COLOMBO SCIENTIFIC PUBLISHING

INTERNATIONAL JOURNAL OF ECONOMICS FINANCE & MANAGEMENT SCIENCE

E-ISSN: 2536-7897
P-ISSN: 2536-7889

DOI: - https://doi.org/10.55640/ijefms/Volume11Issue05-02 PAGE NO: 25-32

Microbiological Risks and Infection Transmission Pathways in Nail and Aesthetic Practices

Natalia Yefremova
Nail artist, Fair Lawn NJ USA

ARTICLE INFO

Article history:
Submission: March 14, 2026
Accepted: April 24, 2026
Published: May 17, 2026
VOLUME: Vol.11 Issue 03 2026

Keywords:
infection control, onychomycosis, ASHRAE 241, aerosol contamination, SlimEdge 45°, sterilization, biofilms, occupational health and safety, Nailympia, engineering design.

ABSTRACT

In the present scholarly study, a critical, multidimensional reassessment of currently operative infection-control protocols within the professional nail industry is undertaken, grounded in engineering design principles and the methodological toolkit of contemporary epidemiology. The purpose of the work is the theoretical validation and applied development of an updated safety model in which administrative regulations are integrally aligned with technologically advanced solutions aimed at reducing occupational and client-facing risks. The methodological framework of the study is established through a systematic analysis of the academic corpus of publications from recent years, a content analysis of ASHRAE technical standards, and an in-depth examination of case studies pertaining to the author's SlimEdge 45° methodology. The results obtained indicate the fundamental necessity of implementing local exhaust ventilation systems and high-temperature sterilization as baseline instruments for counteracting fine particulate dust and persistent fungal pathogens, including Trichophyton rubrum. It is demonstrated that targeted optimization of the geometric parameters of the nail plate yields a pronounced reduction in bacterial retention within the hyponychial zone by decreasing microcavities and areas of stagnant bio-material accumulation. The concluding propositions confirm the fulfillment of the stated objectives and underscore the high applied significance of the proposed recommendations for elevating sectoral standards in the beauty industry, offering substantive interest to engineers specializing in building life-support systems design, epidemiologists, beauty-center owners, and practitioners oriented toward achieving competitive outcomes in international professional championships.

INTRODUCTION

The contemporary nail-service sector has entered a phase of accelerated growth accompanied by profound technological restructuring. According to market estimates for 2024, the global segment of nail-care products and solutions reached 24,56 billion USD, and by 2032 it is projected to increase to 36,27 billion [1]. Such dynamics signify not only an expansion of the range of procedures and materials, but also an intensification of the cumulative burden of biological and chemical risk factors affecting both the professional environment and the end consumer. In 2024–2025 it became evident that sanitary approaches shaped in previous decades are losing their adequacy: resistant variants of microorganisms are moving to the foreground, along with an increase in allergic and inflammatory reactions associated with polymerization components and the products of their transformations.

Epidemiological reports from 2024–2025 document a persistently significant prevalence of onychomycosis: in the general population, frequency fluctuates within the range of 3–12%, whereas in the cohort older than 65 years the indicator reaches approximately 35% [2]. Publications from early 2025 further underscore diagnostic vulnerability: the clinical manifestations of fungal involvement are characterized by variability and often mimic nonfungal dermatologic conditions, as a result of which, without laboratory verification (culture testing or direct microscopy), recognition accuracy remains unacceptably low [5]. In the applied context of the beauty industry, this translates into a principled commitment to universal precautions, whereby every

presentation must be treated as potentially infection-significant until it has been objectively ruled out.

A substantial scientific-and-practical deficit is determined by the fact that existing regulatory and guidance documents (including OSHA frameworks and provisions of regional boards of cosmetology) have traditionally concentrated on the contact mechanism of transmission, while the aerosol component and the biomechanical regularities governing biofilm formation on artificial and modified surfaces remain insufficiently accounted for [6]. The long-standing perception of nail services as a low-risk domain relative to clinical disciplines comes into conflict with the factual conditions of work zones: concentrations of fine particulate matter PM2.5 and levels of volatile organic compounds in salon environments not infrequently exceed the reference points articulated by WHO and OSHA, thereby forming an environment of elevated occupational hazard [8].

Under these conditions, **the aim of the study** is formulated as the development and substantiation of an integrated engineering-technical model of infection control grounded in the biomechanics of the nail plate, the parameters of air exchange and flow distribution within the working volume, and current requirements for sterilization processing of instruments.

Scientific novelty is defined by substantiating a direct relationship between the filing angle of the free edge (the authorial SlimEdge 45° technique) and the hydrodynamic stability of bacterial biofilms, which makes it possible to interpret aesthetic modeling as an element of engineering-based infection prevention.

The proposed hypothesis proceeds from the premise that the crisis of infection control in the beauty industry is linked to a systemic underestimation of the aerosol route of pathogen transmission and can be overcome through the implementation of equivalent clean air (ECA) standards in combination with geometric optimization of the nail aimed at reducing microbial retention.

MATERIALS AND METHODS

The methodological framework of the study is constructed on an interdisciplinary basis, synthesizing epidemiological approaches to assessing infectious risks, principles of industrial design, and the toolkit of engineering design for ventilation systems. Within the project, a set of complementary methods was employed to ensure data comparability and the reproducibility of conclusions.

The empirical-theoretical contour was defined by a systematized review of the scholarly literature: publications from 2020–2025 indexed in Scopus, Web of Science, and PubMed were examined, with priority attention to etiological models of onychomycoses, the spectrum of occupational diseases among nail technicians, and the comparative effectiveness of disinfection and sterilization approaches [5]. This selection of sources made it possible to establish an evidentiary basis for interpreting the salon environment as a potentially significant epidemiological node, where risks are determined not only by contact transmission but also by air quality and pathogen persistence.

The normative-and-engineering component of the study relied on content analysis of specialized technical documents: a detailed examination was performed of updated editions of ASHRAE 62.1-2025 and ASHRAE 241 Control of Infectious Aerosols, published in 2024–2025, followed by extrapolation of air-environment parameter requirements characteristic of medical facilities to the conditions of beauty coworking spaces [11]. Such adaptation was treated as a means of transferring formalized criteria for managing aerosol risks into an industry in which simplified sanitary algorithms had traditionally dominated.

Engineering verification of technological solutions was implemented through a comparative analysis of operational parameters of key control measures: local exhaust ventilation (LEV) systems, autoclaving, and high-temperature dry-heat processing were compared. The comparison was conducted according to criteria of the capacity to inactivate spore forms, the stability of the sterilization effect, and the influence of procedures on degradation and service life of metal instruments, which is critical for practices of repeated use [14]. This approach provided a basis for selecting solutions that optimize both biosafety and the economics of operation.

The practice-oriented part of the methodology is presented by a case study of professional practice using the experience of project preparation of material for the Nailympia championship (Poster category). This case made it possible to reconstruct the transformation of an artistic concept into a regulated product consistent with the requirements of competitive hygiene, thereby identifying points of conflict between aesthetic objectives and sanitary-engineering constraints.

A separate methodological block consisted of biomechanical modeling aimed at analyzing the effect of the SlimEdge 45° technique on the hydrodynamic conditions of cleaning the subungual space. The computational component relied on parameters of contact angles of bacterial colonies and the regularities of microorganism adhesion to polymer surfaces, which made it possible to link the geometry of the free edge with the probability of formation and the stability of microbial accumulations under the impact of cleansing procedures [17]. Thus, aesthetic geometry was treated as a controllable variable influencing microbial retention.

The source corpus of the study is structured according to a three-level principle of prioritization. The highest level is formed by peer-reviewed publications indexed in Scopus, as well as official CDC and OSHA guidance, ensuring the regulatory and evidentiary validity of key propositions [5]. The second level is composed of ASHRAE technical reports and WHO materials from 2022–2024, used for accurate interpretation of air-environment parameters and engineering requirements [12]. The applied level includes regulatory documents of international championships (Nailympia 2025) and authorial methodological developments (Secrets of the Perfect Design), serving as a source of contextual constraints of professional practice and criteria of competitive standardization.

RESULTS AND DISCUSSION

In 2024–2025, the nosological structure of infectious pathology relevant to nail-service practice demonstrated shifts driven by transboundary dissemination of pathogens and transformations in behavioral patterns of service consumption. Against this background, retrospective studies with a sample of N=2722, completed in early 2025, showed a statistically significant association between the topographic localization of the infectious process and the etiological profile of the pathogen, which allows the anatomical localization of the lesion to be treated as an informative marker of the probable type of causative agent and the risk of its transmission in a professional environment [5] (see Table 1).

Table 1. Etiological structure of onychomycoses and bacterial complications (compiled by the author on the basis of [4, 5, 6, 22]).

Localization	Prevailing pathogen	Frequency of occurrence (%)	Primary risk factor
Fingernails	Candida albicans	71.9%	Frequent contact with water, disruption of cuticle integrity
Toenails	Trichophyton rubrum	81.5%	Wearing occlusive footwear, visiting public places
Subungual space	Pseudomonas aeruginosa	Growing trend	Material detachment, green syndrome
Surrounding tissues	Staphylococcus aureus	25–30% (secondary)	Microtrauma associated with electric-file manicure

The analysis of transmission mechanisms demonstrates that infectious risks are formed not only through direct contact, but also via fomites, that is, contaminated instruments and work surfaces. Cutting and rotary instruments, including nippers and burs, when even minimal microscopic contact with blood is present, are capable of becoming vectors of bloodborne infections, including HBV and HCV [25]. An additional vulnerability factor in the professional environment is the low coverage of hepatitis B vaccination among manicure professionals: according to 2024 data, the indicator remains at approximately 17,2%, which objectively increases the probability of occupational infection [28].

The key threat under conditions of the modern salon is to a large extent associated with difficult-to-detect, invisible contamination of the air environment. Filing of artificial coatings is accompanied by the generation of fine particulate dust with pronounced sorption properties with respect to microbial agents and chemical vapors, which intensifies the combined exposure to biological and chemical factors. Publications from 2024 indicate that in 71% of cases existing ventilation solutions in salons do not ensure even the minimally permissible air-exchange rate, as a result of which conditions are created for the accumulation of the aerosol fraction and secondary contamination of surfaces [8]. Within this logic, the transition to the requirements of ASHRAE 241 (2025), oriented toward the control of infectious aerosols through the concept of equivalent clean air (ECA), acquires applied significance for the nail industry as an engineering-substantiated standard of risk management. The practical implementation of this concept presupposes a combination of local capture of dust aerosol in the filing zone through LEV, the application of filtration at the level of MERV 14 or HEPA to remove particles on the order of 0,3 μm with an efficiency of 99% and higher, as well as the use of UVGI to inactivate viral particles in the upper zone of the room when correctly integrated into air exchange [12].

Below, Figure 1 presents the comparative effectiveness of reducing bioaerosol concentration under different ventilation regimes.

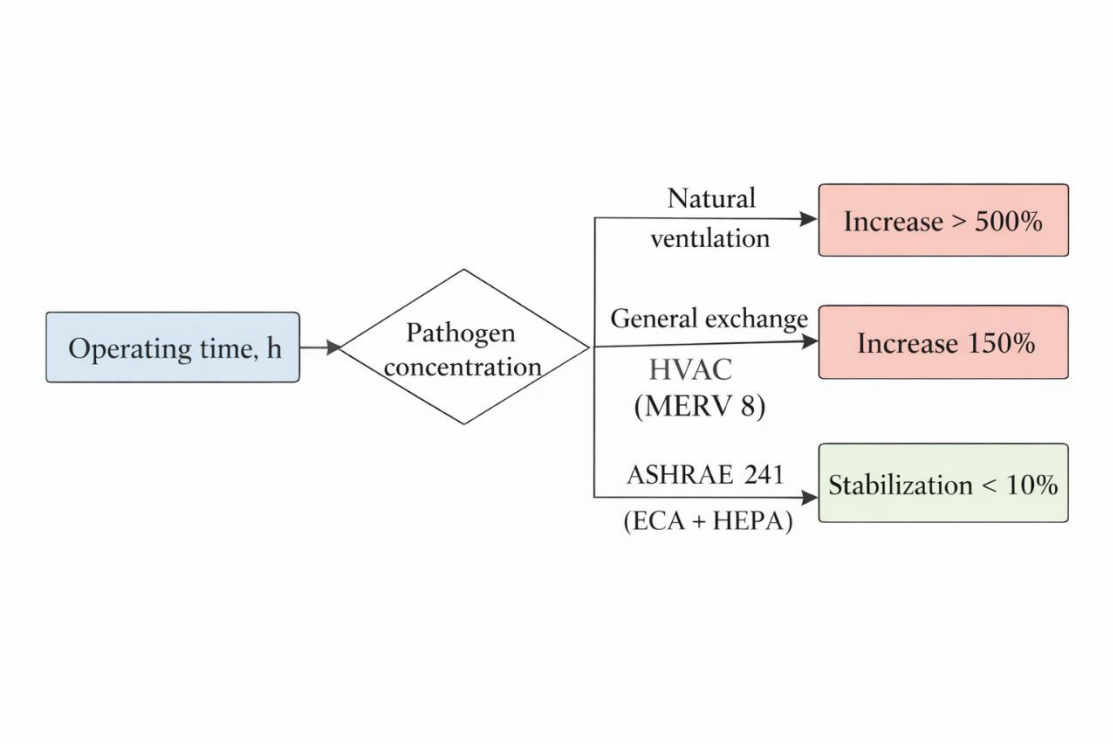

Fig. 1. Comparative effectiveness of reducing bioaerosol concentration under different ventilation regimes (compiled by the author on the basis of [9-16]).

Data from 2025 indicate that the use of gel polymerization systems in and of itself is not associated with an increased bacterial burden, provided that hand hygiene is maintained and the free-edge length is kept at the level of ≤2 mm [29]. An adverse scenario is formed predominantly when lifting of the coating occurs, where locally oxygen-limited microniches are created that are favorable for the growth of Pseudomonas.

From the standpoint of infection control, the geometry of the free edge is a significant factor: traditional filing not infrequently leads to the formation of barrel-shaped or weighted contours that promote the emergence of stagnant zones in the lateral grooves and beneath the free edge. Such microrelief areas facilitate the retention of moisture and organic substrates, increasing the probability of microbial retention. The SlimEdge 45° technique is positioned as an engineering-calibrated solution to this problem through precision geometrization: the free edge is formed by filing at an angle of 45° to the longitudinal axis of the finger. This ensures visual thinning without a substantial loss of strength characteristics, modifies the surface contact angle, which in the physics of biofilms is treated as a critical parameter influencing their growth and spread, and also increases the accessibility of the hyponychial zone for antiseptic treatment during routine hygiene procedures [17, 24].

A mathematical description of adhesive interactions in this context is correlated with the Young–Dupré equation, in which changes in geometry and surface wettability affect the free energy of microorganism adhesion. Under a 45° configuration, a directionality of forces is formed that promotes more effective mechanical flushing of contaminants by the water flow, which reduces the likelihood of stable fixation of microbial conglomerates and increases the effectiveness of routine cleaning [17, 23].

Table 2 presents the results of comparing classical filing and the SlimEdge 45° technique according to safety criteria.

Table 2. Comparison of classical filing and the SlimEdge 45° technique according to safety criteria (compiled by the author on the basis of practical experience and analysis of [12, 17, 29]).

Parameter	Classical filing (90°)	SlimEdge 45°	Advantage
Dust contact area	High (flat end face)	Minimal (beveled edge)	Reduced absorption of volatile organic compounds
Bacterial retention	High (pockets in corners)	Low (streamlined geometry)	Prevention of green syndrome
Strength	Standard	Increased (stiffening ribs)	Reduced risk of cracks and delamination
Aesthetics	A barrel effect is possible	A thin, elegant end profile	Competition level (Nailympia)

In 2024, the emphases of professional discussion regarding sterilization regimens shifted perceptibly toward achieving a balance between the microbiological reliability of processing and preservation of the operational service life of costly instruments. Steam sterilization in autoclaves is characterized by a high cycle speed, approximately 15–30 minutes, at comparatively moderate temperatures on the order of 121–134 °C, which makes the method technologically efficient for high-throughput practice; at the same time, the presence of moisture within the cycle can accelerate corrosion processes and, when drying or storage regimens are violated, reduce the durability of metal items [14]. High-temperature processing with dry hot air, widely used in the private segment, presupposes longer cycles, approximately 60–90 minutes, at 160–180 °C; however, the absence of an aqueous phase fundamentally reduces the risk of rusting and renders this regimen especially preferable for metal burs and cutting instruments, for which surface stability and cutting-edge integrity are critical [15, 21].

For greater clarity, Figure 2 demonstrates a schematic of the instrument sterilization cycle under the conditions of a modern salon.

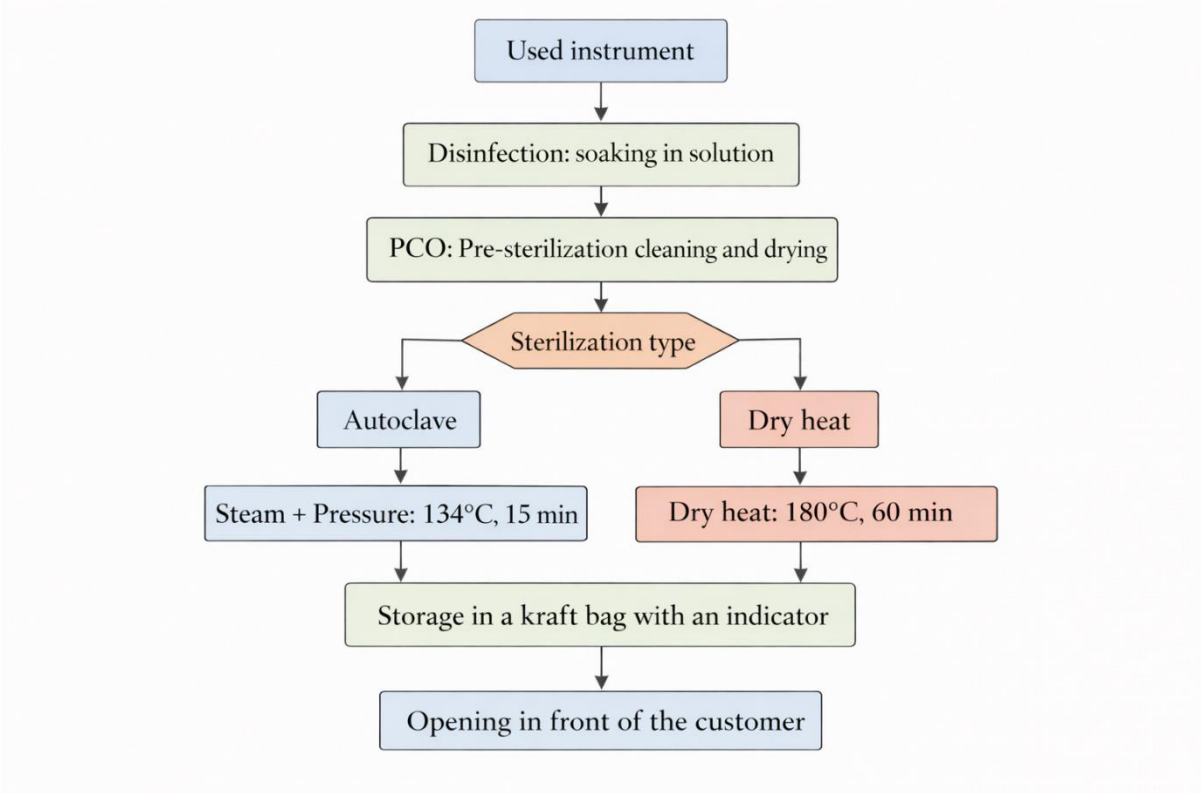

Fig. 2. Schematic of the instrument sterilization cycle under the conditions of a modern salon (Author's original development).

Among the most significant violations in industry practice is the positioning of ultraviolet cabinets as means that provide sterilization. Available evidence indicates that the bactericidal action of ultraviolet radiation is realized predominantly on open areas that are directly exposed, whereas in hinged joints, microirregularities, internal cavities, and shaded zones the achievable dose proves insufficient. This fundamentally constrains the method and rules out its suitability for full-scale decontamination of instruments, especially when reliable inactivation of resilient forms of microorganisms is required [14, 20].

Preparation for the international Nailympia championship in the Poster category served as an applied model demonstrating the integration of a theoretical apparatus and professional technique under conditions of competitive standardization. The specificity of the nomination presupposes the formation of a coherent visual image in which nails constitute the central object of high-quality photographic capture, and the result is evaluated by the aggregate of artistic and technical parameters. Implementation of the project took four months and required coordination of work with a hairdresser and a photographer, as well as organizational support from the family.

In the course of executing the case, the principle of absence of boundaries was articulated, according to which an impeccably constructed system of infection control and technical execution is transformed into a resource of creative freedom, because it reduces uncertainty and eliminates compromises between aesthetics and safety. The reflection on and structuring of the experience obtained were used as the foundation of the methodological manual Secrets of the Perfect Design: How to Create Winning Works for Competitions, where the logic of constructing a competition design is disclosed step by step through the prism of technical standards [18, 19].

Chemical safety in the nail industry constitutes an independent block of risks comparable in significance to infectious threats. In 2025, confirmations were obtained that a substantial share of products labeled as toluene-free in fact contain toluene in concentrations of practical significance, and such nonconformities were identified in 83% of the samples studied [10]. Within an engineering logic, this requires interpreting the ventilation system as an instrument for simultaneous control of the aerosol and gas phases: the calculation must account not only for capture and removal of the dust fraction, but also for effective dilution of methacrylate vapors and toluene to levels that ensure a reduction of sensory and toxicological load [26, 27].

Prolonged exposure to volatile organic compounds among specialists with workloads exceeding 46 hours per week correlates with an increased frequency of bronchial asthma, contact dermatitis, and adverse effects on reproductive health [3, 7]. At the level of personal protection, the selection of glove materials is of fundamental importance: the use of nitrile is treated as mandatory, because standard latex exhibits permeability to methyl methacrylate (MMA). This monomer, despite regulatory restrictions, remains present in the low-budget materials segment, which increases the likelihood of sensitization and toxic exposures under conditions of insufficient barrier control and ventilation [8].

CONCLUSION

The study conducted substantiates the necessity of a principled revision of approaches to infection control in the nail industry. Under the conditions of 2025, the transition from predominantly surface-oriented disinfection to comprehensive engineering protection of the work environment is treated as a key condition for ensuring sustainable safety in the presence of combined biological and chemical risk factors.

The results obtained confirm that traditional sanitary measures require mandatory supplementation by equivalent clean air (ECA) systems implemented in the logic of ASHRAE 241 requirements, because it is precisely this architecture of control that makes it possible to reduce in a targeted manner the influence of the aerosol route of transmission of infectious agents and, simultaneously, to decrease inhalational chemical load. Within the framework of biomechanical prevention, the applied value of the SlimEdge 45° technique is demonstrated: optimization of the geometry of the free edge and the associated contact angles functions not only as an instrument of aesthetic modeling, but also as a factor in reducing bacterial retention by lowering the probability of forming stagnant zones and stable fixation of microbial conglomerates. A separate significance attaches to the educational component, in which the methodological manual Secrets of the Perfect Design and systematic preparation for competitions at the Nailympia level form a new trajectory of professionalization, wherein hygienic discipline and technical excellence function as a unified standard of quality. The practical outlook of the proposed model is expressed in a potential reduction in the frequency of occupation-conditioned diseases among specialists and a decrease in the probability of cross-infection of clients by fungal and viral agents under typical salon scenarios.

Taken together, the work confirms the achievement of the stated aims and forms a reproducible methodological foundation applicable to engineering design, epidemiological assessment, and managerial decision-making in enterprises of the beauty industry. The institutionalization of the proposed principles in everyday practice is capable of simultaneously supporting the economic sustainability of services and reducing the population burden of preventable health risks.

REFERENCES

1. Nail Care Products Market Size, Share & Industry Analysis, By Product Type (Nail Polish, Top & Base Coats, Nail Polish Remover, Cuticle Care, and Others), By Distribution Channel (Online and Offline), and Regional Forecast, 2025–2032 | Fortune Business Insights. Retrieved from: https://www.fortunebusinessinsights.com/infographics/nail-care-market-106149 (date accessed: December 20, 2025).

2. Overview: Nail fungus | InformedHealth.org – NCBI Bookshelf. Retrieved from: https://www.ncbi.nlm.nih.gov/books/NBK279547/ (date accessed: October 1, 2025).

3. Albucker, S. J., & Lipner, S. R. (2023). A bibliometric analysis of the top 100 highly cited onychomycosis publications using SCOPUS database (1972–2022). Skin Appendage Disorders, 9(5), 333–341. https://doi.org/10.1159/000531184

4. Onychomycosis: An updated review. (2020). https://doi.org/10.2174/1872213X13666191026090713

5. Jaworek, A. K., Hałubiec, P., Wojas-Pelc, A., & Szepietowski, J. C. (2025). Analysis of causative factors and potential predictors of onychomycosis: A retrospective single-center study in Poland. Journal of Fungi, 11(2), 131. https://doi.org/10.3390/jof11020131

6. Health hazards in nail salons – Biological hazards | Occupational Safety and Health Administration (OSHA). Retrieved from: https://www.osha.gov/nail-salons/biological-hazards (date accessed: October 3, 2025).

7. Health hazards in nail salons – Overview | Occupational Safety and Health Administration (OSHA). Retrieved from:

https://www.osha.gov/nail-salons (date accessed: October 5, 2025).

8. The nail salon workforce: A systematic scoping review of carcinogen exposure assessments, health outcome, and workforce intervention research. (2025). Reviews on Environmental Health. Advance online publication. https://doi.org/10.1515/reveh-2025-0047

9. Infection control in the salon | California Board of Barbering and Cosmetology. Retrieved from: https://www.barbercosmo.ca.gov/consumers/infect_cont_factsheet.pdf (date accessed: October 29, 2025).

10. The safety of nail products: Health threats in the nail industry. (2025). International Journal of Dermatology. Advance online publication. https://doi.org/10.1111/ijd.17826

11. Standards 62.1 & 62.2 | ASHRAE. Retrieved from: https://www.ashrae.org/technical-resources/bookstore/standards-62-1-62-2 (date accessed: October 7, 2025).

12. Standard 241 (Control of Infectious Aerosols) | ASHRAE. Retrieved from: https://www.ashrae.org/technical-resources/bookstore/standard-241 (date accessed: October 9, 2025).

13. April 25, 2025 – Standards actions | ASHRAE. Retrieved from: https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20actions/saapr_25_2025.pdf (date accessed: October 11, 2025).

14. Guideline for disinfection and sterilization in healthcare facilities | CDC. Retrieved from: https://www.cdc.gov/infectioncontrol/guidelines/disinfection/ (date accessed: October 13, 2025).

15. Disinfectants for use against SARS-CoV-2 (List N) | U.S. Environmental Protection Agency (EPA). Retrieved from: https://www.epa.gov/coronavirus/about-list-n-disinfectants-coronavirus-covid-19-0 (date accessed: October 15, 2025).

16. Cleaning, disinfection, and sterilization of medical devices | World Health Organization (WHO). Retrieved from: https://www.who.int/publications/i/item/9789240011126 (date accessed: October 17, 2025).

17. The geometry of life: Physicists determine what controls biofilm growth | Georgia Tech. Retrieved from: https://www.gatech.edu/news/2024/07/09/geometry-life-physicists-determine-what-controls-biofilm-growth (date accessed: October 19, 2025).

18. Helbig, R., Günther, D., Friedrichs, J., Rößler, F., Lasagni, A., & Werner, C. (2016). The impact of structure dimensions on initial bacterial adhesion. Biomaterials Science, 4(7), 1074–1078. https://doi.org/10.1039/c6bm00078a

19. Drescher, K., Dunkel, J., Cisneros, L. H., Ganguly, S., & Goldstein, R. E. (2011). Fluid dynamics and noise in bacterial cell–cell and cell–surface scattering. Proceedings of the National Academy of Sciences of the United States of America, 108(27), 10940–10945. https://doi.org/10.1073/pnas.1019079108

20. Information sheet – Viral hepatitis B and C burden of disease | WHO. Retrieved from: https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/2025-whd-hep-information-sheet.pdf(date accessed: October 21, 2025).

21. ANSI/ASHRAE Standard 62.1 (Ventilation for acceptable indoor air quality) | ASHRAE. Retrieved from: https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda (date accessed: October 23, 2025).

22. Achinas, S., Charalampogiannis, N., & Euverink, G. J. W. (2019). A brief recap of microbial adhesion and biofilms. Applied Sciences, 9(14), 2801. https://doi.org/10.3390/app9142801

23. Flow-induced bending of flagella controls bacterial surface behavior. (2025). bioRxiv. https://doi.org/10.1101/2025.01.07.631359

24. Mancini, G., Figliomeni, S., Puccinelli, C., & Romanelli, G. (2018). A descriptive survey on microbiological risk in beauty salons. Microchemical Journal, 136, 547–555. https://doi.org/10.1016/j.microc.2017.02.021

25. Bloodborne pathogens and needlestick prevention | Occupational Safety and Health Administration (OSHA). Retrieved from: https://www.osha.gov/bloodborne-pathogens (date accessed: October 25, 2025).

26. Villar, L. M., de Paula, V. S., de Almeida, A. J., do Ó, K. M. R., Miguel, J. C., & Lampe, E. (2014). Knowledge and prevalence of viral hepatitis among beauticians. Journal of Medical Virology, 86(9), 1515–1521. https://doi.org/10.1002/jmv.23993

27. Kose, Ş., Mandiracioglu, A., Oral, A. M., Emek, M., Gozaydin, A., Kuzucu, L., & Turken, M. (2011). Seroprevalence of hepatitis B and C viruses: Awareness and safe practices of hairdressers in Izmir — A survey. International Journal of Occupational Medicine and Environmental Health, 24(3), 275–282. https://doi.org/10.2478/s13382-011-0032-0

28. Bashir, H. H., Kamani, L., Usman, M., & Kishwar, K. (2022). Awareness and safe practices of Hepatitis-B and C prevention and transmission among workers of women beauty salons. Pakistan Journal of Medical Sciences, 38(8), 2156–2162. https://doi.org/10.12669/pjms.38.8.6166

29. Arreba, P., Iglesias, J., Ríos, J., Herrera, S., Marco, D. N., Montoya, M., Brey, M., Pitart, C., Hernández-Meneses, M., Cardozo, C., García, N., Sempere, A., Verdejo, M., Morata, L., Bodro, M., García-Vidal, C., García, F., Soriano, A., Martínez, J. A., & Del Río, A. (2025). Gel nail polish does not have a negative impact on the nail bacterial burden nor on the quality of hand hygiene with an alcohol-based hand rub. Journal of Hospital Infection, 157, 40–44. https://doi.org/10.1016/j.jhin.2024.12.006