hædersdal[10] and Lilit Garibyan[11]

At the cutting edge of innovation, where clinical dermatology, esthetics, and skincare converge with the dynamic digital landscape, we explore the transformative potential of emerging digital technologies. Each year, the Skin & Digital Summit (SDS) (Skin & Digital Summit, 2024) unveils a new cadre of visionaries, each poised to redefine how we integrate digital technology in dermatology, esthetics, or skincare. In 2022, we introduced ground-breaking collaboration between the SDS, Magic Wand Initiative (Massachusetts General Hospital, 2024), and New Ideas for Medicine (New Ideas for Medicine,). Startups from 5 different countries showcased their innovative solutions at the SDS, highlighting their potential to make a significant impact and reshape the skin industry (du Crest et al, 2023)

The 2023 edition of the SDS (6 SDS in total) was more than an event; it was a vibrant ecosystem pulsating with innovative ideas and digital technologies. The premises of 6 startups were presented. These startups led by entrepreneurs are tackling some of the most pressing challenges in dermatology, esthetics, and skincare with solutions that promise to enhance diagnosis, personalize treatment plans, and revolutionize patient engagement through advanced digital tools. Their work is not just about innovation for innovation's sake; it is about meaningful advancements that deliver real-world benefits to practitioners, patients, and consumers.

In this paper, we dive into the narratives of these dynamic enterprises. From online dermatologist, skin microbiome testing, DNA-based skincare, skin analysis artificial intelligence (AI), digital tools for skin health monitoring, to skin rash application, these entrepreneurs are setting new standards for what technology can achieve in the realms of skin and digital. The summit also serves as a launching pad for the next wave of digital pioneers set to transform the landscape of dermatology, esthetics, and skincare.

These narratives, presented by the entrepreneurs themselves, provide a brief update on their approach to unmet needs in dermatology and their progress to date. Each section was authored by the corresponding entrepreneur, supported by the respective companies involved.

SKIN & DIGITAL: THE 2023 STARTUPS
OnlineDoctor—online dermatologist

Context. Access to specialist dermatologic care is inadequate, especially in Germany. The average waiting time for a physical appointment with a dermatologist is over 30 days nationwide (Jameda 2022; Krensel et al, 2015). This gap in care is to be closed with the help of digital health applications. It is important that digital and physical treatment options do not compete with each other but complement each other in so-called hybrid treatment models. Such models represent an integrated approach to patient care that combines in-person visits with virtual care.

Solution. In Germany, OnlineDoctor (OnlineDoctor, 2024) operates as a close partner of the Professional Association of German Dermatologists. OnlineDoctor currently works with around 750 dermatologists. By connecting local specialists with local patients, the goal of hybrid care is significantly taken into account. Patients can be called in for a physical appointment at any time if required. In addition, over 300 pharmacies and hospitals in Switzerland use the OnlineDoctor Pro app for advice on skin problems. Anyone diagnosed with a skin condition can receive a diagnosis and treatment recommendation from a dermatologist of their choice within a maximum of 48 hours. A total of 200,000 people have already used the service. Only in 15% of cases is it necessary to visit a practice in person after a consultation through OnlineDoctor. In Germany, OnlineDoctor cooperates with over 50 health insurance companies, which means that over 40 million patients can use the service free of charge. In 2022, the company acquired the leading AI startup A.S.S.I.S.T. and is now in the final stages of deploying an AI service. In December 2023, OnlineDoctor received the ISO 13485 certification, a key requirement for labeling as a medical device in risk class IIa.

Sequential—skin microbiome testing

Context. Microbiome targeting topical products have been convincingly shown to treat skin infections, alleviate aging pathologies, and accelerate wound repair. In fact, a significant number of skin conditions have a microbiome component (Byrd et al, 2018). However, the current landscape of skin microbiome research lacks consistency, reliability, and quality, often limited to in vitro testing, presenting a critical challenge to skincare advances.

[1]SkinAid SAS, Levallois Perret, France; [2]OnlineDoctor AG, Zürich, Switzerland; [3]Sequential, London, United Kingdom; [4]Nomige, Ghent, Belgium; [5]Medicall, Boston, Massachusetts, USA; [6]Department of Dermatology, Dermanalytica, Bangalore, India; [7]Department of Dermatology, Saveetha Medical College, SIMATS, Chennai, Tamilnadu, India; [8]Department of Dermatology, University of Rochester College of Medicine, Rochester, New York, USA; [9]Department of Dermatology and Allergy, School of Medicine and Health, Technical University of Munich, Munich, Germany; [10]Department of Dermatology, Copenhagen University Hospital, Copenhagen, Denmark; and [11]Wellman Center for Photomedicine, Department of Dermatology, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Correspondence: Dominique du Crest, SkinAid SAS, 50 Rue Danton, Levallois Perret 92300, France. E-mail: ducrest@skinaid.eu

Cite this article as: JID Innovations 2025;5:100316

COMMENTARY

The most translational approach is to use living human skin because it provides the advantage of preserving the intrinsic skin structure and cellular heterogeneity (Smythe and Wilkinson, 2023). Despite this, no testing solution has been able to standardize next-generation sequencing data; most rely on highly variable results of swabs and have not been able to integrate seamlessly with a software that can deliver digital solutions for skin health.

Solution. In 2018, Sequential (Sequential, 2024) developed the world's first consumer skin microbiome test, a noninvasive technique that relies on an adhesive patch that is shown to consistently collect more material for downstream analysis and was tested on 7 different body sites.

Paired with a fully digital and integrated mobile application that gives a quantitative read out of skin health through the lens of the microbiome, Sequential's testing system has been designed to reduce inefficiency in sample collection and created a digital tracker for consumers to monitor their skin health over time. Using machine learning (ML) on a dataset of over 20,000 skin microbiome samples, they are training models around the microbiome and skin types to support more accurate skin health reports.

With over 10 years of microbiome research, Sequential has partnered with multiple large personal care groups, such as Johnson & Johnson, to further advance their technology and work with over 60 clients globally. Sequential aims to revolutionise skin health testing, starting with the microbiome: the future looks bright for personal care!

Nomige—antiaging skin care based on your DNA

Context. In the skincare landscape, an unmet need persists owing to the inadequacy of personalized solutions accommodating genetic variations influencing skin health (Rizzo and Maibach, 2012). Conventional skincare often neglects crucial genetic factors, resulting in dissatisfaction worldwide.

Solution. Nomige (Nomige, 2024) addresses this void with an inventive digital skincare platform, utilizing advanced algorithms and digital diagnostics to tailor unique routines on the basis of individual genetic profiles. Positioned within cosmetics, Nomige's focus on digital diagnostics enhances the skincare experience by providing insightful genetic data, fostering a deeper understanding of inherent skin needs.

Pioneering a ground-breaking approach, Nomige conducted a clinical study utilizing digital technology and advanced algorithms. This study aimed to assess the effectiveness of a skincare regimen tailored to a specific genetic risk profile, leading to the development of personalized skincare products. The analysis of DNA samples from 100 participants resulted in 24 individuals with the most prevalent genetic risk profile undergoing a 56-day antiaging efficacy study. Findings showcased significant improvements in wrinkle depth and skin roughness compared with baseline and the comparator. Furthermore, an investigational skin serum demonstrated substantial antioxidant efficacy for up to 24 hours (Geusens et al, 2020).

This investigation underscores the relevance of Nomige's personalized approach based on genetic profiles and digital diagnostics, challenging conventional hit-or-miss methods in skincare. Nomige's precision skincare marks a pivotal industry advancement, emphasizing the need for a scientifically rooted, genetic-based approach over subjective experimentation. Digital technology and advanced algorithms played a crucial role in conducting the clinical study and formulating recipes for personalized skincare products.

Medicall—skin analysis AI

Context. Despite the advances in AI for dermatology applications, there has been minimal inroads in the development of software that impacts clinical work. Much of the development effort has focused on trying to automate the diagnosis of conditions using images. Overall, although the use of AI in dermatology for diagnostic purposes is more visible, the potential for AI to impact screening, drug development, and clinical workflows represents a significant opportunity to revolutionize the field. The nondiagnosis aspects would offer more comprehensive and personalized care for patients.

Although developing tools to support or even automate the diagnosis process shift the paradigm, the potential for closing dermatologic care gaps and relieving the unmet access needs of patients requires developing tools that impact the rest of the clinical workflow. Much of the time spent during a dermatology visit involves spending valuable time eliciting information from patients, asking the right questions, and documenting key information.

Solution. Medicall (Medicall, 2024) offers an automated AI-based triage system that augments existing teledermatology services. It works by automating patient intake, photo acquisition, photo quality control, developing a differential diagnosis, and asking high-yield questions on the basis of the differential diagnosis. This package of information helps to ensure that dermatology consultations are efficient and support the work of the dermatologist. The automated system reduces the clinical workflow and allows the dermatologist to focus the patient visit on value-add discussions for the patients.

Dermanalytica—digital tools to democratize skin health monitoring

Context. Dermanalytica aims to contribute to the collective efforts in combating neglected tropical diseases (NTDs) related to skin health in the tribal regions of South India. With India shouldering the world's largest burden of 11 of 13 major NTDs, including leprosy, scabies, filariasis, leishmaniasis, and yaws, the challenge is monumental (Acharya et al, 2017). These areas, characterized by poverty, limited access to health care, ecological shifts, stigma, and misinformation, demand a nuanced approach to healthcare delivery. Dermanalytica leverages digital health technologies to bridge these gaps, ensuring effective, equitable, locally feasible, and sustainable healthcare solutions.

Solution. In response to the complex challenges of skin NTDs in tribal areas, Dermanalytica (Dermanalytica, 2024) has launched DERMTROPICARE, an initiative aiming to develop an eco-friendly and sustainable system for managing skin health. Through community engagement, remote diagnosis and consultation, educational resources, public health campaigns, and integration with local health systems, Dermanalytica ensures a comprehensive approach to skin NTD prevention and management. Key elements include technological innovation through the support of local government bodies and public health institutions, customized local context solutions through mobile and web-based applications, collaborative partnerships, and multilingual chatbot support to foster a culture of sustainability and enhanced healthcare accessibility. With a team comprising medical experts, digital health professionals,

community liaisons, and linguistic experts, Dermanalytica is setting new standards in dermatologic care for India's tribal populations, hoping that one day, skin NTDs are a thing of the past.

Aysa—skin rash application

Context. In today's digital age, individuals seeking information on skin health often find themselves lost in a sea of search engine results. Despite the abundance of online resources, the quest for reliable information becomes a frustrating journey, with users spending considerable time sifting through irrelevant or inaccurate content (Portillo et al, 2021). As dermatologic AI- and ML-based applications grow in number, trust in the software is a fundamental issue. The challenge lies in the complexity of skincare concerns and the overwhelming volume of information available. Many individuals embark on a lengthy search, navigating through various websites and forums, only to be left with uncertainty and confusion. The need for a streamlined and efficient solution is evident, but users' trust in the software and content is paramount (Sbaffi and Rowley, 2017).

Solution. "In 2 minutes Aysa (Aysa, 2024) answered questions I spent hours searching for on Google." From Karen P., an Aysa user. The key is harnessing the power of ML and meshing ML with great content, thereby creating a tool that guides and teaches. This is an application that recapitulates the physician's reasoning. The idea is to engage people in understanding descriptions of skin features and not to focus on self-diagnosis in a patient facing application. Consumer educational applications can analyze user-specific concerns and provide tailored advice, eliminating the need for extensive searches. The application becomes a personal guide, offering reassurance on the basis of reference imagery and text.

In essence, Aysa is an AI-powered educational application designed around explaining the skin examination features. It engages the user around the description of the morphologic features of the rash. Hundreds of thousands of users have validated the experience of Aysa, by taking a skin photo, confirming a skin lesion search criterion, and then reviewing world class imagery and writing.

CONCLUSION

As reflected in "Skin and Digital—The 2024 Narrative" (du Crest et al, 2024), the field of dermatology is undergoing significant transformation. The collaborative efforts between the SDS, Magic Wand Initiative, and New Ideas for Medicine, initiated in 2022, have laid a strong foundation for digital transformation and innovation in clinical dermatology, esthetics, and skincare. Building on this momentum, the SDS emerges as a pivotal force to showcase Skin & Digital entrepreneurs in our fields. By integrating cutting-edge digital technologies such as AI, generative AI, and the Metaverse, these entrepreneurs aim to revolutionize dermatologic care, making it more accessible, proactive, predictive, and patient centered.

There are numerous challenges ahead, and dermatologists and skin-trained healthcare professionals must retain their central role in care, ensuring that human touch and expert judgment guide patient care in the increasingly digital age (du Crest et al, 2024). This is the condition of success to address current issues and anticipate future needs, ensuring

that skin health care evolves in tandem with technological advancements.

Beyond product or service innovation led by the industry, the continued digital innovation led by entrepreneurs in this space underscores the importance of maintaining the human touch and expert judgment in dermatologic care. As we look ahead, the ongoing collaboration and synergy between basic, translational, and clinical dermatologic researchers; clinicians; and digital innovation promise to drive groundbreaking advancements, transforming the landscape of dermatologic science and care for years to come.

ORCIDs
Dominique du Crest: http://orcid.org/0000-0002-2496-3018
Philipp Wustrow: http://orcid.org/0009-0003-5627-4027
Oliver Worsley: http://orcid.org/0009-0002-9790-6775
Barbara Geusens: http://orcid.org/0009-0001-3757-3342
Omar Badri: http://orcid.org/0000-0003-2662-472X
Monisha Madhumita: http://orcid.org/0000-0001-5652-8785
Art Papier: http://orcid.org/0000-0002-0181-0481
Alexander Zink: http://orcid.org/0000-0001-9313-6588
Merete Hædersdal: http://orcid.org/0000-0003-1250-2035
Lilit Garibyan: http://orcid.org/0000-0002-9266-0887

CONFLICT OF INTEREST
DdC is an employee of SkinAid SAS and receives a salary from this company. PW is an employee of OnlineDoctor and receives a salary from the company. OW is an employee of Sequential and receives a salary from this company. BG is an employee of Nomige and receives a salary from this company. OB is an employee of Medicall and receives a salary from this company. MM is a faculty at Saveetha Medical College, Saveetha Institute of Medical and Technical Sciences (Chennai, India) and received a salary from this institution; is an adjunct faculty at Father Muller Research Centre, Father Muller Medical College (Mangalore, India) and received honorarium from this institution; and is an employee at Dermanalytica (Bangalore, India) and received salary from this company. AP is an employee of VisualDx and receives a salary from this company. The remaining authors state no conflict of interest.

DECLARATION OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI) OR LARGE LANGUAGE MODELS (LLMs)
The author(s) did not use AI/LLM in any part of the research process and/or manuscript preparation.

REFERENCES

Acharya AS, Kaur R, Goel AD. Neglected tropical diseases—challenges and opportunities in India. Indian J Med Spec 2017;8:102—8.

Aysa. Get your answers to your skin condition questions with Aysa. https://askaysa.com/; 2017. (accessed June 1, 2024).

Byrd AL, Belkaid Y, Segre JA. The human skin microbiome. Nat Rev Microbiol 2018;16:143—55.

Dermanalytica. About dermanalytica. https://dermanalytica.com/; 2020. (accessed June 10, 2024).

du Crest D, Garibyan L, Hædersdal M, Zink A, Madhumita Harth Y, et al. Skin & digital—the 2022 startups. Dermatologie 2023;74:899—903.

du Crest D, Madhumita M, Enbiale W, Zink A, Papier A, Matewa G, et al. Skin and digital—the 2024 narrative. Mayo Clin Proc Digit Health 2024;2:322—30.

COMMENTARY

Geusens B, Rodrigues L, Matias R, Tavares B, Fonesca AL, Silva AM, et al. A double blinded, randomized, controlled split-face study to investigate the efficacy of a tailor-made anti-ageing skin care regimen adapted to a genetic skin ageing risk profile. J Clin Exp Dermatol Res 2020;11: 527.

Jameda. Busy phones and months of waiting: online appointment scheduling in demand but rarely used. https://presse.jameda.de/219894-besetzte-telefone-und-monatelange-wartezeit-online-terminvergabe-gefragt-aber-selten-genutzt; 2022. (accessed June 10, 2024).

Krensel M, Schäfer I, Gieler U, Kupfer J. Wartezeiten und Behandlungsorganisation in der Hautarztpraxis. JDDG J Dtsch Dermatol Ges 2015;13:812—4.

Massachusetts General Hospital. Magic Wand Initiative. http://www.magicwandinitiative.org/. (accessed June 1, 2024).

Medicall. Next-generation AI for frictionless visual telemedicine. https://medicall.com/. (accessed June 1, 2024).

New Ideas for Medicine. NIM 10: 10th Virtual Symposium "New Ideas for Medicine,". https://www.ideasformedicine.de/. (accessed June 3, 2024).

Nomige. Not skincare routines: anti-aging huidverzorging op basis van je DNA. https://www.nomige.com/en/. (accessed June 1, 2024).

OnlineDoctor. Without an appointment online to the dermatologist of your choice!. https://www.onlinedoctor.ch/en/. (accessed June 1, 2024).

Portillo IA, Johnson CV, Johnson SY. Quality evaluation of consumer health information Websites found on Google using DISCERN, CRAAP, and HONcode. Med Ref Serv Q 2021;40:396—407.

Rizzo AE, Maibach HI. Personalizing dermatology: the future of genomic expression profiling to individualize dermatologic therapy. J Dermatolog Treat 2012;23:161—7.

Sbaffi L, Rowley J. Trust and credibility in web-based health information: a review and agenda for future research. J Med Internet Res 2017;19: e218.

Sequential. Your clinical microbiome testing partner. www.sequential.bio. (accessed June 1, 2024).

Skin & Digital Summit. Vision, https://www.skindigitalsummit.com/#part3; 2021. (accessed June 1, 2024).

Smythe P, Wilkinson HN. The skin microbiome: current landscape and future opportunities. Int J Mol Sci 2023;24:3950.