Bulletin de veille risques biologiques N°133 – Décembre 2025 – avril 2026

Objectifs : veilles spécifiques sur la thématique du risque biologique : biotechnologies (nouveaux procédés), équipements de protection individuelle (fièvre hémorragique, Ebola), protection respiratoire (ajustement), protection respiratoire des professionnels de santé (retrait, astreinte thermique, nouveaux équipements, efficacité), zoonoses (pathologies émergentes), légionellose (cas professionnels), endotoxines (effets toxiques/multi-expositions), mycotoxines (voie respiratoire, risque professionnel), recyclage textiles (technologies, risques), usages de l'eau dans l'industrie (usages de retraitement de l'eau, process, risques).

+ suivi d'organismes français et internationaux (sélection d'actualités classées par thème).

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS. Les éléments issus de cette veille sont fournis sans garantie d'exhaustivité.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

Les bulletins de veille sont disponibles sur le portail documentaire de l'INRS. L'abonnement permet de recevoir une alerte mail lors de la publication d'un nouveau bulletin (bouton « M'abonner » disponible après connexion à son compte).

Sommaire :

- **Protection respiratoire : ajustement**

Armistead M, Dandekar A, Mathews M, Smith M, Gaskill M, Girase A, et al.

Development of an animatronic headform test method for determining the efficacy of medical masks and barrier face coverings-part 1: total filtration efficacy.

Journal of occupational and environmental hygiene. 2026:15.

https://www.tandfonline.com/doi/pdf/10.1080/15459624.2026.2612992

The effectiveness of face coverings against respiratory viruses is crucial for public health but often lacks realistic performance assessments of protection and comfort. In this study, a system-level test method was developed using an animatronic headform to incorporate fit and dynamic wear into the assessment of total filtration efficacy of medical masks and barrier face coverings. Six commercially available products were evaluated, including an N95 respirator as the control. Total filtration efficacy was calculated from differential particle counts recorded inside and outside of face coverings each minute. The baseline method was able to statistically differentiate between products to a difference in means of 5% at a particle size of 0.3 mu m optical diameter. The 16 and 28 L/min sinusoidal flow rates significantly impacted total filtration efficacy, as did the influence of headform movement and duration of wear for select products. There were statistical differences between operators at both flow rates for the KN95 and surgical style masks that were difficult to don consistently, highlighting the variability in performance due to fit. However, the product type remained the most significant cause of variance in the method at 66.10%, demonstrating that the headform test method was able to repeatedly and reproducibly evaluate the efficacy of various face coverings. Furthermore, there were significant decreases in filtration when the facepiece was not sealed properly due to poor fit. This highlights the importance of evaluating these source control devices, including barrier face coverings and public use of medical masks, as they are intended to be worn to incorporate their fit into the reported results.

Chughtai AA, Kpozehouen E, Seale H, Shah S, Marks GB, MacIntyre CR.

Facemask and respirator use for bushfire smoke protection: A cross-country comparison of public health policies in Australia, Canada, India, and the United States.

Health Policy. 2026;164:9.

https://www.sciencedirect.com/science/article/pii/S0168851025002647?pes=vor&utm_source=clarivate&getft_integrator=clarivate

Background: As climate change intensifies the frequency and severity of bushfires, exposure to bushfire smoke emerging as a significant public health concern, associated with numerous adverse health outcomes, including exacerbation of chronic obstructive pulmonary disease, asthma, cardiovascular diseases, and respiratory infections. Objective: This study examined policies related to the use of masks and respirators as protective measures against smoke exposure. Methods: Policies and guidelines of health departments, emergency and fire services, and other relevant orga nisations of selected eduntries were reviewed. Guidelines were sourced from organizational websites, PubMed and Google Scholar uning specific keywords. Result: There is variability in policies regarding mask and respirator use during bushfires. Health departments generally recommend using P2/N95 respirators to protect the public from particulate exposure arising bushfire smoke, while emergency and fire services

generally recommend surgical or cloth masks. Few guidelines provided detailed instructions on the proper use of respirators, including fit testing, or fit checking procedures. Most guidelines emphasised monitoring air quality and avoiding bushfire smoke, particularly for high-risk groups There is no guidance provided on the length of time a mask should be used in any guideline. Conclusion: The inconsistent recommendations from health organisations and countries regarding mask and respirator use during beshfires highlights the lack of high-quality evidence in this area. Health, emergency and fire services, and othe relevant organisations should provide clear guidance around types of facemasks, the length of time a facertask should be used and on proper use of respirators use, including training and fit checking.

Fakherpour A, Jahangiri M, Haghighi A.

A systematic review of fit improvement strategies for respirators: lessons learned from the COVID-19 pandemic.

BMC public health. 2025;25(1):27.

https://doi.org/10.1186/s12889-025-24867-7

IntroductionThe use of respirators and masks has increased dramatically during outbreaks of respiratory infections, such as the COVID-19 pandemic. Both filtration efficiency and respirator fit testing influence the provision of effective respiratory protection to users. If healthcare workers (HCWs) do not have access to tight-fitting N95 filtering facepiece respirators (FFRs) or if fit testing procedures are not feasible, some cost-benefit fit improvement strategies (FISs) could benefit HCW respiratory protection against respiratory infection pandemics.ObjectiveThe objective of this systematic review is to investigate the importance of fit testing and to identify the optimal factors influencing respirator or mask fit characteristics, particularly in emergency situations.MethodsWe searched four databases, including PubMed, Scopus, Web of Science, and Science Direct from February 5, 2020, to December 7, 2024, covering the COVID-19 pandemic period. Finally, a gray literature search was conducted to ensure that no further studies were missed. Additionally, quality assessment of the included studies was performed according to the Newcastle-Ottawa Scale.ResultsA total of 39 full texts were included in the systematic review. Seven categories of FISs included fitters or braces, double masking with cloth or medical masks over FFRs, ear loop knotting and tucking or using ear guards (hooks, clips), adhesive tape, skin protectants/dressings, wearing goggles over FFRs, and using cloths over facial hair to improve fit. Each FIS has its own advantages and disadvantages. Overall, there was an improvement in fitting after the application of the FISs.ConclusionsAmong all, mask frame, ear loop strap modification, medical tape, thin dressings, double masking, and goggles donning modification are considered as pleasant FISs during performing the occupational activity. Among all, the mask frame and medical tape outperformed the other FISs. It is crucial that all respirators modified with FISs undergo standard fit testing procedures to avoid a false sense of security and prevent exposure to hazardous respiratory substances. Both safety and ergonomic factors are of great importance when applying each FIS.

Gibbs JL, Sheridan CE, Duysen E, Danielson E, Tutor R, Anthony TR.

Organization of Community-Based Respirator Fit Testing Programs for Agricultural Workers.

Workplace health & safety. 2026;74(2):89-97.

https://journals.sagepub.com/doi/10.1177/21650799251388480

Background: The agricultural industry exposes individuals to diverse respiratory hazards, yet historically, respirator use has been low. Ensuring proper protection remains challenging due to complex agricultural hazards (e.g., pesticides, dust, zoonotic diseases, wildfire smoke) and limited rural

access to health care services. This professional practice publication outlines the development and initial impact of Community-Based Respirator Fit Testing Programs, highlighting the vital roles of nurses and community collaboration.Methods: This publication draws upon over 40 years of combined experience from a multidisciplinary team in conducting Community-Based Respirator Fit Testing workshops. It synthesizes insights from eight workshops over 5 years, engaging 175 participants across five states. These workshops trained diverse agricultural safety stakeholders on requirements for the Occupational Safety and Health Administration (OSHA), respiratory exposures, qualitative fit testing principles, and fit tester responsibilities, informed by two comprehensive Respirator Fit Test Guides developed in collaboration with National Institute for Occupational Safety and Health (NIOSH)-funded Agricultural Health and Safety Centers.Findings: Community-Based Respirator Fit Testing Programs require multiple steps, including on-farm hazard identification, appropriate respirator selection (considering cost challenges), medical evaluation, annual fit testing, training, and documentation.Discussion: Major challenges to fit test programs in rural agricultural areas include the cost of equipment and limited healthcare provider engagement. The most significant barriers identified during workshops were community awareness about respiratory protection and distance to services. These are compounded by agriculture's time-sensitive nature which favors task-based guidance.Conclusion: Respiratory protection is vital for agricultural health. While self-reported use has increased in recent years, proper implementation through Community-Based Respirator Fit Testing Programs is crucial.

Hosen MS, Derraik JGB, Shahbaz M, Anderson WA, Anderson YC, Staiger MP.

From Bench to Breath: Material Integrity and Performance of Filtering Facepiece Respirators and Surgical Masks After Multi-Cycle Dry-Heat Reprocessing.

Microorganisms. 2025;14(1):28.

https://doi.org/10.3390/microorganisms14010069

Dry heat inactivates pathogens on personal protective equipment without chemical residues, but its effects on material integrity and performance across multiple reprocessing cycles have not been comprehensively assessed. We evaluated five filtering facepiece respirator (FFR) models and three surgical mask (SM) models after one, two, and three cycles of dry heat (80 degrees C, 90 min). We measured fabric and strap tensile properties as indicators of mechanical durability [Young's modulus (E), yield strength (sigma y), ultimate tensile strength (sigma UTS), and strain at failure (epsilon f)]. We also assessed particle filtration efficiency (PFE) and airflow resistance (breathability). Under the methods applied herein, all untreated SMs and FFRs performed within the range anticipated for their type. Tensile properties exhibited heterogeneous, model-specific responses to thermal stress. FFR fabrics ranged from progressive stiffening (Dr äger DR-X1720C; +120% E) to marked softening (3M-8210; -82% E), while SM fabrics exhibited softening, consistent with thermal relaxation. Straps made of thermoplastic elastomer (3M-8210 and 3M-9320A+) weakened (15-31% sigma UTS decrease), whereas braided polyisoprene straps (3M-1860S and 3M-1870+) maintained their original strength. Despite these changes, all treated FFR replicates met filtration requirements across all cycles (45/45). For SMs, 24/27 treated replicates met the required PFE threshold (>= 98%), but 3 treated RH-S919B replicates fell below this threshold (PFE 94.9% and 97.7% after one cycle, and PFE 97.3% after three cycles), identifying a potential model-specific vulnerability to the treatment. Breathability remained within control ranges for most models; however, the Level 2 ZA-S001B showed decreased breathability (higher airflow resistance) after two (+11.1 Pa) and three (+13.3 Pa) dry-heat cycles, whereas the Level 3 RH-S920TFG showed modest improvements in breathability (lower airflow resistance, up to -10.1 Pa). Under these laboratory conditions, up to three cycles of dry heat at 80 degrees C for 90 min preserved PFE and breathability in all treated FFR replicates and in most treated SM replicates. Nonetheless, there were measurable, component-specific mechanical changes (especially in some straps) that could

compromise fit and durability with repeated use. These findings support dry heat at 80 degrees C for 90 min as a potential component of emergency PPE processing strategies, provided that model-specific quantitative fit testing and extended-wear studies confirm safe real-world reuse, regulatory approvals are met, and end-user acceptability is considered.

Sawada H, Kakine M, Kubota Y, Sekine K, Hiraide A.

Evaluation of the protective efficacy of a user seal check for N95 respirators through quantitative fit testing in an ambulance crew.

Scientific reports. 2025;15(1):7.

https://www.nature.com/articles/s41598-025-17616-8.pdf

To ensure health and wellbeing of healthcare workers, prevention of infection is essential. Although N95 filtering facepiece respirators (N95 respirators) are potentially effective respiratory protective devices, scientific evaluation for healthcare workers, particularly for ambulance crews has been insufficient. We investigated if N95 respirator user seal checking ensures seal quality through quantitative fit testing among ambulance crews. A user seal check was performed according to the manufacturer's instructions and based on each participant's subjective assessment of fit. A quantitative test was then performed using a dedicated counter. In the results, although the pass rates for both the user seal check and the quantitative test exceeded 50%, the kappa coefficients between the two tests were -0.072 (95%CI: -0.38-0.23), 0.11 (95%CI: -0.11-0.33), and 0.013 (95%CI: -0.31-0.34) for three kinds of N95 respirators respectively suggesting extremely low rates of agreement similar to other reports from health providers. Therefore, we compared the patterns of distributions of the two tests. In the result, probability of agreement of the two tests was determined to be 50%, which was identical to a coin toss. It is unknown what level of protection an N95 respirator will provide when only a user seal check is performed.

Vij A, Barnes N, Carter L, Palmer J, Konatham-Haribabu P.

Examining the effects of custom 3D-printed respirator frames on the seal of KN95 masks: A pilot study.

Journal of occupational and environmental hygiene. 2026;23(2):124-9.

https://www.tandfonline.com/doi/pdf/10.1080/15459624.2025.2571702

During most of the COVID-19 pandemic, N95 respirators were in short supply, creating a need for alternative solutions to protect healthcare workers and others from infection. The current pilot study was conducted to determine whether using a KN95 respirator with a custom respirator frame would be an effective alternative to an N95 respirator. Using the Bellus3D Dental Pro application on an iPhone, a 3D face scan was obtained for six adult volunteers (three women, three men), and a custom mask frame was 3D printed in gray resin. Next, a PortaCount Fit Tester was used to test the fit of a KN95 respirator, a KN95 respirator with the custom mask frame, and an N95 respirator. The three respirator configurations were compared for overall fit and fit during four day-to-day movements (bending over, talking, and moving the head side to side or up and down). Fit factor values could range from 1-200, and a value of 100 was considered the minimum to meet established safety specifications. The mean (SD) overall fit factor was 12.1 (1.8) for the KN95 respirator, 195.4 (11.2) for the KN95 respirator with the custom mask frame, and 170.0 (38.3) for the N95 respirator. Differences were found between the three configurations for all outcomes (all $p < .004$). Post hoc comparisons indicated differences between the KN95 respirator and KN95 respirator with the custom mask frame for all outcomes (all $p < .02$) and between the KN95 respirator with the custom mask frame and N95 respirator for moving the head side

to side (p = .04). Results of the pilot current study suggested using a KN95 respirator with a custom mask frame significantly improved the fit factor to meet existing safety specifications. In the future, healthcare workers and organizations should consider this configuration as an effective alternative to N95 respirators.

Wang GF, Luo CW, Cui C, Wang SJ, Huang J.

Establishment of a fit prediction model of N95 respirator based on facial images.

Environmental health and preventive medicine. 2025;30:9.

https://www.jstage.jst.go.jp/article/ehpm/30/0/30_25-00258/_pdf

Background: The protective effectiveness of an N95 respirator depends on the filtration efficiency of the material from which the N95 respirator is made of, as well as the wearers' facial fit. The facial fit of an N95 respirator mainly depends on the degree of matching between the wearers' facial dimension characteristics and the N95 respirator. Quantitative fit testing objectively evaluates the fit of N95 respirators; however, it is not easy to promote because of the limitations of testing conditions. The aim of this study is to establish a fit prediction model of N95 respirator based on facial images. Methods: Facial images and fit factor (FF) value of 5 N95 respirators were gathered from 299 medical staffs in 10 hospitals in Beijing. Face geometry measurement was based on 3D face modelling, and the American TSI-8038 Porta Count Pro+ was used to conduct quantitative fit test. Multiple linear regression analysis was employed to identify facial dimensional features that significantly influenced the fit of N95 respirators. Through matching training of facial image and FF values, a fit prediction model has been established, enabling rapid recommendation of N95 respirators meeting the fit standard via facial image recognition. Results: A fit prediction model for N95 respirators based on facial images has been developed, which enables the rapid recommendation of N95 respirators with acceptable FF value for healthcare personnel. The model demonstrated an accuracy of 55.93%, a precision of 98.43%, a recall of 51.65%, and an F1 score of 0.68. Conclusions: It is feasible to utilize computer-based facial recognition technology to rapidly recommend N95 respirators for medical personnel. Given the high level of accuracy achieved, the model demonstrates significant potential for practical application.

- ## Protection respiratoire des professionnels de santé (hors fit test, voir ci-dessus) : retrait, astreinte thermique, nouveaux équipements, efficacité

Beam EL, Herstein JJ, Kupzyk K.

Exploring the Impact of Prerequisite eLearning on Respiratory Protection Equipment Safety Behaviors in Simulation Training.

Health security. 2025;23(6):456-63.

https://journals.sagepub.com/doi/10.1177/23265094251398059?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub

Military healthcare workers (HCWs) face similar clinical challenges in providing care during the pandemic as the civilian workforce. The most common respirator used in healthcare is the N95 filtering facepiece respirator (FFR). Video scoring has been successful in describing the challenges HCWs face with transmission-based precautions in healthcare. This case study explores the critical safety behavioral outcomes of 2 training interventions for respiratory protective equipment use by military

HCWs during a Center for Sustainment of Trauma and Readiness Skills course on biocontainment care in Omaha, Nebraska, at the University of Nebraska Medical Center. The study included a knowledge quiz and computer-based educational materials. Behavioral assessment was done by video recording and scoring skills performance during 3 donning and doffing N95 respirator opportunities in the training course. The main finding of the knowledge quiz was the gap in recognition that hand hygiene is warranted after the personal touching required when donning a respirator. The expert scoring of respirator use showed poor performance of critical safety behaviors such as performing the user seal check for the respirator. Training opportunities can be used for data collection related to respirator safety behavior change, but our investigators would recommend isolating the behavioral interest more than this case study was able to do. There were limitations in this project by the nature of combining this assessment with the training course and its dense curriculum. This investigation into respiratory protection equipment behavior interventions during a pandemic may provide for improvement in future educational and behavioral assessment activities.

Bouchoucha SL, Martin L, Cartron E, Lucas JJ, Hoon LS, McKenna K, et al.

More Than a Barrier: Exploring the Personal and Professional Impact of Personal Protective Equipment Use in Healthcare.

Nurs Health Sci. 2025;27(3):e70231.

https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/nhs.70231?download=true

Personal protective equipment used to provide protection to healthcare workers during the pandemic was impacted by shortages in supply and side effects from use. The aim of this study was to explore the prevalence of personal protective equipment (PPE) side effects experienced by healthcare workers in France, including access to, use of PPE, and PPE training. A cross-sectional descriptive survey was used. Reporting followed the STROBE statement. Three hundred and forty-six participants completed the survey. Most were female (41.2%), nurses (59.7%) and aged between 31 and 45 years old. Surgical masks were associated with side effects (54.6%), including acne (24.05%), pressure injuries (26.49%) and burning/pain (7.62%). N95 respirator use was associated with side effects (30.43%), of acne (11.88%) and abrasions (11.88%). Side effects were most frequently reported by female participants and those working in COVID-19 areas. The side effects caused by PPE use and the impact this has on healthcare workers cannot be underestimated. Findings in this study identify the need to develop preventative measures to reduce side effects and improve patient interactions.

Doll M, Martin EM, Rittmann B, Ching PR.

The rise and fall of contact precautions: how does personal protective equipment fit into sustainable healthcare?

Antimicrob Steward Healthc Epidemiol. 2026;5(1):7.

https://doi.org/10.1017/ash.2025.10217

Contact precautions (CP) remain a core infection control strategy, recommended by expert guidelines to decrease transmission of infectious diseases in healthcare settings. Yet, the incremental benefit of CP over standard infection prevention practices is questioned by many experts particularly for organisms considered to be endemic, or widely prevalent in healthcare settings and the community. Specifically, the gowns and gloves used in CPs are the primary sources of angst within the overall isolation strategy, due to the difficulty in sustaining adherence with personal protective equipment (PPE) use, the potential adverse effects to patients stemming from PPE requirements for all patient care, and the material waste. Healthcare sustainability advocates have targeted overuse of

PPE, as it is highly visible, generally unpopular with staff, and often misused. As the field re-calculates risk benefit ratios of our recommendations through a sustainability lens, it is important to distinguish between CP as a policy (the subject of this discussion) and CP as a single act of infection prevention. As a single act, we know barrier methods prevent spread of infection in a single patient-provider encounter. However, does this intervention maintain success when we attempt to implement it to scale? This is the nature of many infection prevention dilemmas.

Foster CR, Weston D, Maynard-Smith L, McGuire E, Taylor-Egbeyemi J, Carter H, et al.

Infection prevention and control risk assessment and policy for respiratory viral infections in National Health Service trusts in England: a national survey.

Journal of Hospital Infection. 2026;170:246-52.

https://doi.org/10.1016/j.jhin.2026.01.016

*Background: Guidance on the use of fluid-resistant surgical masks (FRSMs) and filtering facepiece protection level 3 (FFP3) respirator masks by healthcare staff in England is produced nationally and applied locally by hospital trusts. In April 2022, national infection prevention and control guidance was updated with reference to the importance of local risk assessment when considering the use of FFP3 respirator masks. Aim: Our aim was to evaluate local hospital policies for use of face masks and risk assessment for healthcare staff. Methods: A cross-sectional online survey (February-March 2023) of National Health Service trusts in England was conducted. Responses were analysed using Fisher's exact tests and the framework approach. Results: Fifty nine percent (109/186) of eligible hospital trusts responded. All trusts required staff to wear FRSMs or FFP3 respirator masks when providing direct care to patients with suspected respiratory viral infection (RVI), 87% (95/109) and 13% (14/109), respectively. FFP3 respirator masks were required by 13% of trusts (14/109) when providing direct care to individuals with suspected RVI and by 9% of trusts (10/109) when present in a bay/ward with patients with suspected RVI. Over half of the trusts used locally developed risk assessment tools. Conclusions: There was clear variation in policies for use of face masks and use of workplace and individual risk assessments across hospital trusts. There was also variation in application of mask use, fit testing and audit of adherence. Further work is required to explore whether development of further guidance and national implementation tools could reduce unwarranted variation.
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Hung TY, Yu SH, Weng CH, Su YC, Hu SC, Lin T, et al.

Comparative Effectiveness of Negative Pressure, N95 Respirators, and HEPA Evacuators in Reducing Aerosol Exposure During Inhalation Therapy: A High-Fidelity Simulation Study.

Indoor air. 2026;2026(1):9.

https://doi.org/10.1155/ina/3556640

Background Inhalation therapy, widely used for asthma and COPD, remains classified as a potential aerosol-generating procedure (AGP), leading to restrictive infection-control practices. Evidence on aerosol dispersion and the comparative efficacy of mitigation strategies-including negative pressure (NP), HEPA evacuators, and mask type-remains inconsistent. Research Question Which mitigation strategy most effectively reduces healthcare worker aerosol exposure during inhalation therapy: NP rooms, N95 respirators, surgical masks, or portable HEPA evacuators? Study Design and Methods A high-fidelity simulation quantified aerosol dispersion during inhalation therapy in an isolation suite.

Two delivery methods (T-tube and mask inhalation) were tested under two breathing conditions (minute ventilation = 12 and 30 L/min). Each was evaluated with or without an NP, HEPA evacuator, and three PPE states (N95 respirator, surgical mask, or none). Aerosol concentrations were continuously measured for 10 min at three standardized near-field sites located 50 cm from the mannequin ' s mouth. Results NP achieved the greatest and most consistent reduction, lowering aerosol levels by 75%-78% across all conditions. N95 respirators reduced exposure by 35%-50% relative to surgical masks, which in some low-flow settings exceeded no-mask baselines, indicating leakage. HEPA evacuators showed conditional efficacy-reducing aerosols by 27%-45% during mask inhalation but paradoxically increasing concentrations by up to 29% during open-circuit T-tube use due to suction-induced recirculation. Pooled analysis identified NP and N95 respirator use as the dominant factors associated with exposure reduction (p < 0.001). Interpretation Aerosol dispersion during inhalation therapy depends on ventilation rate and device type. NP combined with N95 respirator use provided the most effective protection (> 80% reduction). HEPA evacuators were beneficial in partially sealed mask systems but counterproductive in open-circuit T-tube setups, supporting prioritization of NP environments and N95 respirator use over surgical masks or single-point suction systems.

Jaladara V, Khairani N, Prabandari YS, Mahendradhata Y, Daniel D.

Heat stress and thermal perceptions related to personal protective equipment in healthcare workers during the COVID-19 pandemic in Indonesia.

Work. 2026;83(4):1100-10.

https://journals.sagepub.com/doi/10.1177/10519815251394699

BackgroundThe COVID-19 pandemic necessitates the use of personal protective equipment (PPE) by healthcare workers (HCWs), elevating heat stress risks and potentially reducing work productivity. However, limited information exists on HCWs' experiences with PPE-related heat stress in Indonesia.ObjectivesThis study examines HCWs' experiences with PPE, their perceived knowledge and attitudes, and anticipatory practices using a case study in the Covid emergency hospital (Rumah Sakit Darurat Covid (RSDC) in Bahasa) in Jakarta, Indonesia.MethodsNinety-two HCWs completed self-reported surveys and 12 people participated in qualitative interviews between February and March 2022.ResultsCommon heat stress symptoms were thirst, excessive sweating, and fatigue. While HCWs frequently took breaks in designated rest areas, they rarely removed PPE or hydrated regularly. Reasons included avoiding urinating, strict policies on drinking and eating, reducing the risk of disease transmission, and conserving PPE. Notably, HCWs with more positive attitudes were less likely to remove PPE during breaks. Moreover, no specific policies or infrastructure exist to assist HCWs in managing heat stress risks.ConclusionTo mitigate or minimize heat stress, HCWs should wear comfortable, thin shirts inside PPE and receive training on how to keep hydrated when using PPE. PPE manufacturers should develop and design PPE that reduces excessive heat, since the need for comfortable PPE may increase in the future to avoid reducing HCWs' work productivity. Finally, dedicated guidelines and supportive facilities are needed to enable healthcare workers to cope with heat stress associated with PPE usage.

Kamble AV, Khobragade SC, Belgaumkar V.

Difficulties faced by healthcare workers in PPE use during covid-19 pandemic: A mixed-method study from a tertiary hospital in India.

Bioinformation. 2025;21(12):4338-43.

https://doi.org/10.6026/973206300214338

A mixed-method cross-sectional study at Sassoon General Hospital, Pune, assessed PPE-related challenges among 257 HCWs between August and December 2021. Nearly all HCWs (99.2%) reported discomfort, primarily excessive sweating (95.3%), headaches (60.3%), communication barriers (56.8%) and feelings of suffocation (52.1%). Over half experienced improper sizing and dermatological issues, while 32.7% struggled with donning and doffing despite prior training. Almost half (48.7%) admitted breaking PPE protocol due to discomfort and 31.5% tested positive for COVID-19 while on duty. Thematic analysis highlighted ergonomic inadequacies, prolonged wear, harsh environmental conditions and psychological burden, underscoring the urgent need for climate-appropriate, user-friendly PPE and strong institutional support.

Lee SJ, Kim E, Im JH, Lee JS, Baek J.

Effect of Personal Protective Equipment on the Prevention of SARS-CoV-2 Infection in Healthcare Workers.

J Korean Med Sci. 2025;40(43):6.

https://jkms.org/Synapse/Data/PDFData/0063JKMS/jkms-40-e276.pdf

Background: During the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) pandemic, healthcare workers (HCWs) faced significant challenges related to their exposure to the virus and the prevention of its transmission. HCWs were advised to use personal protective equipment (PPE) when treating patients diagnosed with or suspected of having coronavirus disease 2019. However, the effectiveness of PPE in preventing SARS-CoV-2 infection remains unclear. This study aims to investigate the protective effect of PPE against SARS-CoV-2 infection. Methods: HCWs without a history of SARS-CoV-2 infection or vaccination were enrolled. Blood samples were collected at two-time points: the first between February and April 2020, before any patient contact, and the second between February and March 2021. Anti-SARSCoV-2 immunoglobulin G antibodies were measured to assess SARS-CoV-2 infection. Results: Among the 181 participants, only one developed SARS-CoV-2 antibodies. However, an epidemiological investigation suggested that this infection was more likely acquired outside the hospital than during clinical duties. Conclusion: Our findings suggest that PPE is effective in preventing SARS-CoV-2 infection among HCWs.

Lundstrom JA, Krumholz E, Hedin DS, Tri J, Seifert G, Asirvatham S, et al., editors.

Rapid Point-of-Care Sterilization of Personal Protective Equipment for Frontline Healthcare Workers.

47th International Conference of the Engineering in Medicine and Biology Society-EMBC-Annual; 2025 Jul 14-18

2025; Copenhagen, DENMARK: Ieee.

https://ieeexplore.ieee.org/document/11253647/?denied=

During the COVID-19 pandemic, shortages of filtering facepiece respirators (FFRs), including N95 masks, highlighted the critical need for effective decontamination and reuse strategies. Current decontamination methods often rely on large, expensive equipment, hindering point-of-care application and timely reprocessing. This study presents the design and evaluation of a portable, low-cost system utilizing high-voltage pulsed electric fields (PEF) for FFR sterilization and electrostatic recharge. A novel PEF generator was developed, featuring precise control over pulse parameters and significantly faster rise/fall times compared to existing systems. The generator was integrated into a compact, user-friendly enclosure with custom- designed electrodes. Testing demonstrated that PEF treatment did not compromise N95 mask filtration efficacy, as confirmed by Bacterial Filtration

Efficiency (BFE) and Differential Pressure (Delta P) testing conducted by Nelson Labs. Furthermore, in collaboration with the Mayo Clinic, the system's efficacy against SARS-CoV-2 inoculated onto FFR fabric was evaluated. Results showed significant reduction in viral load after PEF treatment short of complete inactivation, comparable to or exceeding the efficacy of traditional sterilization methods but with significantly shorter treatment times. This portable PEF system offers a promising solution for rapid, efficient, and cost-effective FFR decontamination and reuse, potentially mitigating PPE shortages and reducing healthcare costs and waste.

Lv Y, Cai MH, Xiang Q, Wang PP.

Artificial intelligence-assisted personal protective equipment donning and doffing training for health professions students and healthcare workers: a scoping review.

BMC Med Educ. 2025;26(1):14.

https://doi.org/10.1186/s12909-025-08498-5

BackgroundErrors in donning and doffing personal protective equipment (PPE) significantly contribute to self-contamination among healthcare workers and health professions students, potentially leading to occupational exposure. Artificial intelligence (AI) offers a promising approach to enhance PPE training, but no comprehensive review of its applications and effectiveness exists.MethodsThis scoping review followed the Joanna Briggs Institute (JBI) framework and PRISMA-ScR guidelines. Four databases (PubMed, Scopus, Embase, Web of Science), grey literature, and citation searching were searched for studies published between January 2000 and November 2025. Included studies focused on AI-assisted PPE donning and doffing training for healthcare workers or health professions students.ResultsFive studies (published 2022-2025) from China (n = 2) and Australia (n = 3) met the inclusion criteria. Study designs were heterogeneous, including controlled experiment, prospective cohort, clinical cohort validation, pilot simulation study, and pre-post intervention, with sample sizes ranging from a single participant to 3382 individuals. The applied AI technologies primarily involved computer vision and machine learning, integrated into systems for real-time feedback, virtual simulation, and compliance monitoring. Evaluations suggested that AI-assisted training was associated with improved operational accuracy, with some studies reporting an increase to over 98%. One study observed a concurrent decrease in clinical infection rates, though causality cannot be established due to study design limitations.ConclusionAI shows strong potential to enhance PPE training through real-time feedback and personalized skill development. However, the current evidence base is limited to five studies conducted exclusively in China and Australia, which restricts the geographical generalizability of the findings. Future research should explore integrated training curricula, long-term effectiveness, and cost-efficient AI implementations.

Lyrio MP, Rocha JPD, Silva CP, Azevedo AJR, Pinto GS, Tavares JD, et al.

Accidents with biological material among health professionals in Brazil: a cross-sectional study involving medication administration.

Rev Epidemiol Control Infecc. 2025;15(3):1-6.

https://doi.org/10.17058/reci.v15i3.20304

Background and Objectives: Healthcare professionals, particularly nursing technicians, are frequently exposed to occupational risks involving contaminated biological materials, such as blood, increasing their vulnerability to infections like HIV and hepatitis B and C. This study aimed to analyze the association between biological material exposure during medication administration among nursing technicians, compared to other healthcare professionals. Methods: A cross-sectional analytical study

was conducted using 69.129 work-related accident notifications recorded in the SINAN database in 2022. Sociodemographic and clinical variables were analyzed. The association measure used was the Prevalence Ratio (PR), with 95% Confidence Interval (CI) and p <= 0.05. Results: Most affected individuals were aged 26 to 45 years (61.3%) and female (76.9%). Blood was the main biological material involved (74.7%). Nursing technicians showed a 2.54 times higher prevalence of accidents during medication administration compared to other professionals (PR = 2.54; 95% CI: 2.46-2.62; p < 0.0001). The Southeast region of Brazil reported the highest number of cases. Although 84.8% were vaccinated against hepatitis B, underreporting remains a concern, with 30.4% of Work Accident Reports (CAT) not issued. Conclusion: The high frequency of accidents among nursing technicians highlights the urgent need for public policies focused on prevention, improved reporting practices, and proper use of personal protective equipment (PPE). Underreporting compromises health surveillance and calls for educational and organizational strategies to enhance workplace safety in healthcare settings.

Mehmood Qadri H, Dar SA, Gondal A, Ahmad HS, Chaudhry MJ, Ali S, et al.

Monkeypox in Healthcare Settings: A Narrative Review of Transmission, Exposure, and Protection Among Healthcare Workers.

Cureus. 2026;18(1):e101286.

https://assets.cureus.com/uploads/review_article/pdf/310546/20260210-107204-rvswwe.pdf

Monkeypox, caused by an Orthopoxvirus, poses a significant occupational risk to healthcare workers due to their frequent contact with infected patients and contaminated materials. This risk is increased by potential lapses in infection control protocols in hospitals, such as a lack of personal protective equipment (PPE), improper hand hygiene, and other issues, making hospitals a key site for occupational transmission of monkeypox. The objective of the study was to evaluate monkeypox transmission among healthcare workers and identify critical preventive strategies. A comprehensive literature search was conducted using PubMed, focusing on case reports and series published between 2000 and 2024. Eight studies comprising seven case reports and one case series, documenting a total of nine patients, were selected based on predefined inclusion criteria. Data regarding transmission routes, risk factors, and preventive measures were extracted and analyzed. The primary mode of monkeypox transmission among healthcare workers was percutaneous exposure, notably from needlestick injuries during the care of patients with active lesions. Fomite exposure accounted for 22.22% (2) of cases, highlighting the risk posed by contaminated surfaces and medical equipment. Respiratory transmission was suspected in some cases, though conclusive evidence remains limited. Key risk factors included inadequate use of PPE and breaches in infection control protocols. Post-exposure vaccination was administered to 33.33% (3) of patients, and post-exposure medication was given to 66.66% (6) of patients. Although respiratory transmission is not evident, asymptomatic or mildly symptomatic individuals may contribute to disease transmission. This highlights the need for improved surveillance and enhanced infection control protocols, including PPE utilization, hand hygiene, and avoidance of needlestick injuries. Post-exposure vaccination and antiviral treatment of exposed individuals effectively curb the spread of monkeypox.

Ng I, Kave B, Paynter C, Bodas C, Roberts M, Hung S, et al.

Speech intelligibility and hearing acuity assessments of N95/P2 respirator with under-mask elastic band beard cover.

Infect Control Hosp Epidemiol. 2025;46(11):1127-33.

https://www.cambridge.org/core/services/aop-cambridge-core/content/view/5799C14E44C7797E3B9A79FE3B781802/S0899823X25102973a.pdf/div-class-

title-speech-intelligibility-and-hearing-acuity-assessments-of-n95-p2-respirator-with-under-mask-elastic-band-beard-cover-div.pdf

Objective: Using the Modified Rhyme Test in accordance with the National Institute for Occupational Safety and Health (NIOSH) protocol, we assessed the communication performance for both speech intelligibility and hearing acuity in bearded healthcare workers (HCWs) wearing a N95/P2 respirator with an under-mask elastic band beard cover.Design and setting: A prospective simulation study conducted at the respiratory fit test center of the Royal Melbourne Hospital.Participants: Bearded HCWs who required respiratory protection and could not shave for medical, cultural, or religious reasons.Results: The overall performance rating score was 91.3% and 99.8% for speech intelligibility and hearing acuity respectively. There was a reduction in the percentage of correct words perceived by a panel of trained listeners when bearded HCWs were speaking while wearing the N95/P2 respirator/elastic band combination compared to the uncovered beard condition (84.5% vs. 92.9%, p = 0.011). However, no significant difference was found in the perception of medical phrases between these two conditions. In the hearing assessment, there were no differences found in hearing correct single words or medical phrases between the two conditions.Conclusions: This study demonstrates that when bearded HCWs wore the N95/P2 respirator/elastic band combination, their speech intelligibility and hearing acuity greatly exceeded the NIOSH standard of 70% in the Modified Rhyme Test. This finding is crucial for ensuring effective communication among bearded HCWs, thereby supporting both respiratory protection and operational efficiency in healthcare settings.

Pfuderer L, Friedl A, Wiggli B, Grass R.

Doffing procedures of personal protective equipment evaluated with lipid nanoparticles as viral surrogates: uncovering potential blind spots.

Antimicrobial resistance and infection control. 2025;15(1):7.

https://link.springer.com/content/pdf/10.1186/s13756-025-01680-w.pdf

BACKGROUND: Personal protective equipment (PPE) should effectively protect health care workers (HCWs) when treating infectious patients. However, during doffing contamination from outside of the PPE could be transferred and might cause serious infection. Therefore, complex doffing procedures have been developed, which include disinfection steps and would thereby protect the HCWs even if a contamination event occurred during doffing. However, assessing these complex multi-step procedures regarding risk of contamination and infection is challenging. The use of harmless surrogates with pathogen mimicking properties such as lipid nanoparticles encapsulating DNA (LNPs) could provide valuable insights into the effectiveness of doffing and disinfection procedures. Compared to the state-of-the-art method of contamination monitoring using fluorescent lotions LNPs promise to be more sensitive and give additional insights into the value of the disinfection steps. METHODS: After pre-testing the suitability of LNPs as viral surrogates in terms of detection limit and susceptibility to ethanolic disinfection, LNPs with different barcodes were used to evaluate the PPE doffing procedure in place at the Cantonal Hospital Baden (Switzerland). During the biannual HCWs' PPE training, several sites of the PPE were deliberately contaminated with LNPs after donning. After completion of the doffing procedure, the hands and faces of the HCWs and several environmental sites were analysed for LNP contamination via qPCR. RESULTS: The analysis showed that no contamination of HCWs' hands and faces was detectable, indicating the effective protection of HCWs. But some environmental sites were contaminated during the doffing procedure. Owing to the disinfection sensitivity of the LNPs it could be shown that the LNPs detected were disintegrated during one of the disinfection steps of the procedure. CONCLUSIONS: This study demonstrates that LNPs can be used as viral surrogates during the evaluation of PPE doffing procedures. LNPs can lead to insightful results due to their low detection limit and the susceptibility towards disinfection, making this method superior to fluorescent lotions.

Consequently, indications for the procedures' effectivity in inhibiting pathogen transfer to HCWs were found using LNPs. At the same time, blind spots in environmental contamination were uncovered, and the necessity of the disinfection steps in the protocol was displayed.

Rao L, Lu J, Wang S, Li H, Han W.

Evaluating the efficacy of action-based instructions on the suitability of medical protective masks in healthcare settings.

Journal of Hospital Infection. 2025;166:63-70.

https://doi.org/10.1016/j.jhin.2025.10.001

Background: The leakage of protective masks remains a problem that cannot be ignored in clinical practice, and the insufficient protection caused by the leakage can lead to unnecessary occupationally acquired respiratory tract infections. Aim: This study aimed to identify the factors influencing nursing staff's adherence to wearing medical protective masks through behavioural intervention. A quantitative fit test was conducted to assess the effectiveness of the intervention, providing guidance for correct mask usage among nursing staff. Methods: A sample of 40 nurses from the International Peace Maternity and Child Health Hospital of the China Welfare Institute was selected to observe three different methods of wearing medical protective masks, followed by a behavioural intervention. The quantitative fit test was administered before and after the intervention, recording the passing rate of medical protective masks. Findings: A pithy formula combined with a fit test can promote the correct rate of mask wearing and improve protection. The compatibility and comfort of the mask model with the wearer's head and face size will affect the effectiveness and compliance of mask use. Conclusions: Pithy formula intervention and the use of fit test combined with dynamic scene simulation evaluation provided a scientific and operational solution for improving the pass rate of mask wearing and promoted the paradigm shift from 'static compliance' to 'dynamic adaptation' in the field of respiratory protection. (c) 2025 The Author(s). Published by Elsevier Ltd on behalf of The Healthcare Infection Society. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Reis A, Silva V, Joaquim JJ, Valadares L, Matos C, Valeiro C, et al.

Health Effects of Ergonomics and Personal Protective Equipment on Chemotherapy Professionals.

Curr Oncol. 2025;32(10).

https://doi.org/10.3390/curroncol32100563

(1) Background: With the increasing incidence of cancer, the need for handling cytotoxic drugs has also grown. However, manipulating these drugs exposes healthcare professionals to significant risks, including occupational exposure to hazardous chemicals. Therefore, it is important to adopt protective measures, including personal protective equipment (PPE) and correct ergonomic practices, to ensure safe drug preparation and minimize health risks for the operators. However, while chemical exposure and PPE have been extensively addressed in the literature, the combined impact of ergonomic practices and protective measures remains insufficiently emphasized, representing a critical gap this review aims to address. Accordingly, the objective of this literature review was to analyze the ergonomic and individual protection practices during the handling of cytostatic drugs and all the implications that bad ergonomic practices and/or poor individual protection have on the operator's health; (2) Methods: In order to perform this integrative review, a structured literature search was conducted using online databases (Web of Science(®), Google Scholar(®), and PubMed(®)) from January 2005 to June 2025. (3)

Results: A total of 19 articles were analyzed, with 17 focusing on PPE and 17 on ergonomics. The findings emphasize that PPE, such as gloves, masks, gowns, sleeves and safety glasses, plays a critical role in the safe handling of cytotoxic drugs, particularly when combined with other safety measures. Additionally, maintaining correct ergonomic posture is important in preventing musculoskeletal disorders; (4) Conclusions: This review emphasizes the significance of integrating appropriate PPE use with sound ergonomic procedures. Although PPE is still the secondary line of defense against occupational exposure, ergonomic issues must also be addressed to avoid chronic musculoskeletal problems. Continuous training, rigorous attention to safety procedures, and ergonomic enhancements should be prioritized by healthcare facilities as a key element of occupational safety programs to reduce the short-term and long-term health hazards for personnel handling dangerous drugs.

Schwartz A, Mikati S, Knipper F, Vogel AR, Stiegel MA.

Innovation in Personal Protective Equipment Decontamination During the COVID-19 Pandemic: The Powered-Air Purifying Respirator Hood Optimal Decontaminant Distribution System.

Applied biosafety : journal of the American Biological Safety Association. 2025;30(4):306-13.

https://journals.sagepub.com/doi/10.1089/apb.2025.0006

BACKGROUND: The COVID-19 pandemic highlighted critical shortages in personal protective equipment (PPE), particularly respirators, which limited healthcare workers' safety worldwide. Decontamination and reuse of PPE, including powered-air purifying respirators (PAPR) hoods, became essential to mitigate shortages. Conventional methods were inadequate for complete decontamination, prompting innovative solutions. OBJECTIVE: To design and evaluate a novel device, the PAPR Hood Optimal Decontaminant Distribution System (PHODDS), for efficient decontamination of PAPR hoods using hydrogen peroxide vapor, ensuring safety, sustainability, and scalability. METHODS: PHODDS was constructed using polyvinyl chloride tubing to facilitate hydrogen peroxide vapor circulation throughout PAPR hoods. Three PAPR models were tested in incremental batches of one, six, 10, and 20 hoods. Biological and chemical indicators (BIs and CIs) were placed in challenging areas to verify decontamination efficacy. Off-gassing of the decontaminant was assessed over 7 days post-decontamination. RESULTS: Conventional decontamination methods failed to achieve full decontamination, as indicated by positive biological indicator growth and lack of chemical indicator color change. In contrast, PHODDS demonstrated consistent 6-log reduction efficacy across hoods and batch sizes, with BIs and CIs yielding negative results. The retention of H(2)O(2) was minimal, except in some comfort strips. CONCLUSION: PHODDS successfully achieved effective decontamination of PAPR hoods, offering a scalable, cost-effective solution for PPE shortages during a pandemic response. It enables safe PPE reuse, potentially supporting pandemic resilience and environmental sustainability.

Shamrani MA, El-Saed A, Al-Fayez S, Almousa L, Alanazi FK, Alkhodairy M, et al.

Adherence to infection prevention and control best practices in emergency units at a tertiary care hospital, Riyadh.

BMC Emerg Med. 2026.

https://link.springer.com/article/10.1186/s12873-026-01598-5?utm_source=getftr&utm_medium=getftr&utm_campaign=getftr_pilot&getft_integrator=clarivate

BACKGROUND: Emergency department presents a distinctive challenge for implementation infection prevention and control (IPC), due to their complex and dynamic environment, diverse patient population, and unknown carrier status. The objective was to assess the compliance with a number of IPC practices among a group of healthcare workers (HCWs) working in the emergency department.

METHODS: An observational cross-sectional study was conducted at a large emergency department at a tertiary care hospital between 2018 and 2023. Data were gathered during observation sessions using a standardized IPC observation form. Observers were either experienced IPC professionals or trained medical students. RESULTS: Out of 123,947 HCW-specific practices observed, 85,542 (69.0%) were compliant and out of 41,650 unit-specific practices observed, 38,355 (92.1%) were compliant. The compliance was highest in the competence of acute respiratory infection procedures (97.3%), followed by isolation precautions (97.0%), housekeeping (96.8%), disposal of sharps (96.8%), waste management (94.5%), donning and doffing of personal protective equipment (PPE, 72.9%), use of PPE (72.3%), hand hygiene (67.2%), patient sitters (64.1%), and disinfection of medical equipment (61.2%). Nurses across all units had much better compliance than other professions. There were >10% differences in the compliance across the units, with higher compliance in mainly pediatric compared with adult units. The compliance was highest during the COVID-19 pandemic years. CONCLUSIONS: There is considerable variability in implementation of IPC at the emergency department, by practice, profession, unit, and pandemic time. The findings underscore the importance of strategies to improve disinfection of medical equipment, hand hygiene, and adherence of patient sitters.

Sheel M, Talwar A, Smith KJ, Stephens N, Sheehan F, Causer L, et al.

Examination of factors affecting SARS-CoV-2 transmission among healthcare workers following a large healthcare-associated outbreak of COVID-19 in North West Tasmania.

Public Health Res Pract. 2025;35(4):9.

https://doi.org/10.1071/pu24030

Objectives In March 2020, Australia experienced its first large COVID-19 outbreak in a healthcare setting when two persons who had returned from cruise ship travel were admitted to a hospital in North West Tasmania, leading to sustained severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission among healthcare workers (HCWs) in this hospital and another hospital co-located in the same health precinct. We examined factors influencing SARS-CoV-2 transmission in these hospitals to inform policies and practices that could reduce the risk of future outbreaks.Methods Using the results of a survey and SARS-CoV-2 testing of HCWs who attended work at one or both hospitals during the exposure period (20 March to 13 April 2020), we assessed the association of demographic variables, work-related variables, and the average score for each of three infection prevention and control (IPC) measures (hand hygiene, personal protective equipment [PPE] donning and doffing, and personal distancing) with being a COVID-19 case using logistic regression.Results Of the 1779 HCWs invited to participate in the survey, 410 responded, of which 125 met the inclusion criteria for our analysis. On multivariable regression analysis, HCWs who were aged 31-50 years (odds ratio [OR] = 0.12 [95% confidence interval (CI): 0.03, 0.48]) or 51+ years (OR = 0.17 [95% CI: 0.04, 0.68]) had significantly lower odds of being a COVID-19 case when compared with HCWs who were aged 30 years or less, whereas those who worked part time (OR = 0.29 [95% CI: 0.08, 0.91]) had significantly lower odds of being a COVID-19 case when compared with HCWs who worked full time. HCWs having direct care of a COVID-19-positive patient (OR = 5.42 [95% CI: 1.65, 20.8]) had significantly higher odds of being a COVID-19 case when compared with HCWs without direct care of a COVID-19-positive patient. The IPC measures showed no significant association with COVID-19 case status.Conclusions Our study identified important associations between COVID-19 acquisition and age, work frequency, and direct contact with COVID-19 patients. However, the small sample size of IPC measures meant our study was inadequately powered to determine the significance of these associations with COVID-19 acquisition.

Sheikh F, Dolovich M, Schwartz L, Khan S, Hosseinidoust Z, Fox-Robichaud AE.

Evaluating N95 respirator designs: A mixed-methods pilot and feasibility study.

PloS one. 2025;20(12):e0328746.

https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0328746&type=printable

BACKGROUND: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has had a global impact, underscoring the importance of personal protective equipment (PPE). Use of N95s reduces the risk of airborne infection; however, in the absence of equitable designs, health care workers (HCWs) who do not fit the average White male head and face are at an increased risk of airborne infectious diseases. OBJECTIVES: Primary: Feasibility of a mixed-method study, with a sample size of 100, 50% of participants self-identifying as non-White and having at least one characteristic of interest. Secondary: (1) Generate quantitative evidence on N95 fit using a PortaCount fit test, (2) describe participant-reported feelings on fit and breathability, and (3) evaluate the impacts of the pandemic on a HCW's physical and mental well-being. METHODS: This was a mixed-method prospective pilot and feasibility study. Quantitative fit was assessed using a TSI PortaCount test and measurements of bizygomatic breadth and Menton-Sellion length. A survey was administered to collect sociodemographic information, HCWs' assessment of N95 fit, comfort, and the impact of PPE-related challenges on well-being. RESULTS: This study was limited by a small sample size, as COVID-19 pandemic restrictions prevented adequate recruitment to detect differences between groups. We describe key findings that should inform analyses of the impact of gender and ethnicity on N95 respirator fit. Following a study amendment to increase eligible sites, 37 of the 41 (90.2%) approached HCWs consented to participate. Compared to other HCWs, non-White females had the lowest mean fit factor. Differences in Menton-Sellion length and bizygomatic breadth were observed between males, females, and White and non-White HCWs. Most HCWs reported physical discomfort and negative impacts on their psychological well-being. CONCLUSIONS: We identified gender and ethnicity as key factors in the fit of N95s. Differences in gender, ethnicity, and anthropometric measures must be considered in respirator designs.

Vasilopoulos T, Smith CR, Frantz AM, LeMaster T, Martinez RA, Gunnett AM, et al.

Long-term retention following best practices instruction for proper donning and doffing of personal protective equipment.

Am J Infect Control. 2026.

https://doi.org/10.1016/j.ajic.2026.01.011

BACKGROUND: The recent history of viral global epidemics highlights the importance of teaching the proper use of personal protective equipment (PPE) for personal safety and infection prevention. The present study evaluated long-term retention of knowledge for proper donning and doffing of PPE following face-to-face and video instruction. METHODS: Three cohorts of residents were examined, with long-term retention assessment occurring in subsets of each cohort at least 7 months following initial training. Without instruction, the anesthesiology residents donned appropriate PPE and then sprayed with Glo Germ before doffing to identify areas of contamination. Following instruction, the process was repeated both immediately post-training and at long-term follow-up. RESULTS: Twenty-three participants completed long-term assessment. Overall donning compliance from post-training to long-term retention did not change significantly (mean difference = -4.5%; 95% CIs: -10.7%, 1.7%; P = .105); however, doffing compliance decreased significantly (mean difference = -20.7%; 95% CIs: -28.1%, -13.4%; P < .001). Contamination rates of multiple sites increased by 17.4% (P = .248), though did not reach statistical significance. CONCLUSIONS: At long-term follow-up, there was a higher retention of proper donning with a decay of knowledge with doffing. It is important to implement educational maintenance programs, not single courses, for healthcare workers to prevent contamination during these common, highly virulent epidemics.

Yang W, Myers WR, Ryan KJ, Zheng L, Zhang Y, Li X.

Source control with masks and respirators in hospitals: exhalation aerosol shedding, jet suppression, and near-/far-field persistence.

Journal of Hospital Infection. 2026;170:236-45.

https://doi.org/10.1016/j.jhin.2026.01.024

Background: Infectious exhalation aerosol source control using masks and respirators in hospitals depends on the aerosol shedding and its dispersion. Methods: In a simulation study with a headform, we used a leakage testing system for total outward leakage (TOL) and count median diameter (CMD) and a separate hood for horizontal exhalation-jet velocity at 1, 2, and 3 ft (0.30, 0.61, 0.91 m). Neutralised NaCl aerosols were generated to mimic human exhalation shedding. Five devices for source control - surgical mask (SM), non-valved N95 filtering facepiece respirator (N95 FFR), valved N95 (FFRV), elastomeric half-mask respirator (EHMR), and EHMR with an SM overlay (EHMRSM) - were tested under three faceseal conditions (0%, 50%, and 100%) and three flow rates (17, 28, 39 L min(-1)). We derived a near-field (NF) emission index and a far-field (FF) persistence index. Results: Device type significantly affected TOL and CMD (P < 0.01). The N95 FFR minimised TOL (approximate to 5-9%) and eliminated horizontal jets, yielding near-zero NF and the lowest FF. The EHMR had the highest TOL (approximate to 82-88%) and persistent jets, producing the largest NF and FF; FFRV was intermediate. The SM and EHMRSM collapsed jets (NF approximate to 0) but retained moderate to high TOL, sustaining elevated FF. Leaked particles were predominantly submicron (CMD approximate to 0.42-0.61 mu m). Conclusions: Gravitational loss (approximate to 0.02-0.05 h(-1)) is negligible compared with clinical ventilation to clean leaked aerosols, yielding orders of magnitude longer clearance times, so settling alone cannot deliver timely clearance. In practice, low-leakage devices - preferably non-valved N95s - should be paired with adequate air-change rates. (c) 2026 The Healthcare Infection Society. Published by Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

Yang W, Park B, Kim MS, Sarcevic A, Anwar SM, Linguraru MG, et al.

SAFE: A Smart Adherence Detection Framework for Monitoring Personal Protective Equipment in Healthcare Settings.

IEEE J Biomed Health Inform. 2026;Pp.

https://ieeexplore.ieee.org/document/11386895/

Personal protective equipment (PPE) is critical for infection control in healthcare, protecting workers and patients from infection risks. The COVID-19 pandemic further highlighted the importance of correct PPE use, yet adherence to U.S. Centers for Disease Control and Prevention guidelines remains inconsistent. Continuous human monitoring of PPE adherence is impractical because it is labor-intensive and may expose observers to infection risk. Automated monitoring is a promising alternative, but reliable PPE assessment in clinical videos remains difficult due to occlusion and subtle differences between adherence levels. To address these challenges, we propose SAFE - Smart Adherence detection Framework for PPE, a cascaded computer vision system for real-time monitoring of PPE wearing status, including complete, incomplete, and absent cases, with a focus on gowns and masks. SAFE uses a two-stage design: Stage 1 detects gown status and localizes head regions, and Stage 2 classifies mask status from head crops. We evaluate SAFE on R2PPE, a ceiling-view trauma-room simulation dataset with dense PPE annotations and complex scenes. SAFE improves overall average precision from 0.48 to 0.67 and increases mask-class average precision by 0.33 compared to a baseline one-stage detector. We further validate SAFE across modern detector backbones, including transformer-based detectors, and

on real-case trauma-room data using class-level and alarm-level criteria, improving class-level mask accuracy from 0.59 to 0.65 while maintaining a high alarm-level recall of 0.98. SAFE could enhance PPE monitoring with minimal human intervention, providing a scalable solution for improving infection control in healthcare settings.

- ## Protection respiratoire : fièvres hémorragiques, Ebola

Muzembo BA, Hayashi C, Kitahara K.

Poor preparedness of congolese healthcare workers for Ebola during the 10th outbreak (2018-2020).

Industrial health. 2026;64(2):202-10.

https://www.jstage.jst.go.jp/article/indhealth/64/2/64_2025-0020/_pdf

We conducted a hospital-based survey among frontline healthcare workers (HCWs) in This study aimed to assess HCWs' knowledge, preparedness, and practices regarding the management of suspected Ebola cases, considering the challenges faced by hospitals in Kinshasa. A total of 290 HCWs from 72 healthcare facilities participated in the study (response rate: 83.0%). While all HCWs were aware of Ebola, significant knowledge gaps were identified, particularly regarding transmission routes and clinical symptoms. Only 16% of the participants had received formal Ebola training, and those who received training reported greater confidence in managing suspected cases. Notably, only 28% of HCWs were aware that Ebola could be transmitted through traditional funeral ceremonies and 34% were aware of transmission through contact with contaminated clothing. Adherence to standard precautions, such as hand hygiene (72%) and glove use (63%), was suboptimal, and 47% of the healthcare facilities lacked designated triage areas. These findings emphasize the need for targeted training, better adherence to precautions, and reinforced healthcare infrastructure. Addressing knowledge gaps, especially regarding transmission through funeral practices and contaminated clothing, and enhancing frontline HCWs' preparedness are crucial for improving responses to future Ebola outbreaks and other emerging infectious diseases.

Ngatu NR, Kanbara S, Wansu-Mapong C, Tonduangu DK, Leon-Kabamba N, Nsadi-Fwene B, et al.

Occupational Infection Prevention Among Nurses and Laboratory Technicians Amidst Multiple Health Emergencies in Outbreak-Prone Country, D.R. Congo.

Trop Med Infect Dis. 2026;11(1).

https://doi.org/10.3390/tropicalmed11010014

Millions of healthcare workers experience percutaneous exposure to bloodborne communicable infectious disease pathogens annually, with the risk of contracting occupationally acquired infections. In this study, we aimed to assess the status of occupational safety and outbreak preparedness in Congolese nurses and laboratory technicians in Kongo central and the Katanga area, amidst multiple ongoing public health emergencies in the Democratic Republic of the Congo (DRC). This was a multicenter analytical cross-sectional study conducted in five referral hospitals located in Kongo central province and the Katanga area between 2019 and 2020 amidst Ebola, Yellow fever, Cholera and Chikungunya outbreaks. Participants were adult A0 grade nurses, A1 nurses, A2 nurses and medical laboratory technicians (N = 493). They answered a structured, self-administered questionnaire related to hospital hygiene and standard precautions for occupational infection prevention. The majority of the respondents were females (53.6%), and 30.1% of them have never participated in a training session on

hospital infection prevention during their career. The proportions of those who have been immunized against hepatitis B virus (HBV) was markedly low, at 16.5%. Of the respondents, 75.3% have been using safety-engineered medical devices (SEDs), whereas 93.5% consistently disinfected medical devices after use. Moreover, 78% of the respondents used gloves during medical procedures and 92.2% wore masks consistently. A large majority of the respondents, 82.9%, have been recapping the needles after use. Regarding participation in outbreak response, 24.5% and 12.2% of the respondents were Chikungunya and Cholera epidemic responders, respectively; 1.8% have served in Ebola outbreak sites. The proportion of the respondents who sustained at least one percutaneous injury by needlestick or sharp device, blood/body fluid splash or both in the previous 12-month period was high, 89.3% (41.8% for injury, 59.2% for BBF event), and most of them (73%) reported over 11 events. Compared to laboratory technicians, nurses had higher odds for sustaining percutaneous injury and BBF events [OR = 1.38 (0.16); p < 0.01], whereas respondents with longer working experience were less likely to sustain those events [OR = 0.47 (0.11); p < 0.001]. Findings from this study suggest that Congolese nurses and laboratory technicians experience a high frequency of injury and BBF events at work, and remain at high risk for occupationally acquired infection. There is a need for periodic capacity-building training for the healthcare workforce to improve infection prevention in health settings, the provision of sufficient and appropriate PPE and SEDs, post-exposure follow-up and keeping records of occupational injuries in hospitals in Congolese healthcare settings.

Oisakede EO, Asogun D, Otaigbe O, Iyoriobhe I, Erhieyovwe EO, Emorinken A, et al.

Assessment of healthcare worker preparedness and health literacy for Marburg virus disease in Nigeria: A cross-sectional study.

South Afr Infect Dis. 2026;41(1):7.

https://sajid.co.za/index.php/sajid/article/download/764/2001

Background: Marburg virus disease (MVD) poses an emerging threat to Nigeria, particularly following the 2022 outbreak in neighbouring Ghana. With Nigeria already managing Lassa fever and Mpox outbreaks, assessing healthcare workers' preparedness at viral haemorrhagic disease reference centres is crucial for effective outbreak response. Objectives: This study aimed to assess healthcare workers' knowledge, attitudes and preparedness regarding MVD at Nigeria's primary viral haemorrhagic fever reference centre. Method: A cross-sectional study was conducted at Irrua Specialist Teaching Hospital, from May 2024 to October 2024. Healthcare workers were recruited using simple random sampling and data collected via semi-structured questionnaires. Descriptive and inferential statistics were analysed using Stata 17. Results: Of the 216 participants, 126 (58.3%) were doctors and 90 (41.7%) were nurses. Doctors demonstrated significantly higher knowledge of MVD symptoms (65.9% vs 46.7%, p < 0.001) and risk factors, with fever being the most recognised symptom (68.0%). Only 19.1% of doctors and 10.0% of nurses had received formal MVD training. Confidence in hospital preparedness was paradoxically lower among doctors (32.5%) than nurses (65.6%, p < 0.001). Most participants felt inadequately equipped with personal protective equipment, with only 38.1% of doctors and 48.9% of nurses reporting adequate protection. Conclusion: Significant gaps exist in MVD health literacy and outbreak preparedness among Nigerian healthcare workers at a major viral haemorrhagic disease centre. Contribution: Enhanced training programmes, improved resource allocation and systematic preparedness protocols are urgently needed to strengthen Nigeria's capacity for MVD outbreak response.

• Zoonoses : pathologies émergentes

Ameen KAH, Alyousuf AS, Salh BA, Obaid HM, Aakef IR.

Active transmission of Crimean-Congo Hemorrhagic fever virus, a tick-borne disease, in Iraq: Animal host population movement dynamics and retrospective case study analysis (2018-2023).

Res Vet Sci. 2026;200:10.

https://doi.org/10.1016/j.rvsc.2025.106021

This study is a retrospective and descriptive cross-sectional analysis examining demographic and epidemiological data of Crimean-Congo Hemorrhagic Fever Virus (CCHFV) in Iraq, covering confirmed cases from January 2018 to December 2023. Utilizing data from the Iraq CDC/zoonotic department, 1001 cases were analyzed and confirmed via Real-time PCR and ELISA tests at the Central Public Health Laboratory. The study highlights the climatic conditions of Iraq, with its semi-arid and semi-tropical climate influencing disease prevalence. Results indicate a significant gender disparity in CCHFV cases, with 59.4 % male and 40.6 % female patients, suggesting differing exposure and susceptibility between genders. The age distribution shows higher infection rates among individuals aged 22 to 51, potentially linked to occupational exposure and outdoor activities. A notable increase in reported cases was observed in 2022 and 2023, accounting for 38.0 % and 58.6 % of total cases, respectively. This surge may be attributed to environmental and socio-economic factors, including climate change, urbanization, and population displacement. Geographic analysis reveals that provinces like Thiqar, Baghdad, Basra, and Misan report higher case numbers, indicating regional hotspots for CCHFV transmission. Risk factor analysis emphasizes the role of direct contact with raw meat, animal slaughtering, and tick bites as significant contributors to infection. The study also identifies key symptoms associated with poor prognosis, such as bleeding from injection sites, body orifices, and echymosis, which are significantly correlated with higher mortality rates. These findings underscore the need for targeted public health interventions, including enhanced surveillance, vector control, and public education, particularly in high-risk regions. Understanding the epidemiology and risk factors of CCHFV is crucial for developing effective prevention and control strategies to mitigate the impact of this disease in Iraq.

Arockiaraj J, Subramanian A, Nagarajan LS, Amritanand R, Prakash JAJ, Krishnan V.

Spinal brucellosis - A mimicker of spinal tuberculosis: An analysis of 10 patients from a tertiary care center in India.

J Craniovertebral Junction Spine. 2026;17(1):23-9.

https://doi.org/10.4103/jcvjs.jcvjs_168_25

Introduction:Brucellosis of the spine has emerged as a significant health concern in developing countries. Spinal brucellosis shares identical clinical and radiological features with tubercular spondylodiscitis. A wide range of nonspecific symptoms, chronicity of this disease, and tissue culture which is mostly invasive and time-consuming, pose a challenge in definitive diagnosis. In this study, we aim to report the clinical, radiological, and microbiological features of this disease and analyze the outcome of patients treated for spinal brucellosis.Materials and Methods:This retrospective study was conducted from 2018 to 2022 on confirmed cases of brucellosis of the spine who had adequate follow-up of at least 2 years after completion of treatment.Results:In this retrospective analysis, 10 patients had spinal brucellosis. All of them had presented with chronic history of low back pain for a period of 3-6 months. Occupational exposure was present in six patients (60%). Five (50%) of them underwent

surgical intervention due to failed/doubtful diagnosis. Except for one patient, microbiological evidence of the infection was seen within 10 days from the tissue biopsy. All patients were treated with a triple regimen (gentamycin, doxycycline, and rifampin) for a period of 3 months as per World Health Organization protocol. All patients were healed of the disease with good functional outcome.Conclusion:Culture, either blood or tissue, is the gold standard method for diagnosis of this zoonotic disease. Only 50% of the study patients underwent surgical debridement. All patients in the study had good outcome with 3 months of antibiotic therapy.

Chen-Germán M, González C, Araúz D, Aguilar C, Vega M, Chavarria O, et al.

Detection of Oropouche and Punta Toro Virus Infections by Enhanced Surveillance, Panama, 2023–2024.

Emerging Infectious Disease journal. 2026;32(1):114.

https://wwwnc.cdc.gov/eid/article/32/1/25-1224_article

https://wwwnc.cdc.gov/eid/article/32/1/pdfs/25-1224.pdf

Enhanced arboviral surveillance in Panama revealed an Oropouche virus case, 5 months before the 2025 national outbreak, in samples that tested negative for routinely screened arboviruses. Subsequent contact tracing identified an additional case of Punta Toro virus. Our findings highlight the importance of expanding diagnostic efforts to identify circulating arboviruses.

Cuéllar-Sáenz JA, Rodríguez-Morales A, Faccini-Martínez Á.

Reemergence of Yellow Fever, Magdalena Valley, Colombia, 2024–2025.

Emerging Infectious Disease journal. 2025;31(12):2216.

https://wwwnc.cdc.gov/eid/article/31/12/25-1209_article

https://wwwnc.cdc.gov/eid/article/31/12/pdfs/25-1209.pdf

Yellow fever, a zoonotic arboviral disease, has reemerged in Colombia, triggering a major outbreak in the country. During 2024 through mid-2025, a total of 132 human cases and 68 infections in nonhuman primates were confirmed, primarily in the department of Tolima, historically considered a low-risk area. We analyzed the historical and current epidemiology of yellow fever in Colombia, highlighting ecologic, social, and surveillance factors that contributed to the outbreak. Low vaccination coverage, insufficient epizootic and entomological surveillance, deforestation, habitat fragmentation, and limited application of One Health approaches have all exacerbated the situation. The high mortality rate of nonhuman primate species indicated a more profound ecologic crisis. Immediate, comprehensive measures, including mass vaccination, genomic surveillance, and integrated One Health frameworks, are urgently needed. Colombia's experience underscores the need to reevaluate risk stratification and preparedness strategies across the Americas to prevent future yellow fever outbreaks in previously unaffected regions.

Cui BB, Ali W, Wan WD, Hu YN, Liu SY, Lai TN, et al.

Worker exposure to bioaerosols from sludge dewatering facilities: risks and mitigations.

Water research. 2026;297:13.

https://www.sciencedirect.com/science/article/pii/S0043135426004112?via%3Dihub

Sludge dewatering process is a major source of bioaerosols in wastewater treatment plants (WWTPs) which can pose significant health risks to on-site workers. While quantitative microbial risk assessment (QMRA) is commonly performed to assess the human health risks, it lacks immediacy in determining on-site risk levels. Alternatively, comparing detected concentrations of bioaerosols with critical concentration standards provides a practical approach. This study investigates Escherichia coli bioaerosol emissions from a sludge dewatering process (or facility) in a municipal WWTP under different working postures, ventilation scenarios, and seasonal conditions. The objective was to estimate a ceiling-type exposure limit (EL) corresponding to acceptable risk levels using Monte Carlo simulation and reverse QMRA. Sensitivity analysis was also used to identify the key input parameters significantly affecting the risk exposure. Results showed that the bioaerosol concentration in poor ventilation was 1.6-1.7 times as large as that in natural ventilation. The respirable fractions (particle size < 4.7 & micro;m) accounted for 78 %-100 % of the total bioaerosol emissions. Opening the windows increased the EL up to 1.6 times higher compared to closed-window conditions under the optimistic scenario. Wearing masks reduced significantly the fraction of bioaerosols inhaled by workers, resulting in derived EL that were one to two orders of magnitude higher (2.24 - 20.10 CFU/m(3)) than those estimated without masks (0.09 - 0.41 CFU/m(3)). Among all parameters, the removal of the respirable fraction by the masks was the dominant contributor to EL estimation. EL benchmarks also varied with seasonal conditions and working postures. Overall, this study provides novel quantitative insights for deriving occupational exposure limits for bioaerosol exposure in dewatering facilities.

de Oliveira FMG, Esteves PA, Mendes RE.

Epidemiological study of hantavirus in Southern Brazil, 2009-2019.

Rev Inst Med Trop Sao Paulo. 2026;68:10.

https://www.scielo.br/j/rimtsp/a/VB7LM8DjmVJ9yJBwYzSjzMh/?lang=en&format=pdf

Brazil has the highest number of hantavirus cardiopulmonary syndrome cases on the American continent, with Santa Catarina being the state with the most notifications. This retrospective longitudinal study aimed to describe the epidemiological profile of 177 hantavirus cases reported in Santa Catarina from 2009 to 2019, using data from the Notifiable Diseases Information System (SINAN). Statistical analyses of socio-demographic, clinical, and epidemiological data revealed that the typical patient was a male of working age with low educational attainment, living in a rural area. The highest incidence occurred in the Santa Catarina West, Midwest, and Mountain regions, strongly associated with agricultural activities. The case fatality rate (CFR) was highest among the 15-19-year age group. Clinical risk factors for death included respiratory signs, increased hematocrit, and the need for mechanical ventilation. Patients who sought early care had a higher CFR, possibly due to the initial difficulty of differentiating hantavirus from other viral diseases. Conversely, regions with higher notification rates showed lower CFRs, suggesting better surveillance. This study highlights critical areas for public health intervention and the key characteristics of hantavirus patients (males in rural areas and adolescents aged 15-19 years in regions with low notification rates) and areas for public health intervention. Training for medical professionals in regions with low notification rates should aim to reduce lethality, especially in regions with low reported cases (Itajai river delta and South), where underreporting may be occurring. Furthermore, the high lethality in adolescents and in patients with non-specific initial symptoms requires greater awareness. This study shows the utility of a governmental database in identifying epidemiological patterns and creating public health strategies tailored to regional specificities.

Gaber D, Prusinski M, Hodge A, White A, Santoriello M, Romano C, et al.

Tularemia in New York, USA, 1993–2023.

Emerging Infectious Disease journal. 2026;32(1):142.

https://wwwnc.cdc.gov/eid/article/32/1/25-0854_article

https://wwwnc.cdc.gov/eid/article/32/1/pdfs/25-0854.pdf

During 1993–2023, health officials in New York, USA, received reports of 30 tularemia cases. Of those, 43% were from Suffolk County, 69% were diagnosed during 2014–2023, and 1 person died. Tick surveillance detected Francisella tularensis in 1 pool of nymphs from Suffolk County, indicating localized risk.

Ghai A, Balaga DL, Vedachalam SK, Choudhary S, Nayak KC, Biswal M, et al.

Epidemiology and risk factors in a scrub typhus cluster in Odisha, India, 2023: Investigating with a One Health approach.

One Health Outlook. 2026;8(1):10.

https://link.springer.com/content/pdf/10.1186/s42522-026-00200-z.pdf

Introduction Scrub Typhus accounts for approximately one-fourth of all acute undifferentiated febrile illness cases in India. In September 2023, Odisha, an eastern Indian state, reported several scrub typhus deaths. We investigated a scrub typhus cluster in Block-A, Odisha, to describe the epidemiology and assess risk factors. Methodology We conducted an unmatched (1:1) case-control investigation. Line-list of scrub typhus IgM-ELISA tested individuals was collected from the district laboratory. Cases were defined as scrub typhus IgM-ELISA positive residents of Block-A between July1 and October30, 2023 and controls were test-negative block-A residents. We interviewed cases and controls from list of tested individuals for socio-demographic, clinical and exposure histories. We present adjusted-odds ratio and 95% confidence intervals. We conducted an entomological survey in Block-A, isolated mites to detect pathogen and strain (47kDa Real Time PCR) and report entomological indices. Results Total 151 cases were reported in 2023 in Block-A, with case-fatality rate of 2.6%, median age 30 years, and inter-quartile range 15-46 years. Among the 61 interviewed cases, 46% were hospitalised, 13% admitted in ICU, 16% visited health-facility in second week of symptom onset and 30% were tested in second week of symptom-onset. We enrolled 61 cases and 61 controls, among whom recent farm/forest visit was significantly associated [adjusted OR = 6.1, 95%CI: 2.0-18.4] with illness on multivariate analysis. Chigger-index for block-A was 18.94(322/17); 36%(4/11) of tested mite-pools were positive for Orientia tsutsugamushi and sequences were identified to be Karp-like. Conclusion sOur investigation confirmed a lab-verified scrub typhus cluster in Block-A, identifying farm/forest visits without protective clothing as the most significant factor for acquiring infection. Detection of infected vector, hosts, and pathogen completed the epidemiological triad of scrub typhus, establishing local transmission in Block-A. We sensitised frontline-healthcare workers on early identification and timely referral, recommended community education on limiting mite exposure and seeking timely medical attention.

Hatta Y, De La Cruz J, Murray T, Hiatt B, Jang Y, Frederick J, et al.

Highly Pathogenic Avian Influenza A(H5N1) Clade 2.3.4.4b Virus Infection in Poultry Farm Workers, Washington, USA, 2024.

Emerging Infectious Disease journal. 2025;31(12):2297.

https://wwwnc.cdc.gov/eid/article/31/12/25-1118_article

https://wwwnc.cdc.gov/eid/article/31/12/pdfs/25-1118.pdf

Poultry workers in Washington, USA, were infected with highly pathogenic avian influenza A(H5N1) virus and recovered. The viruses were clade 2.3.4.4b genotype D1.1, closely related to viruses causing poultry outbreaks. Continued surveillance and testing for influenza A(H5) clade 2.3.4.4b viruses remain essential for risk assessment and pandemic preparedness of zoonotic influenza viruses.

Helleren R, Fløystad HK, Tellefsen OA, Boskovic M, Skraastad T, Mengshoel AT, et al.

Severe Respiratory Diphtheria-Like Illness Caused by Toxigenic Corynebacterium ulcerans.

Emerging Infectious Disease journal. 2026;32(2):285.

https://wwwnc.cdc.gov/eid/article/32/2/25-0908_article

https://wwwnc.cdc.gov/eid/article/32/2/pdfs/25-0908.pdf

We report a possible zoonotic case of severe diphtheria-like respiratory illness in Norway caused by a previously unreported toxigenic Corynebacterium ulcerans sequence type. This case highlights C. ulcerans as an emerging pathogen that can cause life-threatening disease. Clinicians should be aware of C. ulcerans infection, even in regions where diphtheria is rare.

Kästner C, Taeger D, Schneider S, Behrens T, Esmann L.

Analysis of Recognized Occupational Infectious Diseases in Germany Between 2018 and 2023.

Journal of Occupational and Environmental Medicine. 2025;67(12):e827-e34.

https://doi.org/10.1097/jom.0000000000003498

ObjectiveOccupational infections pose substantial health risks across various professional sectors. Understanding their precise diagnoses, severity and distribution among different occupations is crucial for effective prevention.MethodsData on recognized occupational diseases from the German Social Accident Insurance (DGUV, 2018-2022) and the Social Insurance for Agriculture, Forestry and Horticulture (SVLFG, 2019-2023) were analyzed by pathogens, occupations, and reduction in earning capacity. SARS-CoV-2 infections were excluded.ResultsThe majority of recognized infectious occupational diseases (71.5%) occurred in health care, welfare, or laboratories. Among these, parasitic diseases (57%) and tuberculosis (35%) were dominating. Among zoonoses, Borrelia burgdorferi was the most frequent pathogen (41% and 58%, respectively). Plasmodium falciparum dominated among the tropical diseases (52%).ConclusionsSpecific pathogens and occupational sectors are responsible for most of the occupational diseases, with the majority being not vaccine preventable. Prevention should therefore focus on organizational and technical measures as well as nonpharmaceutical interventions.

Labana R.

Rethinking Leptospirosis Prevention, the Philippines.

Emerging Infectious Disease journal. 2026;32(3):397.

https://wwwnc.cdc.gov/eid/article/32/3/25-1250_article

https://wwwnc.cdc.gov/eid/article/32/3/pdfs/25-1250.pdf

Leptospirosis, the disease caused by infection with Leptospira spp. bacteria, remains a recurring public health challenge in the Philippines, particularly during monsoon floods and typhoon seasons. Despite responsive measures, such as Code White Alerts, standardized treatment protocols, and postflood prophylaxis, cases and associated deaths persist, emphasizing the limitations of reactive strategies. Structural challenges in flood control, urban sanitation, and rodent management hinder long-term prevention. This policy review applies a systems thinking approach to integrate national programs with community-led interventions, recognizing the interlinked roles of environmental management, behavioral change, and grassroots surveillance. Low-cost, context-sensitive actions, such as community drainage clearing, shared protective gear, local rodent-proofing, and barangay-level reporting, can address immediate risks while reinforcing structural initiatives. Embedding those actions within a feedback loop between local actions and national policies fosters resilience, reduces disease incidence, and shifts the paradigm from reactive response to sustainable prevention.

Mapunda L, Beyanga M, Moremi N, Hakizimana J, Kamori D, Chacha A, et al.

Genomic Insights into Marburg Virus Strains from 2023 and 2025 Outbreaks in Kagera, Tanzania.

Emerging Infectious Disease journal. 2026;32(1):55.

https://wwwnc.cdc.gov/eid/article/32/1/25-1314_article

https://wwwnc.cdc.gov/eid/article/32/1/pdfs/25-1314.pdf

Marburg virus (MARV) is the primary cause of Marburg virus disease (MVD), a severe hemorrhagic fever with a high case-fatality rate. The first reported MVD outbreak in Tanzania occurred in 2023, followed by a second outbreak in 2025, both within the Kagera region. During those MVD outbreaks, 174 suspected cases were identified; of those, 10 were laboratory confirmed. After complete genome assembly and bioinformatic analyses, we found the MARV strains of the 2023 and 2025 outbreaks to be closely related and clustered with MARV strains that caused outbreaks in Rwanda (2024) and Uganda (2014). The sequences from both MVD outbreaks in Tanzania showed >99.71% nucleotide identity, suggesting a possible single spillover event followed by limited human-to-human virus transmission. Further ecologic studies are essential to identify potential spillover events, but our findings indicate that closely related MARV strains circulate in Kagera, Tanzania, posing a risk for future outbreak recurrence.

McNulty MA, Agosto ER.

Infection Risk From Humans and Animals in the Anatomy Laboratory: A Scoping Review.

Clin Anat. 2026;39(3):346-67.

https://onlinelibrary.wiley.com/doi/pdfdirect/10.1002/ca.70049?download=true

Whole-body dissection is a cornerstone of anatomy education. During and following the COVID-19 pandemic, exposure to infectious agents and other risks of dissection were highlighted. To identify potential risks, one must have the data outlining these risks in specific situations. However, information regarding the risks of encountering an infectious pathogen in donors is not readily available for educators and anatomical programs and there are presently no universal guidelines for lowering the risk of exposure to such pathogens. Therefore, this scoping review aims to provide information regarding infectious pathogens that one may encounter in the anatomy lab when engaging in dissection of both humans and animals, including zoonoses (e.g., rabies), blood-borne pathogens (e.g., HIV, HPV), and pathogens that pose a relatively less serious risk to the health of dissectors (e.g., fungal infections). A systematic and comprehensive search across PubMed/MEDLINE, Scopus, and ERIC

databases without date restrictions was performed. When data were available, the prevalence of these pathogens within the worldwide population, viability in cadavers and the surrounding laboratory environment, and effects of formaldehyde fixation on pathogen infectivity are provided. This review also provides examples of mitigation methods and their effectiveness in reducing the risk of exposure to pathogens in the anatomy laboratory as published in the literature. A summary of potential toxicological hazards encountered in the lab is also included. Overall, this scoping review charts existing literature to provide information that anatomy programs worldwide can utilize to identify potential risks and identify mitigation methods to reduce such risks while dissecting.

Moracanin SMV, Kureljusic BI, Maletic J, Kureljusic JM, Jezdimirovic NV, Vasic AM, et al.

Hepatitis E in Wildlife: Emerging Threats to Human Health.

Vet Sci. 2026;13(2):20.

https://doi.org/10.3390/vetsci13020160

Hepatitis E virus (HEV) is a significant public health concern and a leading cause of acute viral hepatitis worldwide. In recent years, HEV has been increasingly recognized as a wildlife-associated zoonotic pathogen, with numerous free-ranging species contributing to its maintenance and transmission. While domestic pigs remain the primary reservoir for human infection globally, growing evidence indicates that wild animals, particularly wild boars, cervids, lagomorphs, rodents, and carnivores, play a critical role in the ecology of HEV. Wild boars are the principal wildlife reservoir, with HEV seroprevalence in Europe ranging from less than 5% to more than 50%, including some of the highest levels reported in the Balkans. In addition to the frequent detection of HEV RNA in wild boar liver and muscle, viral RNA has also been identified in several other game species, most consistently in red deer, roe deer, and, in some regions, hares and wild rabbits, highlighting food safety risks associated with the consumption of raw or undercooked game meat. In regions such as the Balkans, where hunting activities and handling of wild game are widespread, these practices may further increase occupational and dietary exposure to HEV. Rodents may further complicate the epidemiological landscape through environmental contamination of water, soil, and farm surroundings, thereby facilitating indirect transmission pathways. As wildlife populations expand and human-animal interfaces intensify, understanding HEV dynamics in free-ranging species is essential for assessing zoonotic risks and implementing a strengthened One Health approach. This narrative review synthesizes and critically examines current evidence on HEV prevalence, molecular characteristics, and transmission pathways in wildlife, with particular emphasis on Europe and focused consideration of the Balkans as an epidemiologically heterogeneous and underrepresented subregion; examines associated public health implications; and highlights the importance of integrating wildlife into food safety and One Health surveillance frameworks. Existing knowledge gaps and limitations in wildlife surveillance are also discussed.

Moreira G, Almeida D, Cruz R, Vasconcelos-Nobrega C, Santos C, Coelho C, et al.

Toxoplasma Gondii In Shepherds and Cheesemakers - A Case-Control Study on Sheep-Associated Occupational Exposure in Central Portugal.

Journal of Agromedicine. 2026;31(2):235-41.

https://www.tandfonline.com/doi/pdf/10.1080/1059924X.2025.2591051

ObjectivesThe primary objective of this study was to determine if workers occupationally exposed (WOE) to sheep, specifically shepherds and cheesemakers in central Portugal, are more likely to be seropositive for anti-Toxoplasma gondii IgG compared to the general population. Additionally, the study aimed to explore potential differences in seropositivity between shepherds and cheesemakers,

while evaluating age, gender, and activity as possible risk factors for T. gondii infection.MethodsA total of 96 WOE, including 21 shepherds and 75 cheesemakers, were tested for anti-T. gondii IgG using a commercial enzyme-linked immunosorbent assay (ELISA). The control group consisted of 192 sera samples from blood donors matched by age, gender, and residence. Chi-square tests with Yates correction were used to compare seroprevalence between WOE and the general population, and between shepherds and cheesemakers. Univariate and multivariable logistic regression analyses were performed to evaluate potential associations between T. gondii seropositivity and factors such as activity, gender, and age.ResultsThe overall seroprevalence was 63.5% in the WOE and 52.6% in the general population, with no statistically significant difference (p = .101). Among WOE, 52.4% of shepherds and 66.7% of cheesemakers were seropositive, with no significant difference between the two groups (p = .344). Univariate and multivariable analyses indicated neither activity, age, nor gender were significant risk factors for seropositivity in the case population.ConclusionThe study did not find a significant increased risk of T. gondii seropositivity among shepherds and cheesemakers compared to the general population. While high seroprevalence was observed in both groups, other factors unrelated to occupational exposure may be influencing the risk of T. gondii infection. More research is needed, particularly focusing on cheesemakers, to further explore potential occupational health risks related to T. gondii.

Robardet E, Smreczak M, Orłowska A, Malik P, Nándori A, Dirbáková Z, et al.

Rabies Reemergence, Central Europe, 2022–2024.

Emerging Infectious Disease journal. 2026;32(2):229.

https://wwwnc.cdc.gov/eid/article/32/2/25-1597_article

https://wwwnc.cdc.gov/eid/article/32/2/pdfs/25-1597.pdf

Oral rabies vaccination campaigns helped eliminate rabies from parts of Europe, but rabies appears to be reemerging. We analyzed 2022–2024 data, which demonstrated reemergence of 2 virus variants; both were detected in Ukraine, Moldova, Poland, and Romania. Our findings highlight the need to strengthen rabies control efforts in the region.

Rysava K, Madewell Z, Thayer M, Sánchez-González L, Muniz-Rodriguez K, Brown A, et al.

Using Routine Surveillance Data to Assess Dengue Virus Transmission Risk in Travelers Returning to the United States.

Emerging Infectious Disease journal. 2026;32(2):202.

https://wwwnc.cdc.gov/eid/article/32/2/25-1217_article

https://wwwnc.cdc.gov/eid/article/32/2/pdfs/25-1217.pdf

Dengue virus poses a growing global health threat, yet inconsistent local surveillance limits global risk assessments. We analyzed 10,530 travel-associated dengue cases among US travelers reported to ArboNET during January 2010–April 2024, involving travel to 128 countries. By using negative binomial and Poisson models, we developed country-specific thresholds (75th, 80th, 90th percentiles) to identify elevated travel-associated dengue risk. We applied a >10-case threshold in a 3-month period to improve specificity. The final dual-criteria method accurately identified high-risk periods, including sustained transmission in countries with limited official reporting, such as Cuba in 2022–2023. Threshold comparisons revealed a tradeoff between early detection and overclassification, whereas real-time and retrospective assessments revealed consistent high-risk signals. This traveler-based

approach offers a timely, complementary method for travel-associated dengue risk detection, although timeliness might be reduced if reporting delays increase beyond our observations. Our findings support integrating travel surveillance into global dengue monitoring and preparedness efforts.

Sultana S, Islam A, Ng J, Dubey SK, Khan MH, Guo C, et al.

Bat Reovirus as Cause of Acute Respiratory Disease and Encephalitis in Humans, Bangladesh, 2022–2023.

Emerging Infectious Disease journal. 2025;31(12):2302.

https://wwwnc.cdc.gov/eid/article/31/12/25-0797_article

https://wwwnc.cdc.gov/eid/article/31/12/pdfs/25-0797.pdf

We report 5 patients in Bangladesh presumed to have Nipah virus infections after consuming raw date palm sap. PCR and serology for Nipah virus were negative, but high-throughput sequencing identified Pteropine orthoreovirus in archived throat swab samples and virus cultures. This batborne virus should be considered in differential diagnosis of Nipah-like illnesses.

Tsai V, Lai YC, Contreras GP, Yeh TY.

Impact of anthropogenic activities on the ecosystem and emergence of bat-borne zoonotic diseases.

Virology. 2026;617:9.

https://doi.org/10.1016/j.virol.2026.110811

About 70 % of zoonotic infectious diseases originate from wildlife reservoirs, particularly bats, primates, and rodents. Bats comprise about 20 % of all known mammal species worldwide and have been identified as reservoir and carrier hosts of various viral disease outbreaks. They also play a crucial role in viral adaptation and evolution. Given this inherent risk, this review focuses on how anthropogenic activities (habitat destruction, agricultural intensification, bushmeat hunting, and occupational exposure) and climate change are increasing the frequency and intensity of bat-human contact. These factors accelerate the emergence and spillover of bat-borne viruses, posing a significant threat to global public health. We also summarize examples from the families Rhabdoviridae, Flaviviridae, Paramyxoviridae, Filoviridae, Reoviridae, Coronaviridae, and Hepeviridae, showing how anthropogenic factors have direct consequences on the spillover of bat-borne zoonotic diseases.

Ueno TEH, Fagundes ND, Gregori F, de Azevedo SS, Yoshihara E, Barrochelo LH, et al.

Epidemiological investigation of Coxiella burnetii in farms after an outbreak of Q fever in slaughterhouse workers.

Comp Immunol Microbiol Infect Dis. 2026;126:13.

https://doi.org/10.1016/j.cimid.2026.102452

Q fever is a worldwide zoonosis caused by the bacterium Coxiella burnetii. In January/2015, a Q fever outbreak occurred among workers at a cattle slaughterhouse in southeastern Brazil. This study investigated if C. burnetii was circulating on farms that sent cattle to the slaughterhouse at the time of the 2015-Q fever outbreak. Blood, milk, vaginal swab and tick samples were collected from livestock on 35 farms surrounding the slaughterhouse. Serological analyses with C. burnetii whole antigens indicated that 68.6 % farms (24/35) had at least one seropositive animal, 76.7 % (23/30) farms had

seropositive cattle, 37.5 % (3/8) had seropositive sheep, 16.7 % (5/ 30) had seropositive horses, and 20.8 % (5/24) had seropositive dogs. The overall seropositivity rates were 18.8 % (96/510) for cattle, 4.1 % (4/97) for sheep, 4.7 % (5/106) for horses, and 12.7 % (8/63) for dogs. Antibody endpoint titers ranged from 64 to 8192 in cattle, and up to 128 in sheep, 256 in horses, and 512 in dogs. Cattle had 1.9 times higher odds of seropositivity compared to other species tested. Pregnant females showed 1.6 times higher odds than non-pregnant ones. Molecular analyses revealed C. burnetii DNA (partial sequences of IS1111 and cap genes) in 0.5 % (1/213) cattle milk samples, and in a Rhipicephalus microplus tick. We conclude that C. burnetii exposure was widespread among livestock in the study region. The highest seropositivity rate in cattle suggests their potential utility as sentinels for monitoring bacterial circulation. C. burnetii DNA was detected in a R. microplus tick in Brazil for the first time.

Vanstreels RET, Nelson M, Artuso M, Marchione V, Piccini L, Benedetti E, et al.

Novel Highly Pathogenic Avian Influenza A(H5N1) Virus, Argentina, 2025.

Emerging Infectious Disease journal. 2025;31(12):2279.

https://wwwnc.cdc.gov/eid/article/31/12/25-0783_article

https://wwwnc.cdc.gov/eid/article/31/12/pdfs/25-0783.pdf

Genomic sequencing of reemerging highly pathogenic avian influenza A(H5N1) virus detected in Argentina in February 2025 revealed novel triple-reassortant viruses containing gene segments from Eurasian H5N1 and low pathogenicity viruses from South and North American lineages. Our findings highlight continued evolution and diversification of clade 2.3.4.4b H5N1 in the Americas.

Weitzel T, Cordero E, Mujica T, Aravena C, Phillips B, Yabsley M, et al.

Human Infection by Zoonotic Eye Fluke Philophthalmus lacrymosus, South America.

Emerging Infectious Disease journal. 2025;31(12):2293.

https://wwwnc.cdc.gov/eid/article/31/12/25-1126_article

https://wwwnc.cdc.gov/eid/article/31/12/pdfs/25-1126.pdf

We report a case of severe conjunctivitis in a traveler infected with a Philophthalmus lacrymosus eye fluke, probably acquired on the Galápagos Islands in Ecuador. This zoonotic parasite is endemic in Brazil and Venezuela, where it has been reported in birds and capybaras.

Xiaoli L, James A, Stahl A, Okumura M, Cole S, Dietrich J, et al.

Genetically Similar High-Risk Strains of Carbapenemase-Producing Enterobacterales in Humans and Companion Animals, United States.

Emerging Infectious Disease journal. 2026;32(3):341.

https://wwwnc.cdc.gov/eid/article/32/3/25-1458_article

https://wwwnc.cdc.gov/eid/article/32/3/pdfs/25-1458.pdf

To elucidate the zoonotic potential of carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE) in US companion animals (i.e., dogs and cats), we queried the National

Center for Biotechnology Pathogen Detection database to identify One Health clusters containing CP-CRE isolates from companion animals and humans. The 11 One Health clusters we found included most (69% [169/246]) publicly available CP-CRE sequences from US companion animals and were from 8 internationally disseminated, high-risk sequence types from 3 bacterial species (Escherichia coli, Klebsiella pneumoniae, and Enterobacter cloacae). All clustered isolates had New Delhi metallo-β-lactamase–family carbapenemases, and most (92%) carried the blaNDM-5 allele. The One Health clusters included several closely related subclusters with geographically linked isolates from both humans and companion animals. Those results suggest that CP-CRE is an emerging One Health issue and that direct or indirect transmission of CP-CRE is occurring between humans and companion animals in the United States.

Zheng HQ, Shankar A, Osis G, Burgin A, Sheth M, Kiani KG, et al.

Identification of Significant Genomic Changes and Compartmentalization of Simian Foamy Virus in a Human Zoonotically Infected by a Chimpanzee (Pan troglodytes troglodytes).

Viruses-Basel. 2026;18(2):21.

https://doi.org/10.3390/v18020265

Despite increasing reports of zoonotic simian foamy virus (SFV) infections globally, knowledge of its genetic adaptation in humans and impact on viral transmission and pathogenicity remains limited. We obtained complete SFV genomes using metagenomics analysis of viral isolates from peripheral blood lymphocytes (PBLs) and throat specimens from a worker (Case 6) and source chimpanzee (B1) that bit him. We analyzed viral diversity in three genomic regions (LTR, tas, and bet) involved in replication and latency using longitudinal specimens (PBLs, throat, saliva, urine, and semen) from Case 6 over five years, and PBLs from B1 and five additional chimpanzees over three years. Proviral loads were measured using a validated qPCR assay. Phylogenetic analysis revealed nearly identical SFV genomes in Case 6 and B1. Overall, bet sequences exhibited high genetic stability across body compartments and over time, with evidence of compartmentalization in Case 6 urine and semen specimens. G -> A substitutions in GG and GA motifs in bet indicated heterogeneous APOBEC-associated editing across hosts and anatomical compartments following zoonotic transmission. Case 6 had significant deletions in the LTR region that were absent in B1 and other chimpanzees. Length variation in tas, including truncated forms, was observed across longitudinal specimens from Case 6, B1, and other chimpanzees. Proviral loads were consistently low and undetectable in most Case 6 urine specimens. Together, analysis of this SFV transmission pair identifies genomic changes likely to affect viral replication and persistence, highlighting mechanisms that may limit secondary transmission and pathogenicity of SFV in humans.

• Légionellose

Dunn KH, Rinsky JL, Burton N, Feldmann K, Acosta AM, Mohamed HM, et al.

Remediation of novel sources linked to an outbreak of Legionnaires' disease in a manufacturing facility.

Journal of occupational and environmental hygiene. 2025:6.

https://www.tandfonline.com/doi/pdf/10.1080/15459624.2025.2589130

In September 2022, public health officials identified a legionellosis outbreak among workers at a manufacturing facility. Upon recognition of the outbreak, public health officials and company management investigated to identify the source and prevent additional cases. Facility management assembled an inventory of potential water sources and worked with a consultant to conduct sampling. Legionella bacteria were cultured from bulk water samples collected from two water jet cutters and a floor scrubber. All other sampling locations had no Legionella identified by culture. Legionellosis cases were distributed throughout the facility. Floor scrubbers were used to clean up water that spilled from the water jet cutters and to clean the floors adjacent to employee work areas. After multiple cycles of cleaning and disinfection of the water jet cutters and floor scrubbers, repeat sampling revealed no Legionella detected. Company management returned the equipment to service in November 2022 with a maintenance, disinfection, and monitoring plan; no additional cases of legionellosis among employees have been reported. Evidence indicates that water jet cutters provided a conducive environment for Legionella growth, while floor scrubbers may have also contributed to employee exposure. This case study describes a remediation plan and illustrates the importance of identifying all potential Legionella sources and maintaining a comprehensive water management program to protect workers from Legionella and other waterborne pathogens.

Dunn KH, Rinsky JL, Burton N, Feldmann K, Acosta AM, Mohamed HM, et al.

Remediation of novel sources linked to an outbreak of Legionnaires' disease in a manufacturing facility.

Journal of occupational and environmental hygiene. 2026;23(4):209-14.

https://www.tandfonline.com/doi/pdf/10.1080/15459624.2025.2589130

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Visan CA, Filip G, Vasile CC, Draganescu AC, Jugulete G, Streinu-Cercel A, et al.

Characteristics of Legionnaires' Disease Cases Hospitalized at a Specialized Infectious Disease Hospital, 2023-2024, with a Focus on Clusters Associated with Travel to a Spa Resort.

Microorganisms. 2026;14(4):16.

https://doi.org/10.3390/microorganisms14040935

Legionnaires' disease is a rare cause of atypical pneumonia associated with a high mortality rate among untreated patients. In Romania, the disease has historically been underreported due to insufficient surveillance and limited diagnostic capacity. The aim of this study was to describe the characteristics of Legionnaires' disease cases admitted to a specialized infectious disease hospital between 2023 and 2024, with a particular focus on a cluster associated with travel to a spa resort. Most cases included in our study (31/36) were confirmed by urinary antigen testing, while one case was confirmed by a significant increase in the level of specific antibodies against Legionella pneumophila serogroup 1 in paired serum samples. The most frequently reported symptom was fever (28/32), followed by chills (24/32). Among the 32 confirmed cases, 3 patients died. Two cases were identified as part of a family cluster involving a father and son who had undergone physiotherapy at a balneary resort. Both patients presented with fever and gastrointestinal symptoms, and radiological investigations confirmed mixed pneumonia associated with an intense inflammatory syndrome. In the father's case, hepatic involvement and interstitial nephritis were also identified. Early diagnosis based on epidemiological data, clinical predictive scores, and laboratory investigations would allow timely administration of targeted antibiotic therapy and may contribute to reduced mortality.

• Endotoxines

Andrup L, Hadrup N, Madsen AM.

Occupational Health Issues in the Seafood Industry Due to Biological Exposures: A Narrative Review.

Safety and health at work. 2025;16(4):387-97.

https://www.sciencedirect.com/science/article/pii/S2093791125000599?via%3Dihub

Climate change, along with the global shift toward more sustainable seafood production, is giving rise to novel occupational exposures. Anticipated changes in the types and quantities of seafood produced, as well as evolving methods of production and processing, are driven by increasing demands for resource efficiency and environmental impact mitigation. Aquaculture, particularly land-based farming of fish and shellfish, is becoming more prevalent and introduces distinct occupational health challenges related to the animals, their associated microorganisms, feed, and production settings. In this literature review, we aim to identify and categorize the occupational exposures that have been reported to adversely affect human health during the handling and industrial processing of fish and shellfish. The primary focus is on biological exposures occurring within processing facilities. Bioaerosols, which may contain infectious agents, allergens, or toxins, represent a key area of concern. For the purposes of this review, we group biological exposures into these partially overlapping categories. Consideration is also given to the broader context of the green transition, emphasizing sustainability and recent developments within the seafood industry. We find that the potential for zoonotic transmission is considerable, the risk of occupational asthma and allergies is well-documented, and that workers are exposed to a range of potentially toxic substances. Furthermore, significant developments in seafood production, driven by climate change and the pursuit of more sustainable practices, are likely to introduce new occupational exposures for which the industry may not be fully prepared. (c) 2025 Occupational Safety and Health Research Institute. Published by Elsevier B.V. on behalf of Institute, Occupational Safety and Health Research Institute, Korea Occupational Safety and Health Agency. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/ licenses/by-nc-nd/4.0/).

Gomiero A, Skogerbo G.

From waste to workplace: Airborne microplastics and endotoxins in an indoor industrial environment.

International journal of hygiene and environmental health. 2026;274:9.

https://doi.org/10.1016/j.ijheh.2026.114789

Airborne microplastics (MPs) and endotoxins are emerging occupational hazards, yet their co-occurrence in real workplaces is poorly documented. The study examined combined exposure in sludge-based fertilizer plant, where digestate handling and drying generate both polymer-rich dust and bioaerosols. Personal and stationary air samples were collected with calibrated pumps at three indoor hotspots: conveyor pipe, dryer, loading dock with an outdoor site. Microplastics were extracted in an ultra-clean laboratory and characterized by mu-FTIR imaging. Endotoxin levels were quantified by the LAL assay. Indoor air contained significantly higher MP counts (24-312 MP m(-3)) than outdoor (13 MP m(-3)), dominated by fragment-shaped particles (74%) vs fibres (26%) within the inhalable size fractions. Concentrations peaked near the sludge dryer unit and the conveyor, indicating process-related sources and resuspension of contaminated dust. Endotoxins (<0,7 - 30 EU m(-3)) were consistently above outdoor levels and highest where sludge-derived material was agitated yet remained below occupational reference values (90 EU m(-3)). Positive covariation between MP and endotoxin levels suggested that tasks and zones with high dust emissions also drive combined particle-biological exposure. The study provides one of the first integrated datasets on airborne MPs and endotoxin in a circular-economy fertilizer facility and demonstrates a practical, contamination-controlled protocol for joint assessment using coordinated sampling. The results show that workers can be simultaneously exposed to elevated levels of polymer particles and endotoxin, underscoring the need to include microplastics in exposure monitoring, risk assessment, and control strategies across biological-waste and related industrial environments.

Lotterman A, Olufotebi I, Wouters IM, Winkel A, Smit LAM, de Rooij MMT.

Occupational exposure of goat farm workers to particulate matter and endotoxin.

Annals of work exposures and health. 2026;70(3):13.

https://doi.org/10.1093/annweh/wxag020

Introduction Intensive livestock farming exposes workers to elevated levels of particulate matter (PM) and endotoxins, increasing respiratory health risks. Although personal exposure has occasionally been investigated in the 3 major livestock sectors-cattle, pigs, and poultry-emerging sectors such as intensive goat farming remain understudied. This study aimed to quantify personal exposure to inhalable dust, PM10, and endotoxins among workers on Dutch dairy goat farms and to explore associations between exposure levels, specific work tasks, and farm characteristics. Methods Repeated personal air sampling was conducted among 41 participants working at 15 goat farms. Inhalable dust and PM10 samples were collected using filter-based methods attached to portable air pumps. For all inhalable dust and PM10 samples, PM mass concentrations were determined by gravimetrical analyses and endotoxin concentrations with the Limulus-Amebocyte-Lysate assay. Determinants of exposure levels were analyzed by linear mixed modeling. Results Inhalable dust concentrations showed a median of 0.966 mg/m(3) (range: 0.228 to 3.093), with a median endotoxin concentration of 612 EU/m(3) (range: 48 to 7,818). For the PM(10)concentrations, a median of 0.376 mg/m(3) (range: 0.070 to 1.233) was observed, with a median endotoxin concentration of 700 EU/m(3) (range: 8 to 2,886). In total, 90% of the samples exceeded recommended occupational exposure limits for endotoxin (>90 EU/m(3)). PM10 and inhalable dust concentrations were strongly correlated (Pearson r = 0.71), as were endotoxin

concentrations in both fractions (Pearson r = 0.71). Exposure to PM and endotoxin varied significantly between farms, within farms and within workers. Overall, highest exposures were recorded for workers with milking as a primary job task. Discussion and conclusions Goat farm workers are exposed to substantial levels of PM and endotoxins during routine work activities. On average, concentrations exceeded those reported for dairy cattle farm workers, yet remained lower than levels typically observed in pig and poultry farming. The observed considerable variation in exposure both between farms and among individual workers necessitates future research and more detailed microbiological characterization of air samples on determinants of exposure, to guide appropriate measures in husbandry and practices at goat farms. This research highlights that in emerging intensive livestock farming sectors, increased exposure to PM and endotoxins-and related health effects-can be expected among workers unless reduction of these exposures is explicitly addressed in the development of agricultural policies and practices.

Moller SA, Frederiksen MW, Rasmussen PU, Muthalagu A, Kofoed VC, Madsen AM.

Occupational exposure to microorganisms for operators of jet-vac trucks.

Archives of environmental & occupational health. 2026;81(1-2):13-25.

https://www.tandfonline.com/doi/pdf/10.1080/19338244.2025.2608687

This study examines bioaerosol exposure and associated biomarker levels in combination vacuum-jet truck ("jet-vac") operators servicing the sewer network in Denmark. Personal exposures (n = 42) and end-of-shift serum samples (n = 30) were collected from 28 workers across four exposure groups: "Stormwater," "Wastewater," "Combined," and "Other" (non-sewage related work). Geometric means of bacterial and fungal exposure levels were 938 and 301 colony forming units per cubic meter of air (CFU/m(3)), respectively. "Stormwater" workers had significantly higher serum amyloid A (SAA) levels than the "Other" group (p = 0.019). SAA was negatively associated with endotoxin exposure (p = 0.014) across exposure groups. Community compositions differed between exposure groups. Micrococcus was the most abundant bacterial genus in the "Other" and "Wastewater" groups, while Bacillus was the most abundant genus in the "Stormwater" and "Combined" group. Five known human pathogens were identified, including Aspergillus fumigatus and Clostridium perfringens. This first study of jet-vac operators highlights the need for further research on bioaerosol exposures in a larger cohort of workers.

• Mycotoxines : exposition professionnelle

Gherbawy Y, Al-Harthi H, Alomari H, Alqahtani A, Pet I.

Temporal dynamics of airborne fungal succession and detection of azole-resistant Aspergillus fumigatus in a poultry farm over a nine-week production cycle.

All Life. 2026;19(1):11.

https://www.tandfonline.com/doi/pdf/10.1080/26895293.2026.2652725

This longitudinal study assessed airborne fungal ecology and azole resistance in A. fumigatus sensu lato within a commercial poultry facility in Taif, Saudi Arabia, across a complete nine-week broiler grow-out cycle. Weekly aeromycological sampling (189 SDA plates) identified 29 fungal species (11 genera) from 450 isolates, dominated by A. flavus sensu lato (246.44 CFU/m ³), A. niger sensu lato (229.44 CFU/m ³), and Alternaria alternata (183.33 CFU/m ³). Total fungal concentrations peaked at 336.67 CFU/m ³ in Week 7. Among 35 A. fumigatus sensu lato isolates (TUAf102-TUAf136),

disk diffusion testing revealed voriconazole (17.1%; 6/35), itraconazole (20%; 7/35), posaconazole (25.7%; 9/35), and fluconazole (22.9%; 8/35) resistance, plus multidrug resistance (8.6%; 3/35) from Week 1 onset. Mid-cycle resistance peaks (Weeks 5-8) coincided with maximum fungal loads, though sampling variability limits definitive trends. These findings confirm poultry housing as reservoirs of antifungal-resistant aspergilli, warranting cyp51A genotyping, azole residue monitoring, and One Health surveillance to protect occupational health and antimicrobial efficacy in intensive production systems.

Mathew G, Thayil LM, Shenoy MP, Sasidharan M, Kumar BP, Selvam P, et al.

Workplace exposure to aflatoxins & its health effects: A systematic review.

Indian J Med Res. 2025;162(6):809-22.

https://ijmr.org.in/content/175/2025/162/6/pdf/IJMR-162-6-809.pdf

Background & objectives: Aflatoxins pose serious health risks to humans and livestock, with ingestion being the most common route of exposure. In occupational settings, workers can also be exposed through inhalation of organic dust and dermal contact. The review aimed to provide an overview of aflatoxin exposure and health effects among workers. Methods: Observational studies investigating occupational exposure to aflatoxins and their health effects were systematically screened in PubMed, Embase, and Scopus till June 2024. Studies meeting inclusion criteria, were assessed for their methodological quality using the Newcastle-Ottawa Scale. Results: Overall, 12,610 studies were screened of which 17 studies were included in the final review. Foodgrain workers, farmers, millers, bakers, grain handlers, oil pressors, and feed mixers, are at a higher risk of occupational exposure to aflatoxins. Assessment of exposure was done by analysing biological fluids (Blood, Urine, and Bronchoalveolar lavage) and samples from the working environment (settled dust, airborne dust, and personal sampling) using enzyme-Linked Immunoassay and High-Performance Liquid Chromatography. Studies have shown an elevation of hepatic and renal enzymes, an increased risk for hepatobiliary cancer, and an increased risk for tumour markers, oxidative markers, and reduced antioxidant levels. One recent study has also found an association between aflatoxin exposure and weight for age and height among children of workers. Interpretation & conclusions: Occupational exposure to aflatoxins is associated with hepatic and renal toxicity and increased carcinogenic risk. These findings highlight the need of large scale dose- response studies, workplace monitoring and regular health surveillance among workers.

Paba E, Mediati F, Montesanti IER, Chiominto A, Marcelloni AM, Samele P, et al.

Occurrence of toxigenic fungi and mycotoxins in pig feeds: potential implications for workers' exposure.

Mycotoxin Res. 2026;42(1):11.

https://link.springer.com/article/10.1007/s12550-025-00632-y

The objective of the study was to assess the potential exposure of pig farmers to toxigenic fungi and mycotoxins by investigating their presence in feeds to understand whether these matrices may represent a source of release into the environment and pose an occupational health risk. Nine feed samples were collected from several intensive farms located in Southern Italy and analyzed through a multi-methodological approach. A total of 35 molds were isolated and A. flavus turned out to be the most frequently species, representing nearly 46% (16/35), followed by A. niger and A. candidus, each at 11.43%. Among the 16 A. flavus strains, 8 possessed all 5 key genes of the aflatoxin biosynthetic pathway but only 4 showed the true aflatoxigenic capacity as confirmed by HPLC/MS-MS analysis (AFB1

range: 0.52-1030 mu g/L). The most frequent mycotoxin was Ochratoxin A (OTA), occurring in 100% of the samples at mean concentration of 33.6 mu g/kg while Fumonisin B1 (FB1) occurred in 97% of the feed samples at mean concentration of 247.1 mu g/kg. Only one sample was contaminated by Aflatoxin B1 (5.84 mu g/kg), classified as carcinogenic to humans. Our results confirm that feedstuffs can contribute to contamination of the work environment, and tasks involving their handling may represent critical procedures that expose personnel to airborne toxigenic fungi and mycotoxins.

Rodrigues MA, Freitas L, Estevinho L, Oliveira C, Capita R, Esteves A.

Moulds and Mycotoxins in the Meat Production Chain from Slaughterhouse to Market: A Scoping Review on Aspergillus and Penicillium Isolation.

Foods. 2026;15(4):25.

https://doi.org/10.3390/foods15040630

Fungal contamination of meat and meat products represents a significant concern for food safety, particularly due to the potential presence of mycotoxin-producing moulds. This scoping review aimed to map the occurrence and distribution of Aspergillus and Penicillium species along the meat production chain, from slaughterhouse environments to retail products, and to identify associated mycotoxins when reported. A systematic literature search was conducted in the PubMed database, complemented by a search in Google Scholar in accordance with Preferred Reporting Items for Systematic Reviews for Scoping Reviews (PRISMA-ScR) guidelines. Eligible studies reported the isolation of Aspergillus and/or Penicillium species from meat, meat products, or meat-processing environments under natural contamination conditions. The results indicate that both genera are frequently detected throughout the production chain, particularly at processing and storage stages, with several studies reporting species known for mycotoxin production. In addition, the presence of these moulds in processing environments highlights potential implications for both food safety and occupational exposure. However, information on mould occurrence in meat, edible offal, meat products and meat processing environments remains scarce, fragmented and heterogeneous. Overall, this review highlights existing knowledge gaps and underscores the need for harmonised monitoring strategies and further research addressing fungal contamination and mycotoxin risks along the meat production chain.

Schmied A, Berger M, Marske L, Höpfner M, Kujath P.

Organic waste treatment: Biomonitoring of workers exposed to mycotoxins.

International journal of hygiene and environmental health. 2026;274:7.

https://doi.org/10.1016/j.ijheh.2026.114768

In organic waste treatment facilities, bioaerosols containing microorganisms (e.g., bacteria, fungi) as well as biomolecules (e.g., debris from membranes, mycotoxins) are released during the movement of material. We conducted a human biomonitoring study to investigate the possible occupational exposure of workers to mycotoxins. In total, 50 workers from three organic waste treatment facilities in Germany and 37 volunteers without expected occupational exposure to moulds provided spot urine samples. These were analysed for the presence of ten urinary mycotoxin biomarkers using liquid chromatography with tandem mass spectrometry. Deoxynivalenol (DON) was detected in nearly all (96%) of the samples of workers and controls followed by deepoxy-deoxynivalenol (21%) and ochratoxin A (OTA, 16%). Aflatoxins, gliotoxin and ochratoxin alpha could not be detected in any of the samples. Total DON concentrations in post-shift samples of workers were significantly higher than those observe in samples of controls (medians 2.94 vs. 1.69 mu g/g creatinine). Additionally, total DON concentrations increased over the working shift. No exceedance of the tolerable daily DON intake was observed. Thus,

the results point to an occupational exposure to DON that is unlikely to pose a health risk. Contrary, urinary OTA levels reveal no differences between workers and controls, and thus, mainly reflect the dietary background exposure.

Yan MX, Liu ZH, Liu ML, Liu HG, Li ZY, Yang ZT, et al.

Dynamics and Health Risks of Fungal Bioaerosols in Confined Broiler Houses During Winter.

Animals. 2026;16(3):15.

https://doi.org/10.3390/ani16030437

Fungal bioaerosols play a critical ecological and health role in intensive poultry production systems. However, their dynamic characteristics and community succession patterns in confined cage environments during winter remain poorly understood. This study investigated a typical confined broiler house in Hebei Province, China, during winter. A combined approach of Andersen six-stage sampling, colony counting, and Internal Transcribed Spacer (ITS) high-throughput sequencing was employed to comprehensively analyze the concentration, particle size distribution, diversity, and community composition of fungal bioaerosols across three key growth stages: 7 days (brooding phase), 21 days (growing phase), and 35 days (finishing phase). The results revealed a significant increasing trend in fungal aerosol concentration as the rearing cycle progressed, increasing from 1125 +/- 125 CFU/m(3) at day 7 to 3872 +/- 565 CFU/m(3) at day 35 (p < 0.001), reaching high-risk exposure levels in the later stages. Small-sized fungal bioaerosols (<4.7 mu m) were dominant across all stages (54.35-65.50%), with the highest proportion observed at day 21, indicating their potential for deep respiratory deposition and long-distance airborne transmission. The number of Operational Taxonomic Units (OTUs), along with Chao1 and Shannon indices, increased significantly with bird age (p < 0.001), demonstrating a clear community succession from early-stage yeast-dominated forms (e.g., Diutina, Blumeria) to mid- and late-stage assemblages dominated by filamentous fungi (e.g., Aspergillus, Cladosporium, Alternaria). Notably, several zoonotic pathogenic genera were detected throughout all rearing stages, highlighting the potential risks of airborne fungi to animal health, occupational exposure, and environmental safety under winter ventilation restrictions. This study characterizes a stage-dependent pattern of increasing airborne fungal concentrations accompanied by shifts in particle size distribution and community composition under winter confined conditions. The findings provide a crucial scientific basis for optimizing winter ventilation and environmental management strategies, improving environmental control technologies, establishing airborne biosafety standards, and developing targeted fungal monitoring and prevention technologies.

Usages et retraitement de l'eau dans l'industrie

Casañas Gonzalez A, Molina VG, Zerpa FAL, Ramos Martin A.

The Role of Reverse Osmosis as an Essential Desalination Technology in Addressing Spain's Freshwater Deficits.

Membranes (Basel). 2026;16(4).

https://doi.org/10.3390/membranes16040113

Water is increasingly acknowledged as a limited and strategically critical resource, particularly in regions where hydrological imbalances are structurally persistent. Across Europe, countries such as Spain, Turkey, Italy, and Greece face recurrent water scarcity driven by precipitation regimes characterized by low annual rainfall, pronounced temporal variability, and marked spatial heterogeneity. In response to rising water demand associated with tourism, agricultural intensification, and sustained demographic pressures, Spain has implemented a series of national water-management strategies over the past two decades. Notably, the National Hydrological Plan, enacted in July 2005, introduced more than one hundred immediate actions focused on modernizing hydraulic infrastructure and reinforcing the country's desalination capacity. Furthermore, the Royal Decree issued in December 2007 established a comprehensive regulatory framework to promote and standardize water reuse practices nationwide. Within this context, reverse osmosis has emerged as a central technology for the desalination of seawater and brackish water, as well as for advanced water-reclamation applications. This work presents a consolidated examination of Spain's water-resource management framework, drawing on historical material and recent advances to outline the current context of desalination and water reuse. It presents operational performance data from several full-scale reverse osmosis facilities, and reviews recent technological developments in the field, including newly engineered membrane modules, innovative system architectures, and the latest generation of large-diameter RO elements. Together, these advancements illustrate the evolving role of membrane-based desalination and water reuse in supporting water security in semi-arid regions.

Casarano G, Sardella F, Giungato P.

Industrial water reclamation in southern Italy: Insights from the life cycle assessment of a brewery case study.

Journal of Cleaner Production. 2026;553:10.

https://doi.org/10.1016/j.jclepro.2026.147970

Italy, like other Mediterranean regions, is increasingly affected by water scarcity driven by climate change and inefficient water management. The Food & Beverages sector is particularly water-intensive not only for production but also for heating, cooling and cleaning purposes. Brewing, in particular, stands out as one of the most water-consuming processes. To reduce water demand, alternative water supply strategies such as water reclamation from treated wastewater are gaining attention, but a reliable tool for environmental assessment of reclamation alternatives is needed. In this paper, Life Cycle Assessment (LCA) was applied to assess the environmental performance of a tertiary treatment plant for brewery wastewater reclamation in a southern Italian brewery (Apulia region). The plant comprises a filtration stage based on quartz sand, activated carbon and membrane ultrafiltration, followed by disinfection via ultraviolet irradiation and sodium hypochlorite. The environmental performance was compared to the one of the conventional brewery's water supply, consisting of desalinated groundwater. Results show substantial benefits of the reclamation process in water use and ozone depletion impact categories, but in the remaining impact categories, from climate change to eutrophication, reclamation performs worse, largely driven by the ultrafiltration stage. While trade-offs exist and outcomes depend on regional specificities and electricity mix, the findings provide decision-relevant insights for evaluating wastewater reclamation as an alternative water supply in other water-stressed regions where conventional supply relies on desalination or overexploited groundwater.

Cui BB, Ali W, Wan WD, Hu YN, Liu SY, Lai TN, et al.

Worker exposure to bioaerosols from sludge dewatering facilities: risks and mitigations.

Water research. 2026;297:13.

https://www.sciencedirect.com/science/article/pii/S0043135426004112?via%3Dihub

Sludge dewatering process is a major source of bioaerosols in wastewater treatment plants (WWTPs) which can pose significant health risks to on-site workers. While quantitative microbial risk assessment (QMRA) is commonly performed to assess the human health risks, it lacks immediacy in determining on-site risk levels. Alternatively, comparing detected concentrations of bioaerosols with critical concentration standards provides a practical approach. This study investigates Escherichia coli bioaerosol emissions from a sludge dewatering process (or facility) in a municipal WWTP under different working postures, ventilation scenarios, and seasonal conditions. The objective was to estimate a ceiling-type exposure limit (EL) corresponding to acceptable risk levels using Monte Carlo simulation and reverse QMRA. Sensitivity analysis was also used to identify the key input parameters significantly affecting the risk exposure. Results showed that the bioaerosol concentration in poor ventilation was 1.6-1.7 times as large as that in natural ventilation. The respirable fractions (particle size < 4.7 & micro;m) accounted for 78 %-100 % of the total bioaerosol emissions. Opening the windows increased the EL up to 1.6 times higher compared to closed-window conditions under the optimistic scenario. Wearing masks reduced significantly the fraction of bioaerosols inhaled by workers, resulting in derived EL that were one to two orders of magnitude higher (2.24 - 20.10 CFU/m(3)) than those estimated without masks (0.09 - 0.41 CFU/m(3)). Among all parameters, the removal of the respirable fraction by the masks was the dominant contributor to EL estimation. EL benchmarks also varied with seasonal conditions and working postures. Overall, this study provides novel quantitative insights for deriving occupational exposure limits for bioaerosol exposure in dewatering facilities.

Gonzalo Ibrahim FG, Muñoz Torre R, Botero Coy AM, Hernandez F, de Godos Crespo I.

Performance comparison of microalgae-based and activated sludge with membrane filtration (AS-MBR) for emerging contaminant removal and wastewater reuse.

Journal of hazardous materials. 2026;501:140553.

https://doi.org/10.1016/j.jhazmat.2025.140553

The removal efficiency of microalgae cultures was compared to that of an activated sludge system with ultrafiltration. Three systems were assessed: an outdoor algae pond, a lab-scale setup simulating open-air conditions, and a full-scale activated sludge facility. High removal rates (>80 %) were observed for hydrophobic, biodegradable or volatile compounds across all systems, despite differences in treatment nature. In microalgae systems, bioadsorption and photodegradation were key pathways, with enhanced removal of UV-sensitive compounds in the outdoor pond. In the activated sludge membrane-assisted system, biosorption and volatilization led to very low pollutant concentrations in the effluent. The membrane bioreactor outperformed conventional activated sludge systems due to higher aeration, sludge age and the elevated solids concentration. The three tested systems produce final effluents that met European standards for reclaimed water, in terms of biological contamination, and the limits proposed for emerging contaminant removal.

Hamdi R, Mahjoubi N.

Process based assessment of wastewater quality and rinse water reuse potential in denim finishing: a scalable framework for circular water management.

Scientific reports. 2026;16(1).

https://www.nature.com/articles/s41598-026-51562-3.pdf

Industrial textile production is a significant contributor to freshwater pollution, particularly in water-intensive processes such as denim finishing. This study presents a process-based assessment of wastewater quality and rinse-water reuse potential using a stage-specific Water Quality Index (WQI) framework. By analyzing effluents from six major denim finishing stages, critical pollution hotspots were identified, and the feasibility of cascading rinse-water recovery was evaluated. Results demonstrate that WQI values decreased significantly after rinsing, with reductions reaching up to approximately 70% depending on the process stage. Furthermore, the proposed stepwise reuse strategy has the potential to reduce freshwater consumption by nearly two-thirds while maintaining operational performance. Beyond a site-specific application, the proposed methodology offers a transferable framework for industrial water optimization and circular water management in textile facilities globally. The findings contribute to advancing sustainable industrial practices and support progress toward SDG 6 and SDG 12.

Hu HY.

Water reuse standards promote water cycle-starting from the ISO 20761 water reuse safety evaluation standard.

Water Cycle. 2026;7:192-3.

https://doi.org/10.1016/j.watcyc.2025.11.003

Huan HS, Zhou GQ, Wu ZL, Li JB, Xia PF, Wang Q, et al.

Resource utilization of wastewater generated during the etching process in electrode foil production: An engineering case study.

Water Cycle. 2026;7:473-9.

https://doi.org/10.1016/j.watcyc.2025.12.001

The etching process in electrode foil production generates vast quantities of low-concentration acidic rinse water and high-concentration waste acid, posing severe environmental risks. This study presents an integrated engineering solution combining precipitation, ultrafiltration with ceramic membranes (UF), two-stage reverse osmosis (RO), resin softening, and advanced oxidation to achieve near-zero wastewater discharge. The system treats 1960 m(3)/d rinse water and 300 m(3)/d waste acid, achieving >95 % water recovery with effluent quality (TDS <= 200 mg/L, pH 6-9) meeting industrial reuse standards. Crucially, waste streams are valorized: RO concentrate, and waste acid are converted into 40,000 tons/year of high-purity coagulants (solid aluminum sulfate and sodium aluminum sulfate), compliant with GB/T 31060-2014 Class I standards. Economically, daily operational costs (1.224 million CNY) are offset by revenues from water reuse and coagulant sales (1.923 million CNY/day), yielding similar to 20.97 million CNY/year net profit. This circular approach demonstrates scalable resource recovery simultaneously reclaiming water, acid, salts, and aluminum while addressing water scarcity and pollution in electrode foil manufacturing.

Jurga A, Jugowicz A, Lipinska MB, Rodziewicz T, Kazmierczak B.

Duckweed-based systems in the water-energy-food nexus: controlled environment agriculture (CEA) for industrial water reuse and nutrient recovery.

Water Resour Ind. 2026;35:16.

https://www.sciencedirect.com/science/article/pii/S221237172600003X

Duckweed (Lemnaceae) is gaining increasing attention as a multifunctional bioresource for wastewater treatment, nutrient recovery, food, feed, and bioenergy production, as well as for closed-loop life support systems. Its rapid growth, high nutrient uptake capacity, and aquatic growth habit make it particularly suitable for integration into controlled environment agriculture (CEA) systems within the water-energy-food nexus. This review synthesizes recent advances in indoor duckweed cultivation, focusing on laboratory- and pilot-scale systems with working volumes exceeding 1 L. The aim is to identify key biological and engineering factors governing system performance and to assess the feasibility of scaling duckweed-based CEA for industrial and municipal water reuse applications. Comparative analysis of reported studies shows that shortterm laboratory experiments frequently overestimate long-term productivity, with relative growth rates declining as cultivation duration and system complexity increase. System performance is strongly influenced by hydraulic design, culture depth, mat density, harvesting strategy, nutrient dosing, microbiological control, and energy input, particularly for lighting and climate regulation. Pilot-scale studies demonstrate that stable operation and realistic productivity require integrated management of biological processes and engineering subsystems rather than optimization of single parameters. Major knowledge gaps remain in long-term nutrient management, microbial stability, standardized performance metrics, and techno-economic assessment. Overall, duckweed-based CEA represents a promising but still emerging technology for sustainable water reuse and biomass valorization. Progress toward practical deployment will depend on pilot-scale validation, improved process integration, and robust evaluation of economic and safety constraints, with additional insights emerging from space life-support research.

Kumar V, Verma P.

Advances in microbial biotechnology for sustainable wastewater reclamation: recent trends and future prospects.

World J Microbiol Biotechnol. 2025;41(12):478.

https://link.springer.com/article/10.1007/s11274-025-04674-3

The growing demand for freshwater, coupled with the increasing volume of industrial and municipal wastewater, has intensified the need for sustainable and eco-friendly reclamation strategies. Recent advancements in microbial biotechnology have emerged as promising tools for developing cost-effective, efficient, and environmentally sustainable wastewater treatment (WWT) strategies for reuse and safe disposal. This mini-review explores current innovations, such as microbial consortia, bioaugmentation, and the microalgae-bacteria nexus, which have shown promising results in nutrient removal, enhanced degradation of complex pollutants (including emerging contaminants), and biomass valorization. Moreover, bioelectrochemical systems, such as microbial fuel cells (MFC) and microbial electrolysis cells (MEC), have revolutionized WWT by facilitating pollutant degradation while simultaneously generating bioelectricity or biohydrogen. This article also critically examines the role of CRISPR-based tools and 'omics' approaches, which have enabled the development of novel microbial strains and degradative pathways, enhancing wastewater reclamation in challenging environments. Furthermore, advancements through the integration of multi-omics and artificial intelligence, digital twins, and Internet of Things (IoT) for microbial optimization and real-time process control are

discussed. The review highlights the role of microbial systems in resource recovery, supporting a circular economy by transforming wastewater into valuable bioresources. Additionally, this review addresses the major challenges and proposes future research directions for effective wastewater treatment. The novelty of this manuscript is that no single review explores the cutting-edge microbial biotechnologies for wastewater reclamation, uniquely integrating CRISPR-Cas genome editing, multi-omics analyses, and artificial intelligence-driven optimization to advance pollutant degradation and real-time process control in one place. This study concludes that by implementing multi-omics and artificial intelligence (AI)-driven optimization process for wastewater treatment can be effective towards wastewater treatment while simultaneously minimizing the environmental pollution.

Mahboubi A, Kherraz A, Mami A.

Assessment of wastewater quality and agricultural reuse risks in Oran, Northwestern Algeria.

Environmental Monitoring and Assessment. 2026;198(5):18.

https://link.springer.com/article/10.1007/s10661-026-15306-0

Climate change, rapid urbanization, and draughts continue to intensify the issue of water scarcity in the coastal areas of Algeria, making the reuse of treated wastewater a highly relevant alternative for the sustainable management of water resources. On the other hand, inefficient performance can pose a danger to the environment with respect to wastewater reuse. The current study investigates the monthly variation in essential physicochemical values in the treated wastewater discharged from the El Kerma Wastewater Treatment Plant located in Oran, Algeria, with the objective of determining its reuse potential. The effluent exhibited the following concentration ranges: pH (7.06-7.87), TSS (15-34 mg/L), COD (52.55-91.14 mg/L), BOD5 (12-32 mg/L), PO43- (0.22-5.25 mg/L), NO2- (0.09-0.16 mg/L), NO3- (0.36-0.83 mg/L), NH4+-N (0.1-32.6 mg/L), Zn2+ (0.07-0.28 mg/L), and Cu2+ (0.002-0.17 mg/L). Most physicochemical parameters complied with Algerian and international regulatory limits for urban reuse, reflecting effective removal of suspended solids and organic matter (average removal efficiencies of similar to 90% for TSS and similar to 95% for BOD5). However, the BOD5/COD ratio (similar to 0.2) indicated poor biodegradability and the persistence of recalcitrant organic compounds. Compared to international standards for agricultural reuse (US EPA, WHO, FAO), there are some significant limitations. While the levels of pH, nitrate, nitrite, zinc, and copper are within irrigation standards, high electrical conductivity, ammonium, phosphate, and organic load make it not suitable for unrestricted agricultural irrigation of raw-consumed crops. Also, the levels of phosphates are above the stringent reuse standards of more than 80% of the samples, posing a significant risk of eutrophication to the receiving ecosystems, whereas levels of ammonium are regularly above the international agricultural reuse standards, potentially having some adverse impacts on plant growth and soil quality. Besides, while copper and zinc are within the irrigation standards, they are above the levels of ecological protection for freshwater organisms, suggesting some potential long-term ecological impacts. Overall, the El Kerma WWTP effluent is suitable for restricted agricultural reuse (non-food crops, fodder, and industrial crops) but poses risks for sensitive aquatic ecosystems and food-chain safety if discharged or reused without additional treatment. These findings highlight the urgent need for improved tertiary treatment and stricter reuse management strategies to ensure environmentally safe wastewater reuse in semi-arid Mediterranean regions.

Mateo-Pérez V, Corral-Bobadilla M, Roqueñí-Gutiérrez N, Seijo-Veiguela J, Alperi-Ortea J, Sabando-Fraile C.

Reclaimed urban wastewater for industry: blending strategies for circular economy implementation in the Principality of Asturias.

Clean Technol Environ Policy. 2026;28(5):18.

https://link.springer.com/content/pdf/10.1007/s10098-026-03499-4.pdf

Water scarcity presents a critical challenge to industrial growth, environmental sustainability, and effective resource management. This study explores the potential of reclaimed water from the Villap érez Wastewater Treatment Plant in the Principality of Asturias as a sustainable solution for industrial applications, including high-demand sectors such as hydrogen production. With approximately 325 water-intensive companies in the region, the adoption of reclaimed water offers a viable alternative to potable water, reducing pressure on freshwater resources. The research focuses on producing high-quality reclaimed water that meets rigorous industrial standards while minimizing energy consumption, a significant technological hurdle. A treatment system combining ultrafiltration and reverse osmosis was designed to achieve the required water quality. By blending ultrafiltered and osmosis-treated water, the system produced water with low conductivity, reduced salinity, and optimal chemical and microbiological properties suitable for industrial use. The project aligns with Asturias's Circular Economy Strategy, demonstrating how wastewater reclamation can support industrial demand without compromising drinking water supplies. Within the framework of the regional project led by the Principality of Asturias, a comprehensive distribution network spanning 60 km has been designed to deliver reclaimed water to key industrial zones in Avil és, Gij ón, and Oviedo. Pilot studies confirmed the effectiveness of the treatment process, with reclaimed water consistently meeting or exceeding regulatory standards for industrial use. This initiative not only addresses water scarcity but also promotes resource conservation and environmental stewardship. By integrating reclaimed water into industrial processes, this pilot project provides a scalable model for sustainable water management, advancing the circular economy and fostering a balance between industrial growth and ecological preservation. The results highlight the potential of reclaimed water as a strategic resource for non-potable industrial applications, contributing to a resilient and sustainable water supply system. This approach underscores the importance of innovative water reuse strategies in achieving long-term environmental and economic sustainability.

Narkuti B, Vani B, Arundhathi B, Nayak KS, Anand P, Kalyani S, et al.

A Sustainable Integrated Approach for Water Reclamation from Alkali-Pretreated Rice Straw Mother Liquor.

Waste and Biomass Valorization. 2026:16.

https://link.springer.com/article/10.1007/s12649-026-03621-z

Research in the area of wastewater treatment has made significant strides through the development of innovative materials that address critical environmental concerns. Currently, many researchers are utilizing advanced separation techniques at an industrial scale for the purification of effluents. These processes offer practical solutions in the industry, including design flexibility and socio-economic feasibility through scale-up, as well as reduced freshwater consumption through water reclamation after removing various contaminants. The present study focuses on the production of reusable water from alkali-pretreated biomass, integrated with a membrane process. The obtained lignin-rich rice straw mother liquor is initially pretreated with alkali, followed by reverse osmosis (RO)/nanofiltration (NF) for water reclamation. The homogeneously synthesized membranes were characterized by Fourier Transform Infrared (FTIR) spectroscopy and Scanning Electron Microscopy (SEM) for structural interpretation and surface morphology analysis. The bench-scale experiments were conducted using RO and NF membranes at a constant pressure of 8 bar, which demonstrated water recoveries (WR) of 65% and 74%, respectively. Based on the results, the NF process is scaled up to a pilot level to enhance WR to 80% for the economic viability of the integrated process. High rejection of color and conductivity

was achieved at an operating pressure of 21 bar on a pilot level, and the level of pollutants in the permeate was acceptable for effluent discharge or reuse in industry. NF was found to be a significantly cost-efficient technique with higher WR, which directly contributes to pollution control by avoiding discharge to the environment and landfills.

Nemeș NS, Negrea A, Ciopec M, Negrea P, Duţeanu N, Duda-Seiman DM.

Heavy Metal Ion Removal: A Global Review of Wastewater Treatment Technologies.

Int J Mol Sci. 2026;27(4).

https://doi.org/10.3390/ijms27041741

This review addresses the escalating global water crisis driven by water pollution, especially by heavy metal ions, a consequence of rapid industrialization and population growth. Due to their high toxicity, solubility, and persistence, heavy metals pose a severe threat to human health and ecosystems through bioaccumulation. The analysis highlights a strategic shift in wastewater management from simple elimination of the toxics metal ions to the recovery of metal ions with economic value. Given the increasing complexity of industrial effluents, the scientific community is intensifying its focus on evaluating the technical and financial feasibility of various treatment technologies. Significant research is being conducted to address these environmental issues, and innovative technologies are being developed to enhance the quality of water contaminated by metal ions. On the other hand, to prevent pollution, plans containing several barriers must be established, including management, economic, and technical ones. Ultimately, the reuse of treated wastewater is the only viable long-term solution for securing global drinking water supplies. A new analysis focused on the transition from traditional, inefficient, and costly wastewater treatment to advanced, resource recovery-oriented systems is essential. The current perspective shows a clear need to advance beyond synthetic laboratory studies to real-world applications while addressing operational barriers to support a circular economy based on simple disposal of the toxic metal ions to the recovery of metals with economic value (e.g., copper, gold, silver, rare metals). Also, although the field has been explored, a new review is imperative because current technologies that show high efficiency (up to 99%) in the removal of toxic metal ions (adsorption, membrane filtration, electrochemical processes) face major challenges, such as the formation of large volumes of toxic sludge, membrane fouling, and high operating costs.

Raja IB, Ahmad Y, Feroze T, Choudhry MI, Usman M, Genc B.

Integrated techno-enviroeconomic and life-cycle assessment of a solar-green hydrogen hybrid system with industrial wastewater reuse.

Scientific reports. 2026;16(1):25.

https://www.nature.com/articles/s41598-026-44016-3.pdf

The dual pressures of climate change and industrial water scarcity demand integrated solutions that jointly decarbonize power supply and reduce freshwater dependency. This study presents a site-specific, techno-enviroeconomic and life-cycle evaluation of a closed-loop Solar-Green Hydrogen Hybrid System (SGHHS) co-located with Gul Ahmed Textiles in Karachi, Pakistan, integrating 22.75 MW solar PV, a 2.25 MW PEM electrolyser, 450 kg hydrogen storage, and a 1 MW PEM fuel cell to deliver dispatchable, round-the-clock clean electricity under reduced nighttime demand. Unlike most SGHHS studies that assume freshwater inputs and decouple water treatment from system economics, this work quantifies an integrated wastewater-to-ultrapure-water loop (MBR -> RO -> DI) with fuel-cell condensate recovery within a unified TEA-LCA framework. A novel configuration treats 4,050 L/day of textile effluent to produce PEM-compatible ultrapure water while recovering and recirculating clean water for reuse

within the facility, leveraging a broader on-site effluent availability of similar to 400,000 L/day. Over a 25-year project horizon, the integrated water loop reduces the Levelized Cost of Electricity (LCOE) from USD 0.10/kWh to USD 0.0866/kWh through avoided freshwater procurement and effluent-management costs. Life-cycle assessment indicates the potential to avoid over 157,000 metric tons of CO2-equivalent emissions. The proposed framework supports multiple Sustainable Development Goals (SDGs) and provides a replicable, data-driven pathway for circular water-energy integration and industrial decarbonization in semi-arid, resource-constrained regions.

Sharma SK, Thenmani N, Lee JD, Kumar R.

Water Purification from Industrial Effluents Using Gas Hydrates: Process Demonstration of a Continuous Bench Scale Operation.

ACS ES&T Eng. 2026:16.

https://doi.org/10.1021/acsestengg.5c01140

Industrial brines from petrochemical and allied sectors are an escalating sustainability challenge, limiting circular water use and progress toward zero-liquid-discharge and decarbonization targets. Their high salinity and refractory organics make conventional membrane and thermal processes energy and carbon-intensive. We present a continuous dual-reactor gas-hydrate crystallization platform for membrane free, nonthermal purification that enables molecularly selective water recovery under mild conditions (278 K; 0.60-0.85 MPa). Through vapor-liquid interfacial engineering, structure sII hydrates rapidly form at engineered interfaces via Capillarity-driven nucleation, while phase evolution is governed by Ostwald ripening kinetics. Using a mixed propane and HFC-134a gas pair, we achieve in a single pass >65% overall water recovery (7-10 L & centerdot;h(-1)) and >50% water-to-hydrate conversion. The recovered water shows 84-93% removal of total dissolved solids, chemical oxygen demand, and ammoniacal nitrogen. Mechanistically, hydrate formation and selectivity are streamlined using hydrate thermodynamics and cage occupancy. The specific energy requirement is 3.88 kWh & centerdot;m-3, with a global warming potential of 2.79 kg & centerdot;CO2-eq & centerdot;m(-3) and a levelized cost of $1.65 m(-3), demonstrating superior performance relative to representative membrane and thermal baselines (4-15 kg CO2-eq & centerdot;m(-3); 30-45% recovery). These results establish clathroseparation as a new, low-exergy class of phase-selective crystallization for sustainable industrial water reuse, advancing SDGs 6, 9, and 12.

Wang X, Xing T, Namsechi B, Huang P, Yang L, Jiang C, et al.

Utilizing Petroleum Coke for Hydraulic Fracturing Flowback and Produced Water Treatment - Targeting Dissolved Organics and Iron Removal.

ACS Omega. 2026;11(6):10390-401.

https://pubs.acs.org/doi/pdf/10.1021/acsomega.5c11615?ref=article_openPDF

Responsible hydraulic fracturing is important for the future of Canada's oil and gas sector. Hydraulic fracturing operations use significant amounts of water. The flowback and produced water from hydraulic fracturing operations contain toxic chemicals and is stored on site. Alberta Energy Regulator records hundreds of surface spills of flowback and produced water per year. Nevertheless, to promote water reuse during hydraulic fracturing operations and reduce costs, industry uses fit-for-purpose water treatment methods to treat the flowback and produced water, targeting suspended solids and dissolved solids. In addition, the recent interest in the lithium content in hydraulic fracturing flowback and produced water has stimulated direct lithium extraction technology development across Canada. However, most of these technologies require a certain degree of organic removal. Traditional water

treatment technologies are costly, and as such, further development in low-cost water treatment techniques is crucial to treat and reuse flowback and produced water. In this study, we utilized waste materials (i.e., petroleum coke) from the oil sands industry for hydraulic fracturing flowback and produced water treatment by employing an in-house coke activation method. Flowback and produced water samples from different locations in the Western Canadian Sedimentary Basin were analyzed and compared using a suite of analytical techniques. Dissolved organics were analyzed by high-resolution mass spectrometry using nontargeted analysis methods. The organic and iron removal efficiencies of different activated carbon products were compared. Results indicate that the surface area of coke is the primary factor influencing its adsorption capacity for dissolved organics; however, it does not significantly impact the efficiency of iron removal. Overall, this study demonstrated the potential of using petroleum coke for treating flowback and produced water, laying grounds for development of low-cost treatment technologies.

Zulhendri F, Simon A, Ly QV.

Bridging Innovation and Operational Reality in Industrial Wastewater Reverse Osmosis for Water Reuse.

Curr Pollut Rep. 2026;12(1):20.

https://link.springer.com/article/10.1007/s40726-026-00405-w

Purpose Reverse osmosis (RO) is increasingly deployed for industrial wastewater reuse and minimal liquid discharge applications, yet persistent challenges related to fouling, membrane durability, and long-term operability continue to restrict performance. While the literature on this topic has expanded rapidly, most studies often isolate innovation in membranes, pretreatment, or modelling, with limited reconciliation of these advances in full-scale industrial constraints. This review critically examines recent industrial wastewater RO studies through an explicit innovation-versus-reality lens to assess how reported advances translate across laboratory, pilot, and full-scale contexts. Recent findings Across 36 peer-reviewed studies published between 2020 and 2025, lab-scale research predominantly emphasizes short-term performance gains, mechanistic fouling diagnostics, advanced pretreatment, and novel membrane materials and surface modifications under controlled conditions. In contrast, reality-leaning full-scale systems prioritize long term performance and operational continuity, regulatory compliance, retrofit compatibility, and manageable cleaning regimes, often at the expense of peak recovery or flux. Transition-zone studies partially bridge this gap by combining real wastewater, commercial modules, and extended operation, demonstrating that scalability and durability, rather than intrinsic performance, are the primary barriers to technology transfer. Summary This review reveals a persistent mismatch between lab-scale RO research and industrial operating realities. Progress in industrial wastewater RO requires a paradigm shift from short-term optimization toward designs explicitly accounting for variability, lifecycle performance, and system integration. No single membrane or pretreatment strategy is universally applicable; effective implementation depends on context-specific alignment between innovation and operational feasibility. Reframing success metrics around sustained industrial viability is essential to accelerate meaningful adoption of RO technologies.

Recyclage textile

Islam MM, Yin R, West A.

A Brief Review of Mechanical Recycling of Textile Waste.

Textiles. 2025;5(4):20.

https://doi.org/10.3390/textiles5040041

The fast fashion industry has significantly increased global textile demand, driving a surge in fiber production. However, only a minimal portion of this fiber comes from recycled sources. In the United States alone, a vast amount of textile waste is generated annually, with over half ending up in landfills, contributing to environmental degradation and global warming. These developments underscore the urgent need for scalable and efficient textile recycling solutions to address both economic and ecological challenges in the fashion industry. Among recycling methods, mechanical recycling stands out for its low cost and simplicity, making it suitable for processing various types of textile waste. This article reviews current knowledge, identifies key research gaps, and provides direction for future studies in mechanical textile recycling. Despite progress, significant challenges remain in improving the quality and efficiency of recycled fiber. This study shows the importance of advancing pretreatment methods and sorting technologies, and highlights understanding regarding shredding, opening processes, and fabric structural properties.

Silva AC, Barreiros MP, Azevedo T, Brás D, Teixeira MA, Fangueiro R, et al.

Fibre-to-Fibre Recycling in Textiles: Strategies, Limitations and Industrial Perspectives.

Textiles. 2026;6(1):30.

https://doi.org/10.3390/textiles6010030

Textile-to-textile recycling is increasingly recognised as essential to reduce the environmental footprint of the textile sector, yet fibre-to-fibre routes remain constrained by complex composition of fibre blends, chemical finishes and the degradation of fibre quality during repeated processing. This review provides a comprehensive overview of recycling strategies for major textile fibres, cotton, polyester, viscose, polyamide, and wool, from a fibre-level perspective, highlighting the relationships between fibre chemistry, structure, and recyclability. Mechanical, chemical, and biological recycling routes are analysed with a particular focus on fibre integrity, yarn and fabric performance, and their suitability for industrial textile applications rather than solely on waste management aspects. The review also examines industrial initiatives and emerging technologies driving the transition towards circular textile systems, critically identifying key barriers such as feedstock heterogeneity, fibre blending, and downcycling. Building on existing review articles on textile recycling, this work synthesises current knowledge on fibre-to-fibre routes, compares different process options in terms of recycled-fibre quality and scalability, and highlights remaining technological and implementation gaps. To advance textile circularity, integrated recycling frameworks are proposed that align material design, process optimisation, and policy instruments. This work contributes a cross-disciplinary understanding of how fibre-level innovation can enable resource-efficient, closed-loop textile production, offering a roadmap for future sustainable materials engineering in industrial textile systems.

Slobodkina L, Muzyka R, Sajdak M, Sobek S, Werle S.

Recent trends in textile waste recycling: an overview.

Rev Chem Eng. 2026;42(4):283-306.

https://doi.org/10.1515/revce-2025-0027?urlappend=%3Futm_source%3Dresearchgate.net%26utm_medium%3Darticle

The global textile industry is an important economic driver, but at the same time it generates serious environmental challenges. These challenges are twofold: the vast amounts of textile waste generated each year and the substantial climate impacts caused mainly during the production phase. According to the European Environment Agency, about 80 % of the total climate impact of textiles derives from production, 14 % from the use phase (washing, drying, ironing), 3 % from distribution and retail, and 3 % from end-of-life stage, which includes collection, sorting, recycling, incineration, and landfilling. By 2030, global apparel (clothing + footwear) consumption is projected to rise from around 70 million tons today to approximately 105 million tons. Despite this growth, less than half of textile items are collected for reuse or recycling after use, and only a very small fraction - under 1 % - are recycled into new garments. This gap is primarily due to technical barriers: the processing of mixed fibers, chemical finishing and additives, as well as the lack of scalable and cost-competitive processing systems. This review examines current work on textile waste processing, taking into account technological, regulatory, economic, and environmental factors. It also identifies innovations and strategies for developing a circular economy.

Biotechnologies

- ## Nouveaux procédés

Aasa AO, Govender SE, Malgas S, Thantsha MS.

Microbial and enzymatic biodegradation of aflatoxins and ochratoxins: mechanisms, applications, and emerging innovations.

Arch Microbiol. 2026;208(3):27.

https://link.springer.com/content/pdf/10.1007/s00203-025-04683-8.pdf

Aflatoxins and ochratoxins are highly potent mycotoxins primarily produced by Aspergillus and Penicillium species, contaminating various agricultural commodities, especially cereals, nuts, and animal feeds. Chronic exposure to these mycotoxins is associated with liver cancer, immunosuppression, and developmental disorders, posing significant risks to public health and socioeconomic stability in numerous developing countries. Detoxification of mycotoxins has traditionally depended on physical and chemical methods, which exhibit limitations such as partial efficacy, nutrient loss, changes in food quality, high energy requirements, and environmental issues. Biological detoxification has recently garnered significant attention as a sustainable, safe, and eco-friendly alternative. This method utilises microorganisms, including bacteria, yeast, and fungi, along with their enzymes and metabolites, to transform mycotoxins into less toxic or non-toxic compounds, while maintaining the nutritional and sensory quality of food and feed. This review systematically analyses the recent advancements in the understanding of the microbiological and enzymatic

mechanisms of aflatoxin (AFB) and ochratoxin (OTA) degradation. It emphasises the function of essential enzymes such as aldehyde dehydrogenase, amidohydrolase, carboxypeptidases, laccases, manganese peroxidases and oxidases, transforming AFB(1) and OTA into less toxic compounds like AFD(1), AFQ(1,) L-beta-phenylalanine and OT alpha. Industrial applications of these enzymes in feed and food processing are discussed. Contemporary challenges, including incomplete degradation, the formation of unknown by-products, and the variability of enzyme performance across different food matrices, are reviewed. The review proposes strategic approaches to enhance biological detoxification efficiency. These insights provide a framework for developing scalable, safe, and effective biotechnology solutions to mitigate mycotoxin contamination in the global food chain.

Abuhassan Q, Salajegheh A, Muhammad FA, Al-Hussainy AF, Gajjar TB, Hanumanthayya M, et al.

Extracellular vesicles in cardiovascular disease: Biomarkers, therapeutic applications, and drug delivery strategies.

Clin Chim Acta. 2026;588:11.

https://doi.org/10.1016/j.cca.2026.120972

Extracellular vesicles (EVs) have emerged as pivotal mediators of intercellular communication in cardiovascular disease (CVD), influencing inflammation, thrombosis, fibrosis, angiogenesis, and cardiac remodeling through the transfer of proteins, lipids, and RNAs. The presence of EVs in virtually all biofluids and their cargo's close linkage to cellular activation or injury make EVs attractive noninvasive biomarkers for CVD diagnosis, prognosis, and therapy monitoring, with circulating EV signatures reported in myocardial infarction, heart failure, atherosclerosis, and valvular and cardiomyopathic disorders. Parallel advances highlight EVs as cell-free therapeutic agents, recapitulating key paracrine benefits of stem and progenitor cell therapies while avoiding issues of low engraftment and arrhythmogenic risk. In addition to their endogenous activity, both native and engineered EVs are being actively developed as drug delivery platforms, offering biocompatibility, immune stealth, and the capacity to cross biological barriers, with promising data for targeted delivery to the ischemic myocardium and atherosclerotic plaques. Engineering strategies, including surface functionalization, controlled cargo loading, and combination with biomaterials such as hydrogels, can increase cardiac homing, prolong circulation, and improve on-target efficacy. Despite this promise, major hurdles remain: heterogeneity of EV subtypes, lack of standardized isolation and characterization workflows, low production yields, incomplete pharmacokinetic understanding, and unresolved regulatory classification. Addressing these limitations through multi-omics, advanced bioengineering, scalable bioprocessing, and rigorously designed clinical trials will be critical to integrate EVbased biomarkers, therapeutics, and delivery systems into cardiovascular precision medicine.

Alwahbi A.

Advances in Wound Healing Strategies for Diabetic Foot Ulcers: From Conventional to Regenerative Therapies.

Curr Diabetes Reviews. 2026;22(6):10.

https://www.eurekaselect.com/article/151882

Diabetic Foot Ulcer (DFU) is a serious and chronic complication of uncontrolled diabetes, significantly increasing the risk of amputation and mortality in diabetic patients. Conventional wound healing techniques often fail to manage chronic wounds in DFU due to several limitations, which eventually

raises the need for advanced, innovative, and efficient treatment strategies for the better management of DFU. Many novel interventions, such as growth factor therapy, stem cell therapy, gene therapy, nanotechnology, bioengineered skin substitutes, 3D-bioprinting, and regenerative medicine, have shown promising roles in wound healing and tissue regeneration, suggesting their potential implications in the treatment and control of DFU. An integrated and multidisciplinary approach was proven to be a promising option for rapid and effective DFU management, eventually reducing the financial burden on the patients and healthcare system. Besides, AI-driven medical technologies were found to support the healthcare system for the prevention, prediction, diagnosis, and personalized treatment of DFU. The present review article provides a brief overview of DFU and its pathophysiology. It highlights traditional DFU treatment strategies, their limitations, and focuses on emerging innovative strategies, emphasizing their potential for addressing DFU. Moreover, it sheds light on challenges and future research areas of these emerging interventions.

Ameer A, Shahzad A, Ahmad F, Ben Amara D, Nawaz H, Khan A, et al.

Biotechnological approaches for monitoring, mitigating, and bioremediating microplastic pollution: Developing sustainable alternatives to disposable plastics: A review.

J Hazard Mater Adv. 2026;22:24.

https://www.sciencedirect.com/science/article/pii/S277241662600149X?pes=vor&utm_source=clarivate&getft_integrator=clarivate

Microplastic pollution has become a significant environmental concern in recent years, mainly due to the extensive use of non-biodegradable plastics. These materials, which are often produced from petroleum-based hydrocarbons or natural biopolymers, are known for their durability and resistance to breakdown, leading to increased solid waste and environmental degradation. Microplastics comprise a variety of complex contaminants that can carry microbes and absorb harmful substances, presenting potential health risks to humans. In response to this issue, various biotechnological solutions have been developed, including enzymatic and microbial degradation and methods that utilize microorganisms with enzymatic functions. Recent microplastic removal techniques encompass microbial degradation, biodegradation, chemically facilitated coagulation-accumulationsedimentation, bioremediation, advanced oxidation processes, and genetc engineering. This review examines the sources, toxicity, and biodegradation of microplastics while detailing these biological methods, their characteristics, advantages, and limitations. It offers a comprehensive overview of current progress and obstacles in microplastic removal. The study suggests leveraging biotechnological techniques to improve degradation, including gene editing tools and bioinformatics. The findings from this review aim to assist policymakers in advancing research, developing prototypes, and formulating proposals that could significantly enhance water quality through effective remediation strategies.

Bandaru N, Patil YP, Ekghara SD, Patil KS, Bonthu MG.

Exploring marine-derived compounds as potential anti-cancer agents: Mechanisms and therapeutic implications.

Cancer Pathog Ther. 2026;4(3):192-207.

https://www.sciencedirect.com/science/article/pii/S2949713225000941?via%3Dihub

Marine-derived compounds have emerged as a promising frontier in cancer research due to their remarkable structural diversity and broad-spectrum bioactivities. The marine environment, encompassing diverse organisms (e.g., sponges, algae, tunicates, mollusks, and marine microbes), is a

prolific source of novel bioactive molecules with potent anti-cancer properties. Key classes of these compounds include alkaloids, polysaccharides, peptides, terpenoids, and polyketides, which exert anti-tumor effects through diverse mechanisms, including the induction of apoptosis, inhibition of angiogenesis, modulation of immune responses, interference with cell cycle progression, and targeting of critical signaling pathways involved in tumorigenesis and metastasis. Notably, marine-derived drugs such as trabectedin, eribulin, and plitidepsin have received regulatory approval for the treatment of various malignancies, demonstrating the translational potential of these natural compounds. Ongoing clinical and preclinical investigations are exploring a wide range of marine metabolites for their cytotoxic, anti-proliferative, and chemosensitizing properties. Advances in marine biotechnology, including genome mining, synthetic biology, and fermentation technologies, have significantly facilitated the discovery, sustainable production, and structural optimization of marine natural products. However, challenges such as low yield, structural complexity, limited water solubility, and poor bioavailability hinder their broader clinical application. The integration of novel drug delivery systems, such as nanoparticles, liposomes, and conjugates, offers a viable solution to overcome these limitations and improve pharmacokinetic profiles. This review provides a comprehensive overview of the mechanisms of action, therapeutic applications, and clinical development of marine-derived anti-cancer compounds. It also emphasizes the need for deeper insights into their molecular targets and the potential for synergistic use with existing chemotherapeutic agents. Future directions should focus on exploring untapped marine biodiversity, developing eco-friendly harvesting strategies, and developing innovative delivery platforms to fully harness the therapeutic promise of the marine pharmacopeia in oncology.

Bharti N, Modi U, Bhatia D, Solanki R.

Engineering delivery platforms for CRISPR-Cas and their applications in healthcare, agriculture and beyond.

Nanoscale Adv. 2026;8(4):1137-61.

https://pubs.rsc.org/en/content/articlepdf/2026/na/d5na00535c

Clustered regularly interspaced short palindromic repeats (CRISPR)-Cas systems have transformed genome editing through unprecedented precision, and next-generation variants (base and prime editors) further enhance specificity by enabling targeted nucleotide changes without introducing double-strand DNA breaks. These technologies have unlocked broad applications in therapeutic gene correction, functional genomics, infectious disease management, diagnostics, agricultural engineering, environmental biotechnology, and synthetic biology. However, the targeted delivery of these systems remains a major challenge due to the large and chemically distinct nature of their components, including Cas protein or its base/prime editor fusions, guide RNA, and in some cases, DNA repair templates-which complicate packaging, stability, and cellular uptake. Additional hurdles arise from tissue and cell-type specificity, differential intracellular environments, variable editing efficiencies, and the persistent risk of off-target genome modifications. This review outlines the key challenges in the delivery of CRISPR technologies as well provides a comprehensive overview of both current and emerging delivery strategies, including viral vectors (adenovirus, adeno-associated virus, and lentivirus), non-viral physical approaches (microinjection, electroporation, ultrasound, and hydrodynamic tail-vein injection), and nanoparticle-based modalities (lipid and polymeric nanoparticles, gold nanoparticles, DNA nanostructures, and extracellular vesicles). We also discussed the diverse applications of CRISPR-Cas9 in gene therapy, immune cell engineering for cancer therapies, and agricultural innovation.

Cherif H, Riahi L, Masmoudi AS, Cherif A.

Recent advances in the biotechnological application of plant growth-promoting rhizobacteria as biological control agents for the management of Alternaria spp.

Euro-Mediterr J Environ Integrat. 2026;11(5):18.

https://link.springer.com/article/10.1007/s41207-026-01139-3

Alternaria spp. (Pleosporaceae) constitute a cosmopolitan and taxonomically diverse group encompassing saprophytic, endophytic, parasitic, and environmental fungal species. These fungi are among the most widespread and challenging phytopathogens, affecting agronomic, and horticultural crops worldwide, including the Mediterranean region. They cause substantial pre-and post-harvest yield and quality losses and produce over 70 mycotoxins, posing serious risks to food safety and human and animal health. Management strategies, primarily reliant on chemical fungicides, face limitations due to pathogen resistance, public health risks and environmental concerns. Plant Growth-Promoting Rhizobacteria (PGPR) have emerged as effective biocontrol agents capable of suppressing Alternaria spp. through direct mechanisms, including the production of antifungal metabolites and lytic enzymes, as well as indirect mechanisms via the induction of systemic resistance (ISR) and improved plant nutrition and stress tolerance. Bacillus and Pseudomonas species are the most studied PGPR taxa, with many strains showing significant in vitro and in vivo efficacy against key pathogens such as A. alternata, A. solani, and emerging species including A. terricola, A. tenuissima, A. brassicae, A. ricini, and A. porri. Formulation innovations include the application of single strains, multi-strain consortia, and their integration with plant-derived compounds and soil amendments to enhance disease control and productivity. Advances in biotechnological approaches, including omics, transgenesis, genome editing, and predictive modelling, have improved PGPR-based strategies. These ecofriendly approaches mitigate fungal threats, promote plant growth, and support sustainable and resilient agricultural systems aligned with circular economy and global health principles. Critical insights into current limitations and future research challenges were discussed.

Evangelista A, Ruccolo L, Friuli V, Benazzo M, Conti B, Pisani S.

Advances in Fetal Repair of Spina Bifida Integrating Prenatal Surgery, Stem Cells, and Biomaterials.

Biomedicines. 2026;14(1):22.

https://doi.org/10.3390/biomedicines14010136

Spina bifida (SB) is a congenital malformation of the central nervous system (CNS), resulting from incomplete closure of the neural tube (NT) during early embryogenesis. Myelomeningocele (MMC), the most severe form of SB, leads to progressive neurological, orthopedic, and urological dysfunctions due to both NT developmental failure and secondary intrauterine injury ("two-hit hypothesis"). Prenatal repair of MMC has progressed considerably since the Management of Myelomeningocele Study (MOMS, 2011) trial, which showed that open fetal surgery can decrease the need for shunting and improve motor function, although it carries significant maternal risks. To address these limitations, minimally invasive techniques have been developed, with the goal of achieving similar benefits for the fetus while reducing maternal morbidity. Recent research has shifted toward regenerative strategies, integrating mesenchymal stem cells (MSCs), bioengineered scaffolds, and cell-derived products to move beyond mere mechanical protection toward true NT repair. Preclinical studies in rodent and ovine models have shown that amniotic- and placenta-derived MSCs exert neuroprotective and immunomodulatory paracrine effects, promoting angiogenesis, modulating inflammation, and supporting tissue regeneration. Minimally invasive, cell-based interventions such as Transamniotic Stem Cell Therapy (TRASCET), in preclinical rodent models, offer the possibility of very early treatment

without hysterotomy, although translation remains limited by the lack of large-animal validation and long-term safety data. In parallel, advances in biomaterials, nanostructured scaffolds, and exosome-based therapies reinforce a regenerative paradigm that may improve neurological outcomes and quality of life in affected children. Ongoing translational studies are essential to optimize these approaches and define their safety and efficacy in clinical settings. This review provides an integrated overview of embryological mechanisms, diagnostic strategies, and prenatal therapeutic advances in SB treatment, with emphasis on prenatal repair, fetal surgery and emerging regenerative approaches.

Favela-Hernández JM, Delgadillo-Ruiz L, Guerrero-Manriquez GG.

The Peels of Fruits and Vegetables: An Increasingly Recognized Source of Bioactive Compounds for Biomedical Applications.

Plants-Basel. 2026;15(7):18.

https://doi.org/10.3390/plants15070991

Bio-waste (i.e., peels), the by-products obtained from the processing of fruits and vegetables, represents an outstanding advance in agricultural waste valorization due to phytochemical (bioactive compounds) enrichment and the approach to a bio-circular economy and agronomic systems free of hazardous pesticides (soil remediation). These alternatives, which are environmentally friendly and sustainable, are greatly relevant to food and nutraceuticals based on bioactive compounds extracted mostly from peels. Bioactive compounds are defined as natural chemical compounds that have a positive influence on human health. They can aid in the prevention of chronic disease (cancer and degenerative, intestinal bowel and cardiovascular disease) and other types of disease. The bioactive compounds with these properties belong to the family of polyphenol compounds, which include flavonoids (i.e., flavones, flavanones, and anthocyanins), non-flavonoids (phenolic acids, stilbenes, lignin, coumarins, and tannins), and terpenes (carotenoids, lycopene, phytosterols, and monoterpenes). The extraction of these compounds from the peels of fruits and vegetables has gained increasing interest as a sustainable technology because of the use of safety solvents. Another important issue to highlight is the enormous potential of bioactive compounds, as mentioned above, in the biotechnology of these compounds, particularly in terms of the development of a delivery system targeting the site of action.

Haykal D, Benhamou AC, Lotti T, Duteille F.

3D bioprinting in regenerative medicine: From skin to organ engineering.

Ann Chir Plast Esthet. 2026;71(2):203-12.

https://doi.org/10.1016/j.anplas.2025.06.013

3D skin bioprinting is a transformative innovation in regenerative medicine, offering new possibilities for wound healing, reconstructive surgery, and disease modeling. By enabling the precise fabrication of patient-specific skin grafts, this technology addresses critical medical challenges, including severe burns, chronic ulcers, traumatic injuries, and genetic skin disorders. Advances in bioprinting techniques, bioink formulations, and vascularizati on strategies have enhanced graft integration and functional restoration, avoiding immune rejection risks. Beyond transplantation, 3D skin models provide a powerful platform for dermatological research, pharmacological testing, and tissue engineering, accelerating drug discovery while minimizing reliance on animal testing. Additionally, 3D bioprinting is revolutionizing cosmetic and reconstructive dermatology, enabling personalized aesthetic procedures, scar treatments, and anti-aging interventions that complement clinical applications. The future of 3D skin bioprinting lies in multi-tissue fabrication, AI-assisted biofabrication, and immunomodulatory

grafts, which could revolutionize personalized medicine and regenerative healthcare. Despite ongoing challenges in clinical scalability and regulatory pathways, continued interdisciplinary research is driving the field closer to real-world medical applications. This review provides a structured timeline of advancements, compares bioprinting techniques, and offers specific examples of clinical and commercial applications. It concludes with a discussion of future directions, emphasizing sustainable bioinks, AI-assisted fabrication, and ethical frameworks. (c) 2025 Published by Elsevier Masson SAS.

Kumar V, Verma P.

Advances in microbial biotechnology for sustainable wastewater reclamation: recent trends and future prospects.

World J Microbiol Biotechnol. 2025;41(12):478.

https://link.springer.com/article/10.1007/s11274-025-04674-3

The growing demand for freshwater, coupled with the increasing volume of industrial and municipal wastewater, has intensified the need for sustainable and eco-friendly reclamation strategies. Recent advancements in microbial biotechnology have emerged as promising tools for developing cost-effective, efficient, and environmentally sustainable wastewater treatment (WWT) strategies for reuse and safe disposal. This mini-review explores current innovations, such as microbial consortia, bioaugmentation, and the microalgae-bacteria nexus, which have shown promising results in nutrient removal, enhanced degradation of complex pollutants (including emerging contaminants), and biomass valorization. Moreover, bioelectrochemical systems, such as microbial fuel cells (MFC) and microbial electrolysis cells (MEC), have revolutionized WWT by facilitating pollutant degradation while simultaneously generating bioelectricity or biohydrogen. This article also critically examines the role of CRISPR-based tools and 'omics' approaches, which have enabled the development of novel microbial strains and degradative pathways, enhancing wastewater reclamation in challenging environments. Furthermore, advancements through the integration of multi-omics and artificial intelligence, digital twins, and Internet of Things (IoT) for microbial optimization and real-time process control are discussed. The review highlights the role of microbial systems in resource recovery, supporting a circular economy by transforming wastewater into valuable bioresources. Additionally, this review addresses the major challenges and proposes future research directions for effective wastewater treatment. The novelty of this manuscript is that no single review explores the cutting-edge microbial biotechnologies for wastewater reclamation, uniquely integrating CRISPR-Cas genome editing, multi-omics analyses, and artificial intelligence-driven optimization to advance pollutant degradation and real-time process control in one place. This study concludes that by implementing multi-omics and artificial intelligence (AI)-driven optimization process for wastewater treatment can be effective towards wastewater treatment while simultaneously minimizing the environmental pollution.

Li HT, Pan HY, Feng MS.

Enhancing osteoporosis treatment: emerging roles of engineered exosomes in bone regeneration and repair.

J Transl Med. 2026;24(1):20.

https://link.springer.com/content/pdf/10.1186/s12967-025-07653-2.pdf

Background Osteoporosis, a prevalent metabolic bone disease, is characterized by reduced bone density and an increased risk of fractures. The primary challenge in treating osteoporosis lies in correcting the imbalance between bone resorption and formation while minimizing the associated risks of treatment. Current drugs, such as bisphosphonates, teriparatide, and romosozumab, help

reduce fracture risk but have limitations, including long-term safety concerns, incomplete protection, and poor patient adherence. Main body Exosomes, small extracellular vesicles with natural biocompatibility and low immunogenicity, have emerged as promising therapeutic candidates for osteoporosis. These vesicles carry bioactive molecules that regulate bone remodeling, promote osteogenesis, and inhibit osteoclastogenesis. Advances in bioengineering have improved the targeting efficiency and drug-loading capacity of exosomes, while their combination with biomaterials supports localized and sustained bone regeneration. The review explores the signaling mechanisms that contribute to osteoporosis and highlights the biological functions of exosomes. Furthermore, it addresses the challenges in translating exosome-based therapies, such as variability in exosome content, production standardization, scalability, and unresolved safety concerns. Preclinical models play a key role in assessing therapeutic efficacy. The review also considers interdisciplinary innovations, including nanotechnology, biomaterials, advanced imaging, and artificial intelligence, and their potential to enhance the translation of exosome therapies. Conclusions Exosome therapies represent a promising next-generation strategy for the treatment of osteoporosis. With continued advancements in engineering, clinical evaluation, and interdisciplinary innovations, exosomes could offer safer, more effective, and personalized treatment options for osteoporosis. However, challenges remain in ensuring the consistency, safety, and scalability of exosome production, which must be addressed before widespread clinical adoption.

Lisboa HM, Lima J, Monteiro SS, Pasquali MB.

Microbial biorefinery of food processing residues advances ecosystem services and sustainable waste management.

Discov Sustain. 2026;7(1):38.

https://link.springer.com/content/pdf/10.1007/s43621-026-02944-0.pdf

Food-processing industries generate large volumes of organic by-products are frequently underutilized, leading to avoidable environmental burdens when disposed. Microbial biorefineries offer a route to convert these heterogeneous residues into biofuels and high-value chemicals/materials under mild conditions, supporting circular-bioeconomy objectives. This review synthesizes recent advances in microbial valorization of food-processing residues by explicitly linking feedstock physicochemical attributes such as moisture content and spoilage risk, structural recalcitrance, C/N balance, ash/mineral fraction, and inhibitory compounds, to pretreatment needs and bioreactor choice and to culture strategies. We discuss major product portfolios-including ethanol, biogas, organic acids, polyols, polyhydroxyalkanoates, biosurfactants, enzymes, and biosorbents-and highlight representative performance metrics and scale-up considerations. To facilitate cross-comparison, we compile indicative residue generation volumes and summarize key feedstock attributes relevant to microbial accessibility and process selection, and we benchmark sustainability evidence from techno-economic and life-cycle studies using reported metrics where available. Finally, we identify major bottlenecks such as feedstock conditioning, contamination control, downstream separation, and regulatory/market constraints, and outline opportunities for integrated and hybrid valorization schemes that improve carbon efficiency and ecosystem-service outcomes. Overall, the review provides a decision-oriented framework for selecting microbial routes aligned with feedstock properties, product targets, and sustainability goals.

Lokeshwari B, Saranraj P, Al-Abedi HFH, Al-Abedi SFH, Al-Magsoosi HHE, Jaafar MT, et al.

Keratinolytic Fungi for Poultry Feather Waste Valorization: Mechanisms, Biotechnological Applications, Economic Feasibility, and Future Perspectives.

Resources-Basel. 2026;15(3):41.

https://doi.org/10.3390/resources15030046

The rapid expansion of the poultry industry has led to the large-scale generation of feather waste, creating serious environmental and public health concerns due to the recalcitrant nature of keratin. Poultry feathers are composed mainly of highly cross-linked keratin proteins stabilized by numerous disulfide bonds, which confer resistance to conventional proteolytic enzymes and natural degradation processes. This review examines the potential of keratinolytic fungi and their enzymes as sustainable, eco-friendly, and value-added strategies for poultry feather waste management and resource recovery. It discusses the environmental and health risks associated with improper feather disposal, such as pathogen proliferation, odor generation, and ecosystem contamination. Conventional management approaches, steam pressure hydrolysis, mechanical grinding, thermal treatment, acid-alkali hydrolysis, and oxidation, are critically evaluated in terms of efficiency and environmental impact. The review further highlights biological degradation pathways mediated by keratinolytic fungi and enzymes, with emphasis on fungal genera such as Aspergillus and Chrysosporium. Key mechanisms of fungal keratin degradation, including sulfitolysis, proteolysis, deamination, hyphal penetration, enzyme secretion, and biofilm formation, are discussed. Finally, industrial, agricultural, and feed applications of keratinases, along with advances in strain improvement, omics technologies, synthetic biology, and associated biosafety and regulatory considerations, are addressed.

Lukito BR, Sofeo N, Lim HJ, Taufik MHB, Arumugam P, Yu AQ, et al.

Expanding biotechnological applications of Yarrowia lipolytica: Key advances in the past decade.

Biotechnology advances. 2026;88:31.

https://doi.org/10.1016/j.biotechadv.2026.108835

Yarrowia lipolytica is a non-conventional yeast with innate oleaginous metabolism and unusual tolerance for hydrophobic substrates, positioning it as a prime chassis for waste-enabled precision fermentation. In this review, we consolidate advances associated with Yarrowia over the past decade into a coherent, trait-centered framework that links biological capabilities to manufacturing performance. We studied genetic toolkits, adaptive laboratory evolution and mating/fusion for strain hardening and phenotype expansion, and combinatorial metabolic engineering strategies (push-pull-block lipid routing, stage-and compartment-specific expression, export engineering) that together improved production titer, rate, and yield across various scales. By organizing metabolic products based on core pathways, namely, the tricarboxylic acid cycle, mevalonate pathway, pentose phosphate pathway, and fatty acid biosynthesis, and pairing each class with the specific chassis edits that enabled leading titers, we provide actionable guidance for target selection and de-risked development. Finally, we propose a roadmap leveraging emerging approaches, AI-guided design, intensified bioprocessing, and precision co cultures, as key enablers of a scalable, circular bioeconomy with Y. lipolytica as a platform strain.

Madhi M, Gholizadeh P.

CRISPR-Cas9: Genome Engineering and Future Vaccine Applications.

Mol Biotechnol. 2026:23.

https://link.springer.com/content/pdf/10.1007/s12033-026-01563-4.pdf

The CRISPR-Cas9 system, a transformative genome engineering tool derived from prokaryotic adaptive immunity, is reshaping the landscape of biological research and therapeutic development. This review provides a critical synthesis of its rapidly evolving, yet underexplored, application in rational vaccine design. We analyze how CRISPR-Cas9 and its derivative platforms (including base editing, prime editing, and CRISPRi/a) are being repurposed from therapeutic gene editing to become indispensable assets in vaccinology. This transition is powered by the convergence of CRISPR-mediated precision with synthetic biology, enabling the rapid engineering of novel vaccine vectors and attenuated strains, the precise optimization of antigen sequences for enhanced breadth and potency, and the direct modulation of host immune responses. Notwithstanding this potential, significant technical and translational hurdles persist, including off-target editing risks, delivery inefficiencies in vivo, and unresolved regulatory pathways for genetically modified vaccines. We detail these mechanisms and evaluate the current preclinical and clinical landscape, while addressing persistent challenges in safety, delivery, and scalability. By delineating these advances and obstacles, this review outlines a forward-looking framework for leveraging CRISPR technology to create programmable, precision vaccines against emerging and re-emerging pathogens, moving the field beyond empirical methods toward a new paradigm of rational immunization.

Marchezi G, Concolato G, Colla LM, Piccin JS.

Biotechnological adsorbents for removal of drugs from water: use of microorganisms, biopolymers, and composite materials.

International Journal of Environmental Science and Technology. 2026;23(4):18.

https://link.springer.com/content/pdf/10.1007/s13762-026-07040-4.pdf

Emerging contaminants pose significant risks to environmental and human health, warranting detailed investigation. Among these contaminants, pharmaceuticals and their metabolites are of particular concern, as they are widely released into the ecosystem. Their chemical and biological stability contributes to their persistence in aquatic systems and limits the effectiveness of conventional water treatment technologies. Adsorption is one of the most commonly used advanced treatment techniques for removing pharmaceuticals due to its favorable operation and cost-effectiveness. The use of adsorbents obtained through biotechnological processes has emerged as a promising approach due to their efficiency and environmental sustainability. Promising biotechnological adsorbents include live microorganisms such as fungi, bacteria, and microalgae. Dead or inactive biomass also shows applicability, being considered lower in cost. Additionally, algae and adsorbents based on natural polymers obtained through biotechnological processes, such as sodium alginate, bacterial cellulose, and chitosan, stand out. Biocomposites enable the combination of desirable characteristics from more than one material, resulting in adsorbents with better performance and lower environmental impact compared to conventional alternatives. Moreover, adsorption processes employing biocomposites often operate under mild conditions, such as neutral pH and ambient temperature, further increasing their applicability. Thus, this literature review aims to explore the application of adsorption processes for the removal of pharmaceuticals from water using adsorbents derived from biotechnological processes.

Mohapatra R, El Din DMA, Zhao HY, Hartung T, Smirnova L.

Towards learning and memory risk assessment with human brain organoids: barriers and opportunities.

Front Toxicol. 2026;8:12.

https://www.frontiersin.org/journals/toxicology/articles/10.3389/ftox.2026.1783893/pdf

Neurodevelopmental conditions, including autism spectrum disorder, intellectual disability, and learning disabilities, as well as neurodegenerative disorders, affect millions of people in the United States alone. Both genetic and environmental factors contribute to their onset, yet traditional neurotoxicity testing often fails to identify specific risks or mechanisms underlying cognitive impairment. Human brain organoids (hBOs), also called neural organoids or brain microphysiological systems, are three-dimensional (3D) stem cell-derived models that recapitulate key features of human brain development and offer greater physiological relevance than traditional 2D in vitro or animal models. The emerging field of "organoid intelligence" integrates these systems with advanced bioengineering and artificial intelligence to model higher-order neural functions and assess learning and memory-relevant endpoints that were previously less explored in vitro. Despite this promise, we have identified four key barriers that hinder the application of hBOs for the hazard identification phase of functional neurotoxic risk assessments: [1] limited maturity and regional complexity, [2] lack of high-throughput defined procedures for assessing cognitive development and function in vitro, [3] limited standardization for reproducibility, and [4] challenges in translating in vitro results to human health outcomes. Here, we outline current efforts to overcome these challenges, i.e., scientific, technical, and regulatory advances. We also illustrate how hBO-based assays can be applied to advance both mechanistic understanding and the regulatory evaluation of environmental (developmental) neurotoxicants, using heavy metals as a model.

Singh SK, Sharma A, Sundaram S.

Integrated algal systems for industrial CO2 mitigation: advances, challenges, and prospects in environmental biotechnology.

Arch Microbiol. 2026;208(5):21.

https://link.springer.com/article/10.1007/s00203-026-04765-1

Carbon dioxide (CO2) constitutes approximately two-thirds of total anthropogenic greenhouse gas emissions and therefore represents the primary target for mitigation strategies. Among the available approaches, algal-based CO2 capture has emerged as a promising biological option due to the high photosynthetic efficiency, rapid growth rates, and capacity of microalgae to utilize concentrated CO2 streams directly from industrial point sources. Under optimized laboratory and pilot-scale conditions, algal systems have been reported to achieve CO2 fixation rates in the range of approximately 0.1-1.5 g CO2 L-1 d-1, corresponding to areal biomass productivities of roughly 10-40 g m-2 d-1, depending on species, reactor configuration, and environmental conditions. This review critically evaluates the potential of algal-based systems for CO2 biofixation, with particular emphasis on algal carbon assimilation mechanisms, cultivation strategies, and operational constraints relevant to large-scale deployment. Key parameters influencing CO2 capture efficiency, including light irradiance, pH, nutrient availability, and gas-liquid mass transfer are systematically discussed. The role of algal-bacterial consortia in enhancing carbon utilization and enabling integration with wastewater treatment processes is also examined. Furthermore, the review compares open and closed cultivation systems, highlighting trade-offs among productivity, energy demand, contamination risk, and economic feasibility. While emerging approaches such as hybrid cultivation concepts and process-intensification strategies offer pathways to improve system performance, their practical implementation remains constrained by downstream processing costs and scale-up challenges. Overall, the analysis suggests that algal-based CO2 mitigation is most effective when deployed as part of integrated biorefinery frameworks, particularly in conjunction with wastewater treatment and value-added biomass utilization-rather than as a standalone carbon sequestration solution. This integrated perspective provides a balanced assessment of the opportunities and limitations of algae-based CO2 mitigation within sustainable climate and environmental management strategies.

Taghilou M.

Biotechnological Strategies to Enhance Fragrance Longevity and Sustainability: Focus on Bio-Based Materials and Green Technologies-A Review.

Flavour Frag J. 2026;41(3):449-54.

https://onlinelibrary.wiley.com/doi/pdfdirect/10.1002/ffj.70052?download=true

This review aims to discover biotechnological strategies applicable to both natural and synthetic fragrances for enhancing longevity and sustainability, addressing the challenge of limited scent duration in personal care products. A comprehensive literature review was conducted, analysing advancements in bio-based substances, enzymatic technologies, nanotechnology, microbial biosynthesis, microencapsulation, and genetic engineering. Key findings consist of the use of biodegradable polymers (e.g., alginate, polylactic acid) for sustained perfume launch, metagenomic enzymes (e.g., Est16, Lip-1420) for stabilising compounds, and CRISPR-based genetic engineering for greater terpenoid biosynthesis. Nanotechnology and microencapsulation shield high-risk compounds, while microbial methods offer scalable, eco-friendly production. Biotechnological innovations provide sustainable, high-performance answers for fragrance formulations, with promising implications for enterprises and environmentally conscious clients.

Wang XT, You JS, Li XY, Xu YP, Li ZY, Wang LL.

Limitations of traditional mycotoxin control and biotechnological advances toward sustainable solutions.

Biotechnology advances. 2026;88:14.

https://doi.org/10.1016/j.biotechadv.2026.108836

Mycotoxins are harmful fungal metabolites that contaminate food and feed, posing serious health and economic risks worldwide. Traditional control methods often fall short due to inefficiency and safety concerns, prompting the development of innovative biotechnological approaches. This review explores recent advances in mycotoxin management, focusing on engineered microbes for targeted degradation, nanotechnology-based detection and removal systems, phage therapy targeting toxin-producing fungi, CRISPR-Cas gene editing of mycotoxin biosynthesis pathways, and plant-microbe interactions that suppress fungal growth. Additionally, enzyme immobilization strategies are highlighted for improving enzyme stability and reusability in detoxification processes. These integrated biotechnological tools offer promising, sustainable solutions to mitigate mycotoxin contamination, enhancing food safety and agricultural productivity. The review also discusses current challenges and future directions for translating these advances into practical applications. Highlighting that biotechnological tools are technically feasible and increasingly close to industrial deployment in food and feed chains.

Organismes français et internationaux - Actualités

Suivi d'organismes français et internationaux. Sélection d'actualités classées par thème.

- **Crises sanitaires et épidémies**

ANRS – Maladies infectieuses émergentes, Rencontre inter-plateformes : renforcer la coordination nationale face aux crises sanitaires et épidémies, 10/04/2026.

- **Ebola – suite épidémie République démocratique du Congo et Ouganda**

DGS-Urgent, Maladie à virus Ebola (MVE) : vigilance renforcée et conduite à tenir devant un cas suspect, 29/05/2026.

Info.gouv, Ebola : point de situation et mesures mises en œuvre, dernière mise à jour 20/05/2026.

Santé publique France, Ebola : point de situation, dernière mise à jour 22/05/2026.

ANRS Maladies infectieuses, Cellule Emergence filovirus (Ebola), 26/05/2026.

Institut Pasteur, L'Institut Pasteur confirme par séquençage complet l'origine latino-américaine de l'Hantavirus Andes détecté à bord du MV Hondius, 15/05/2026.

ECDC,

Ebola disease outbreak in the Democratic Republic of the Congo and Uganda, dernière mise à jour 01/06/2026.

Risk to Europe remains very low as Ebola outbreak intensifies in DRC, 21/05/2026.

OMS/WHO, Joint statement by the Government of the Democratic Republic of the Congo and WHO concerning the outbreak of Ebola disease caused by the Bundibugyo virus, 31/05/2026.

- **Hantavirus – suite épidémie à bord du MV Hondius**

Légifrance, Décret n° 2026-364 du 10 mai 2026 prescrivant les mesures d'urgence nécessaires à la gestion du risque d'infection à hantavirus Andes, version consolidée en vigueur au 01/06/2026.

Santé Publique France, dossier web Hantavirus/données, voir encadré « Cas d'hantivirus Andes à bord du navire MV Hondius », dernière mise à jour 26/05/2026.

Ministère de la Santé,
Hantavirus, le point sur les mesures santaires en France, dernière mise à jour 21/05/2026.
Foire aux questions sur l'hantavirus Andes, dernière mise à jour 12/05/2026.
Cas d'Hantavirus à bord du navire MV Hondius - Evacuation des ressortissants français, 10/05/2026.

DGS-Urgent, Alerte internationale : cluster de cas d'hantavirus, 11/05/2026.

ANRS Maladies infectieuses émergentes, Cellule Emergence hantavirus, 11/05/2026.

ECDC, Andes hantavirus outbreak in cruise ship, dernière mise à jour 26/05/2026.

OMS, Réponse de l'OMS à des cas d'infection à hantavirus survenus sur un navire de croisière, 07/05/2026.

- ## Hépatite A – suite épidémie Loire-Atlantique

DGS-Urgent, Situation épidémiologique et recommandations sanitaires : épidémie d'hépatite A en Loire-Atlantique + annexe, 23/03/2026.

- ## Infections invasives bactériennes/fongiques

HCSP, Mise à signalement obligatoire des cas d'infection invasive à *Haemophilus influenzae*, 07/04/2026.

Institut Pasteur, Un nouveau test PCR plus fiable pour détecter l'aspergillose invasive, 09/04/2026

ECDC,

ECDC warns of growing spread of multidrug-resistant Shigella in Europe, 20/05/2026.

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