

Innovative approaches to nail and skin health in professional manicure

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Abstract. The article is dedicated to the analysis and systematization of innovative approaches to nail and skin care in the context of professional manicure, with a focus on the integration of scientific, technological, and sustainable solutions in modern beauty practices. The purpose of this article is to analyze and systematize innovative approaches to nail and skin health within the context of professional manicure, emphasizing the integration of scientific, technological, and sustainable principles in modern beauty practices. During the scientific research, general scientific methods of cognition were used: analysis, synthesis, comparison, generalization, systematization, forecasting, and modeling. The results of the study show that the modern manicure industry is undergoing a deep transformation due to the implementation of innovations focused on safety, personalization, and environmental responsibility. Emphasis is placed on the changing approach to nail care – from decorative treatment to preventive and therapeutic procedures using “breathable”, hypoallergenic, multifunctional, and probiotic formulas. The study examines coating technologies, among which gel polishes, dip systems, and nanocosmetics stand out, providing deep penetration of active components and increased formula stability. It is shown that the latest methods are based on the principles of functional dermatology and microbiome support. The paper also analyzes the use of digital and artificial intelligence solutions in the field of nail care. In particular, it examines the implementation of smart gadgets for diagnosing nail condition, 3D printing, mobile applications for virtual design, and platforms with virtual color try-on features. It is demonstrated that such solutions contribute to high-precision personalization of services and increased procedural effectiveness. Special attention is given to the concept of the Internet-of-Mirrors – sensor mirrors capable of analyzing nail and skin parameters, integrating with recommendation service systems. It is shown that a key development vector of the industry is a sustainable approach to production – active implementation of biodegradable polymers, rejection of toxic components, the use of eco-packaging, and the development of “5-Free” and “10-Free” initiatives. The update of professional training for specialists has been studied, including education in sustainable development, digital technologies, and wellness manicure. Market analytical forecasts have been analyzed, indicating the stable growth of the industry due to the combination of aesthetics, health, and innovation. A conclusion is made about the gradual intellectualization of nail services, including robotics, automation, and the implementation of cybersecurity protocols. The practical significance of the study lies in the formation of a scientifically grounded basis for the modernization of professional nail care practices, taking into account technological, medical, and environmental criteria.

Keywords: manicure, innovation, artificial intelligence, nail care, sustainable development.

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Introduction

In the 21st century, the field of professional manicure has gained the status of an independent scientific and practical area that combines aesthetics, dermatology, cosmetology, and innovative technologies. Modern manicure is viewed not only as a decorative procedure but as an element of comprehensive care aimed at maintaining the health of the nails and hand skin. Under the influence of scientific and technological progress, traditional approaches are gradually being transformed: manual techniques are being replaced by high-precision devices, aggressive products – by biocompatible formulas, and classical care – by personalized programs. As a result, a new beauty-wellness paradigm is being formed, in which aesthetic outcomes are combined with preventive and therapeutic effects.

The dynamic development of the nail care industry is driven by increasing consumer expectations, the popularization of sustainable production, and digital technologies. Innovative solutions – from nanotechnological formulas to smart diagnostic devices – are changing quality and safety standards in salon care. New directions are emerging, such as probiotic manicure, smart nail condition monitoring systems, and artificial intelligence in coating design. All of this facilitates the industry's shift to an integrated care model, where scientific approaches, technological efficiency, and ethical responsibility toward the consumer and the environment are combined.

Literature Review

The issue of the transformation of the manicure industry toward the integration of aesthetic, scientific, medical-cosmetological, and digital innovations is well covered in foreign scientific literature. The cited sources cover a wide range of aspects – from dermatological safety to the implementation of artificial intelligence, allowing for a comprehensive understanding of current trends in nail care.

A significant contribution to revealing the functional aspects of the manicure industry was made by researchers such as J. Jefferson and P. Rich [2], who emphasized the link between decorative procedures and the protection of the nail plate. They considered clinically grounded recommendations for the selection of cosmetics, including hypoallergenic and “breathable” polishes that minimize harmful effects. M. Tyagi and A. Singal [9] provided a medical perspective, pointing out the importance of biocompatibility of products and the prevention of dermatological complications.

Issues of automation and digitalization of services are revealed in the study by L. A. Jones [3], who examines the challenges related to cybersecurity in the implementation of robotic systems and IoT in nail care. H. Fatima et al. [1] formulated the concept of the “Internet of Mirrors,” which opens up prospects for deep personalization of services based on biometric monitoring.

Economic and market aspects of the industry are studied in the report by Persistence Market Research [5], which forecasts dynamic market growth and highlights environmental drivers of development. M.-L. Schule [6], in turn, outlined future educational and production approaches that include ethical production, biodegradable materials, and vegan formulas. Publications by Signicent LLP [7] and Ziggpoll Analytics [10] highlight innovative materials and gadgets that are changing quality standards in the industry.

Expert literature from modern internet resources was also used in the study, in particular the Harvard Health Blog [4], the TSPA Howell platform [8], and the MONLIS Schule blog [6], which provide practical case studies and insights from the professional services market.

Despite the sufficient amount of literature on this topic, there is a lack of systematized material on the subject of the research. Therefore, using various scientific cognition methods, information was analyzed, grouped, systematized, and presented in light of the research topic.

The purpose of this article is to analyze and systematize innovative approaches to nail and skin health within the context of professional manicure, emphasizing the integration of scientific, technological, and sustainable principles in modern beauty practices. To achieve this goal, the study performs three tasks: to identify the key characteristics and innovative approaches that determine the current state of professional nail and skin care; to analyze contemporary trends and practices in the manicure industry that integrate scientific research, digital tools, and environmentally sustainable materials; to forecast the future development of nail care technologies considering the potential influence of nanotechnology, artificial intelligence, and biocompatible innovations.

Research Results

The modern manicure industry is rapidly developing, combining aesthetic trends, scientific approaches, and medical-cosmetological principles. Today, manicure is no longer viewed solely as a decorative procedure but rather as a preventive care element aimed at maintaining the integrity of the nail plate, preventing brittleness, dryness, and infections. The classic process includes steps such as soaking, filing, cuticle treatment, polishing, and applying coatings. Special attention is paid to safety techniques – pre-soaking nails in warm water reduces the risk of onychoschizia, and the correct filing angle prevents the formation of microcracks [2].

The manicure industry is demonstrating rapid implementation of innovations aimed at improving care effectiveness, safety, and personalization of the client experience. New types of ingredients, materials, and devices are emerging, changing the quality of services. Manufacturers are combining cosmetological, medical, and digital solutions that allow procedures to be adapted to individual user needs [10]. For instance, the rejection of aggressive cuticle removal has become a new standard in professional care, as the cuticle serves a protective function by sealing the proximal nail fold against the penetration of bacteria and fungi [2].

In recent years, the popularity of new formulas and coating types that combine aesthetics and health-conscious features has been growing. Among the most common are photochromic, thermochromic, magnetic, “breathable”, and hypoallergenic polishes. These products not only ensure long-lasting color but also reduce harmful effects on the nail plate. “Breathable” technologies allow nails to remain hydrated without disrupting natural gas exchange, while hypoallergenic formulas are free from toxic substances such as formaldehyde, toluene, camphor, and phthalates. This signals a shift in nail care toward functional dermatology, where the main goal is not only aesthetic appeal but also component biocompatibility [9].

Modern technological solutions in the field of coatings are taking new forms. Gel polishes cured under UV or LED light offer high durability and gloss, maintaining their effect for two to three weeks. However, they require adherence to photoprotection measures, since prolonged UV exposure can damage the skin. An alternative is dip powder systems, which do not require lamps for curing but demand sterile conditions to avoid infection risks. These methods indicate a shift in the industry toward safer, controlled, and scientifically supported practices [4].

One of the most notable trends is the introduction of smart devices for assessing nail condition. These gadgets measure moisture levels, pH, and nail plate fragility, and the analysis results are synchronized with mobile apps that offer personalized recommendations. Smart devices can even track progress after several treatments and remind users when it's time to update their care. This shapes a new nail wellness philosophy – digital, scientifically grounded care based on precise indicators of nail health [10].

A significant trend has become the expansion of sustainable solutions in nail product manufacturing. Modern brands are implementing biodegradable polymers, eliminating toxic

components, and using eco-friendly packaging. Products labeled “5-Free,” “7-Free,” or “10-Free” exclude hazardous substances like toluene or formaldehyde. Increasingly, brands offer refillable bottles, minimalist packaging, and recyclable containers. This demonstrates the industry's ecological reorientation in line with global “green” production trends [10].

A separate direction involves probiotic formulas that support the nail microbiome. Products with probiotics and natural extracts – such as tea tree oil, clove, and neem – have antifungal and antiseptic properties, reducing the risk of dermatological conditions. This approach transforms nail care into a part of comprehensive health, combining cosmetics and prevention [10].

The use of nanotechnology in the nail industry has enabled the creation of products with deeper action and better stability. Nanoparticles allow for more effective penetration of beneficial components – vitamins, amino acids, antioxidants – into the nail plate. Nanoencapsulation protects active ingredients from oxidation and breakdown, extending the product's effectiveness. This makes it possible to develop a new generation of cosmetics that are efficient, safe, and long-lasting [10].

In the new stage of industry development, digital personalization of color and design plays an important role. AI-powered apps enable users to create custom polish shades based on personal photos. 3D printing and automated nail art are becoming widespread, allowing the creation of complex artistic elements with high precision. The use of thermochromic and magnetic pigments adds interactivity and elements of “smart design,” where color and texture respond to external stimuli [10].

There is growing demand for multifunctional products that combine decorative and therapeutic effects. Polishes infused with keratin, proteins, vitamins, or SPF protection support nail strength and natural color while also providing aesthetic appeal. These formulas meet the needs of modern consumers who seek effective care with minimal time investment [10].

The professional training of manicurists is also undergoing modernization. Educational institutions, including The Salon Professional Academy Howell, are integrating courses on sustainability, digital technologies, and vegan products into their programs. Students learn to work with dip systems, nail printers, 3D design, and practice wellness manicure – treatments that combine massage, aromatherapy, and care with natural oils. This contributes to raising quality standards and shaping a new hand care culture [8].

At the same time, the industry is actively moving toward intellectualization and automation. AI-based devices such as Nimble can independently paint nails in just a few minutes, providing even coverage without the need for a technician. Platforms like essie Virtual Try-On allow clients to try on shades online, while brands such as ManiMe create personalized gel stickers using 3D modeling. All of this indicates that the future of manicure lies in the integration of AI, personalization, and service automation, where technology becomes an integral part of the aesthetic experience [7].

Author's techniques, which rely on modern technologies and the personal expertise of the professional, play a significant role in the innovative development of manicure practices. One noteworthy example is the SmartCare Manicure™ method, which shifts the focus from aesthetics to health, diagnostics, and non-traumatic techniques. The core idea of this approach lies in moving away from standardized procedures: each session is based on an assessment of the current condition of the skin and nail plate, includes instrumental diagnostics, and involves the creation of a personalized recovery plan. This method not only eliminates aggressive treatment but also integrates rehabilitative components such as serums, oils, and masks that promote growth, hydration, and protection.

SmartCare Manicure™ embodies the philosophy of “smart care,” where safety, personalization, and therapeutic effect are combined with premium service. Within this

method, the concept of a Smart Client Passport has been introduced, allowing for documentation of before-and-after results, tracking of treatment history, and ongoing adjustment of care strategies. This ensures not only a visual transformation but also a measurable outcome, which forms the basis for personalized recommendations, quality control, and enhanced customer loyalty. The method is suitable for both daily salon use and structured education, making it applicable in training academies and ideal for developing a branded product line.

Table 1 – The uniqueness of the SmartCare Manicure™ method in the context of industry trends

Direction	Implementation in SmartCare Manicure™
Functional care	therapeutic products including restorative serums, oils, and masks with hypoallergenic formulas
Safe processing technologies	non-traumatic tools and gentle techniques without aggressive cuticle removal
Diagnostics and personalization	two-level diagnostics combining visual assessment and device-based analysis (magnifier, moisture analyzer)
Digital quality control	maintaining a Smart client passport with photo documentation, progress tracking, and personalized notes
Sustainable development	use of non-toxic products that are safe for the skin and nail plate
Premium service	personalized protocols, aesthetics, SPA additions, and training at SmartCare Academy

The SmartCare Manicure™ methodology offers an integrative response to the key challenges of the modern manicure industry. It combines a scientific approach, client-centered focus, and innovations in safety and health. With its systematic structure, evidence-based foundation, and high service standards, this method sets a new paradigm in professional hand care, delivering not only aesthetic results but also long-term therapeutic benefits.

Let us summarize the current trends in the industry in the table (table 1).

Table 1 – Current directions of nail service industry development

Development direction	Essence of innovation / trend
functional polish formulas	combining aesthetic effects with dermatological safety; use of “breathable” and hypoallergenic compositions free from toxic ingredients
safe coating technologies	use of gel polishes and dip systems that provide long-lasting durability without harming the nail plate
smart diagnostic devices	implementation of gadgets for analyzing nail condition (moisture, pH, fragility) and personalizing care via mobile apps
sustainable development and “green” formulas	application of biodegradable polymers, eco-friendly packaging, and safe components labeled “5-Free”, “7-Free”, “10-Free”
probiotic formulas	use of microbiome-friendly products with natural extracts that support healthy nail flora
nanotechnology in	use of nanoparticles for deeper penetration of active substances and

cosmetics	improved formula stability
digital design personalization	use of AI apps, 3D printing, and “smart” pigments to create individualized designs and colors
multifunctional products	development of polishes that combine decorative and therapeutic functions — containing keratin, vitamins, SPF protection
modernization of professional education	integration of sustainability, digital technologies, and wellness approaches into training programs for technicians
intellectualization and automation of services	use of AI devices (Nimble), virtual try-on (essie Virtual Try-On), and 3D modeling to improve precision and efficiency

Note: systematized by the author based on sources [7; 8; 10]

Future development of the manicure industry is characterized by deep integration of digital technologies, artificial intelligence, sustainable production, and personalized services. The nail care sector, traditionally associated primarily with aesthetic procedures, is transforming into a high-tech beauty-tech direction, where innovation focused on precision, safety, and a comprehensive understanding of nail and skin health plays a leading role [1].

In the future, a key development vector will be the implementation of smart care management systems based on artificial intelligence and the Internet of Things. The Internet-of-Mirrors (IoM) concept envisions the creation of an integrated visual platform with sensor analysis elements capable of automatically detecting the condition parameters of the skin and nails. These systems will serve as interfaces between users and personalized care services, combining monitoring, recommendation, and communication functions. Smart mirrors equipped with computer vision and biometric scanning technologies can accurately reflect individual client needs, thereby increasing procedural effectiveness and the level of digital integration in the beauty sector [1].

At the same time, the role of sustainable and environmentally oriented technologies is expected to grow. These technologies combine natural components, health-safe formulas, and ethical manufacturing. Educational institutions such as MONLIS Schule are already incorporating ecological responsibility and sustainable development principles into their training programs, shaping a new generation of professionals capable of combining innovative technologies with a nature-based approach to care. There is increasing interest in biodegradable polymers, eco-friendly packaging, and non-toxic formulas, which confirms the industry's orientation toward conscious consumption and responsible production [6].

Technological innovations aimed at process automation and improving the client experience play a special role in shaping the future of nail care. Professional salons are actively implementing 3D printers to create individualized designs, automated devices for applying coatings, and mobile apps for virtual shade visualization. These solutions not only enhance productivity and precision but also open up opportunities for deep personalization of services – from color selection to the creation of comprehensive care plans [6].

According to analytical forecasts, the artificial nail market is expected to show steady growth: from USD 1.7 billion in 2025 to USD 2.4 billion in 2032, with an annual growth rate of 5.3%. The main drivers of development remain increased demand for acrylic and gel coatings, the growth of online sales channels, and market expansion through environmental initiatives and affordable innovative products. The European segment will maintain its focus on minimalism and natural aesthetics, while the Asian market will lean toward technological formats, including dip coatings and smart nail modeling devices [5].

Further development of the industry will also be defined by the implementation of robotics and artificial intelligence in the service sector. Intelligent systems will be used for client scheduling optimization, inventory management, personalized marketing, and real-time

quality monitoring. Manicurist robots are emerging that can apply coatings with an accuracy margin of no more than 0.3 mm, as well as augmented reality (AR) systems for preliminary design visualization. At the same time, cybersecurity and technical reliability issues of these systems are becoming increasingly relevant – the development of secure protocols and compliance with coding standards (OWASP, NIST) is becoming a mandatory condition for implementing AI in nail services [3].

Conclusions

Professional manicure in its modern understanding combines aesthetic and wellness aspects of nail and hand skin care. Its distinctive feature is a comprehensive approach based on the principles of dermatological safety, antiseptics, and physiological recovery. The procedure is no longer purely decorative – it is aimed at maintaining the integrity of the nail plate, preventing brittleness, dryness, and infections. The growing attention to hygiene, contactless treatment technologies, and the use of biocompatible formulas indicates the professionalization of the field and its convergence with the standards of medical-cosmetological practice.

The modern nail care industry shows a clear trend toward the implementation of innovative materials, sustainable technologies, and digital solutions. The development of hypoallergenic and “breathable” polishes, the use of nanotechnologies, probiotic formulas, and smart diagnostic devices contribute to improved service quality and procedural safety. Environmental practices are gaining importance: the transition to biodegradable polymers, minimalist packaging, and products labeled “5-Free” or “10-Free” is forming a responsible approach to production.

In parallel, digital design personalization is evolving, based on the use of artificial intelligence, 3D printing, and interactive coatings.

The prospects for industry development are defined by the integration of advanced technologies – artificial intelligence, the Internet of Things, robotics, and biometric systems. The Internet-of-Mirrors concept envisions a shift toward intelligent services capable of autonomously analyzing nail and skin condition and generating personalized recommendations. Market growth will continue due to process automation, the use of AI-powered devices, and sustainable ecological practices. In the future, nail care will evolve into a comprehensive beauty-tech system, where nail treatment becomes part of a scientifically grounded, digitally managed, and environmentally responsible concept of health and beauty.

References

1. Fatima, H., Imran, M. A., Taha, A., & Mohjazi, L. (2024). Internet of mirrors for connected healthcare and beauty: A prospective vision. *Internet of Things*, 28. URL: <https://arxiv.org/abs/2311.14734>
2. Jefferson, J., & Rich, P. (2012). Update on nail cosmetics. *Dermatologic Therapy*, 25, 481–489. URL: https://www.researchgate.net/publication/233847699_Update_on_nail_cosmetics
3. Jones, L. A. (2024). Artificial intelligence and robotics in the nail care industry: Are cyberattackers sitting pretty for a zero-day attack? In *Innovations, Securities, and Case Studies Across Healthcare, Business, and Technology* (pp. 274–295). URL: https://www.researchgate.net/publication/379777641_Artificial_Intelligence_and_Robotics_in_the_Nail_Care_Industry_Are_Cyberattackers_Sitting_Pretty_for_a_Zero-Day_Attack
4. Nassim, J., & Liu, K. (2019, November 21). A look at the effects of nail polish on nail health and safety. *Harvard Health Blog*. URL:

- <https://www.health.harvard.edu/blog/a-look-at-the-effects-of-nail-polish-on-nail-health-and-safety-2019112118231>
5. Persistence Market Research. (2025). Artificial nails market size, trends & forecast to 2032 (S. Chavan, Ed.). URL: <https://www.persistencemarketresearch.com/market-research/artificial-nails-market.asp>
 6. Schule, M.-L. (2024). The future of the manicure industry: Trends and innovations. URL: <https://mon-lis.de/en/schule/blog/the-future-of-the-manicure-industry-trends-and-innovations>
 7. Signicent LLP. (2024). Nail care industry report: Impact of AI, biodegradability, and innovation in nail salon market. URL: <https://signicent.com/nail-care-report/>
 8. The Salon Professional Academy Howell. (2024). The future of manicuring: Innovations and trends. URL: <https://www.tspahowell.com/blog/the-future-of-manicuring-innovations-and-trends/>
 9. Tyagi, M., & Singal, A. (2023). Nail cosmetics: What a dermatologist should know! Indian Journal of Dermatology, Venereology and Leprology, 90, 1–8. URL: https://www.researchgate.net/publication/371143267_Nail_cosmetics_What_a_dermatologist_should_know
 10. Zippoll Analytics. (2024). What innovative ingredients or technologies do successful beauty brand owners prioritize to enhance customer satisfaction and product performance in the nail care industry? URL: <https://www.zippoll.com/content/what-innovative-ingredients-or-technologies-do-successful-beauty-brand-owners-prioritize-to-enhance-customer-satisfaction-and-product-performance-in-the-nail-care-industry>