



ČETVRTA MEĐUNARODNA EUROSA KONFERENCIJA

KNJIGA APSTRAKATA

13–16. maj 2026.

Hotel Vrnjačke terme, Vrnjačka Banja, Srbija



Hibridni događaj
13-16. maj 2026.
Hotel Vrnjačke terme, Vrnjačka Banja, Srbija

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METABOLIČKI SINDROM I OSA

Martin Popević,

VMA

Metabolički sindrom (MS) i opstruktivna apneja u spavanju (OSA) su relativno česte bolesti širom sveta. MS je kompleksni poremećaj koji karakteriše abdominalna (centralna) gojaznost, insulinska rezistencija, arterijska hipertenzija, dislipidemija, oksidativni stres i hronična inflamacija. Ovaj sindrom je prisutan kod skoro trećine adultne populacije širom sveta, sa većom zastupljenošću kod osoba ženskog pola i u starijim uzrastu. Sindrom povećava rizik od razvoja kardiovaskularnih bolesti i OSA. Abdominalna gojaznost i insulinska rezistencija su u osnovi patofiziologije MS. Sindrom opstruktivne apneje u spavanju (OSA) je hronično oboljenje koje se karakteriše repetitivnim prekidima u disanju tokom spavanja, usled kompletnog ili parcijalnog kolapsa faringealnog dela disajnog puta. Prema trenutnim procenama, svaka osma osoba na našoj planeti boluje od OSA, od čega oko 400 miliona ljudi ima tešku formu koja zahteva trenutno lečenje. Bolest nije prepoznata kod 85% pacijenata. Osnovni patofiziološki mehanizmi OSA, intermitetna hipoksija i fragmentacija sna su odgovorni za pojačanu aktivaciju simpatičkog dela autonomnog nervnog sistema, oksidativni stres, sistemsku inflamaciju, endotelnu disfunkciju i poremećaje koagulacije. Posledično dolazi do promocije insulinske rezistencije, razvoja hiperglikemije, dislipidemije, centralne depozicije masti i arterijske hipertenzije, koji čine osnovu metaboličkog sindroma. Pacijenti sa OSA imaju abnormalnosti u svakoj od „osnovnih“ komponenti metaboličkog sindroma – visok krvni pritisak, visok nivo glukoze na natašte, povećan obim struka, nizak holesterol lipoproteina visoke gustine (HDL-C) i visoke trigliceride. OSA takođe podstiče metaboličku disfunkciju i povećava učestalost MS-a u celini, kao i njegovih pojedinačnih komponenti. SA je često prisutna kod osoba sa mikro i makrovaskularnom endotelnom disfunkcijom, subkliničkom aterosklerozom i razvijenim kardiovaskularnim poremećajima (arterijska hipertenzija, srčana insuficijencija, atrijska fibrilacija, ishemijska bolest srca) i predstavlja nezavisni faktor rizika za nastanak navedenih bolesti. Gojaznost povećava verovatnoću OSA za 2-10 puta, najviše kod osoba srednje životne dobi. Postoji više prepoznatih mehanizama uticaja gojaznosti, kao što je izmena morfologije gornjih disajnih puteva usled depozicije masti u parafaringealnim jastučićima i tkivu jezika, zatim poremećaj ventilacije pluća (smanjen plućni volumen, hipoventilacija, smanjeno trahealno povlačenje i sekundarna nestabilnost ventilacije) usled nagomilavanja masti u predelu grudnog koša i abdomena. Masno tkivo sekretuje hormon leptin koji može doprineti nestabilnosti disanja povećanjem hemorefleksne senzitivnosti na CO₂. Samo 10-15% populacije sa dijagnozom OSA ima indeks telesne mase u fiziološkim granicama. Rani tretman OSA primenom kontinuiranog pozitivnog pritiska putem tzv. CPAP aparata, mera redukcije telesne težine i fizičke aktivnosti ima korisne efekte i na pojedinačne komponente MS; stoga je rana identifikacija i lečenje OSA kod pacijenata sa metaboličkim sindromom od suštinskog značaja.

Ključne reči: metabolički sindrom, OSA, gojaznost, arterijska hipertenzija

PROMOCIJA ZDRAVLJA NA RADNOM MESTU

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Apstrakt:

Promocija zdravlja na radnom mjestu predstavlja važan segment savremenog javnog zdravlja, naročito u uslovima povećane izloženosti stresu i sedentarnom načinu života. Posebno su ugroženi bankarski službenici, kod kojih specifični uslovi rada, uključujući dugotrajno sjedenje, visok nivo odgovornosti i vremenski pritisak, doprinose razvoju hroničnih nezaraznih bolesti. Metabolički sindrom definiše se kao skup međusobno povezanih metaboličkih i hemodinamskih poremećaja, uključujući abdominalnu gojaznost, insulinsku rezistenciju, dislipidemiju i arterijsku hipertenziju, koji značajno povećavaju rizik za razvoj dijabetesa melitusa tip 2 i kardiovaskularnih oboljenja. Njegova prevalencija je u stalnom porastu, što ga svrstava među vodeće javnozdravstvene probleme savremenog društva. Bankarski službenici predstavljaju rizičnu grupu zbog kombinacije profesionalnog stresa i smanjene fizičke aktivnosti, što pogoduje nastanku insulinske rezistencije i abdominalne gojaznosti kao ključnih komponenti metaboličkog sindroma. Savremeni uslovi rada dodatno doprinose povećanju psihosocijalnog opterećenja i smanjenju ukupne radne sposobnosti. Promocija zdravlja, zasnovana na principima Svjetska zdravstvena organizacija i Otavske povelje, podrazumijeva integrisane mjere usmjerene na unapređenje zdravih stilova života, smanjenje faktora rizika i poboljšanje radne sredine. Poseban značaj imaju intervencije usmjerene na povećanje fizičke aktivnosti, pravilnu ishranu i kontrolu stresa. Primjena ovih mjera u radnoj sredini može značajno doprinijeti prevenciji metaboličkog sindroma, smanjenju incidencije hroničnih nezaraznih bolesti i unapređenju kvaliteta života zaposlenih. Istovremeno, pozitivni efekti ogledaju se i u povećanju produktivnosti, smanjenju apsentizma i ukupnom socioekonomskom napretku.

Ključne riječi: metabolički sindrom, promocija zdravlja na radu, bankarski službenici, radno mjesto, insulinska rezistencija, abdominalna gojaznost, stres na radu, javno zdravlje

HRONIČNE BOLESTI KAO UZROČNIK INVALIDNOSTI – NOVE TERAPIJSKE MOGUĆNOSTI – Prikaz slučaja

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Apstrakt: Hronične bolesti kao što su kardiovaskularne bolesti (KVB), srčana insuficijencija (SI), hronična bubrežna insuficijencija (HBI) i šećerna bolest (DM) sa komplikacijama, su uz maligne bolesti najčešći uzročnici potpunog ili delimičnog gubitka radne sposobnosti. Visoka prevalenca hroničnih bolesti je rezultat starenja populacije i uticaja faktora rizika. Procenjuje se da osobe sa šećernom bolešću (DM) imaju 2x veći rizik za dobijanje KVB, a 33x veći rizik za razvoj HBI, pri čemu je značajno povećan rizik od KV smrti u stadijumu 3 HBI. Više od četvrtine osoba sa inicijalnim stadijumom 3 bubrežne slabosti završi na dijalizi.

Prema propisima o penzijskom i invalidskom osiguranju invalidnost postoji kada zbog promena u zdravstvenom stanju, koje se ne mogu odkloniti lečenjem, nastane potpuni ili delimični gubitak radne sposobnosti. Po važećem Zakonu o penzijskom i invalidskom osiguranju pravo na invalidsku penziju se stiče sa potpunim (100%) gubitkom radne sposobnosti nastalim usled povrede ili bolesti (van rada ili na radu). Po prethodnim propisima to pravo se sticalo sa gubitkom od 75%. Posledica toga je veći broj radnika u radnom procesu sa manjim ili većim ograničenjem radne sposobnosti. Pacijent 1 je 2009.g. zbog naglog pada ejekcione frakcije ispod 35% bio kandidat za invalidsku penziju. Od 2011.g. je na terapiji sa SGLT2 inhibitorima, a nešto kasnije i sa ARNI uz beta blokator i MRI kada se EF LK vraća na >50% i održava do 2025.g. Pacijent je zahvaljujući terapiji bio potpuno radno sposoban još 16 godina. Pacijent 2 je 2011.g. zbog insulinske zavisne šećerne bolesti sa svim komplikacijama imao izrazito ograničenu radnu sposobnost nakon infarkta miokarda. Tada su mu eksperimentalno uvedeni SGLT2 i GLP1 koji su doveli do značajne redukcije telesne težine, poboljšanja lipidnog statusa, bolje glikemijske kontrole, gubitka proteinurije i do vraćanja radne sposobnosti. Iako je dobio zabranu teškog rada, pacijent je nastavio sa teškim fizičkim radom. Radnu sposobnost je izgubio 2025.g., što znači da mu je ista produžena za 14 godina. Otkrićem novih lekova (SGLT2 inhibitori, GLP1 agonisti), i uvođenjem novih terapijskih procedura i skrininga za rano otkrivanje HBI, omogućena je bolja kontrola faktora rizika, prevencija komplikacija, što menja tok bolesti i značajno poboljšava i produžava radnu sposobnost.

THE IMPACT OF AGE AS A RISK FACTOR IN THE SYMPTOMS OF MUSCULOSKELETAL DISORDERS RELATED TO THE WORK OF A DEFINED

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Abstract

Introduction: If musculoskeletal disorders are caused or aggravated by work and/or the effects of the immediate work environment, they are called work-related musculoskeletal disorders. The physical capabilities that enable people to cope with the physical demands of work are naturally subject to decline with age. **Aim:** The aim of the paper is to assess the influence of age as a risk factor in the development of symptoms of musculoskeletal disorders related to work in a defined group of nurses. **Material and method:** The study included 160 nurses divided into two groups. The first group is nurses under 45, and the second group is nurses over 45 years of age. The instrument used is: Medical history questionnaire and checklist for work-related MSD symptoms from the Canadian Centre for Occupational Health and Safety **Results:** Musculoskeletal pain was registered in a total of 136 (85%) nurses, of which 71 (100%) nurses over 45 years of age, and 65 (73.0%) nurses under 45 years of age. 20.2% of nurses under 45 years of age and more than half (57.7%) of nurses over 45 years of age were absent from work due to musculoskeletal disease. 33.8% of nurses over 45 years of age were hospitalized due to musculoskeletal disorder. **Conclusion:** The above studies and the results of our study indicate a significant influence of age on the development of symptoms of work-related musculoskeletal disorders in nurses. Hence the need for timely ergonomic intervention and regular health monitoring

Keywords: aging, musculoskeletal disorders, nurses

PRESENCE OF WORK-RELATED FATIGUE AMONG OFFICE WORKERS

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Introduction: Work fatigue is a significant issue related to workers' health, comfort, and overall well-being. It affects not only physically demanding occupations but also office-based work, where prolonged sitting, screen exposure, and mental strain contribute to fatigue. Work fatigue has a considerable impact on productivity and occupational safety. According to the International Labour Organization (ILO), work-related accidents caused by fatigue result in the deaths of approximately two million workers each year.

Materials and Methods: The study was conducted among 176 office workers whose work is predominantly mentally demanding in the city of Sofia. The gender distribution of participants shows that female respondents predominate - 60%, and male respondents are 40%.

Results: The data reveal notable changes in fatigue-related symptoms over the course of the workweek. Physical and mental fatigue indicators, such as whole-body fatigue (from 16% to 40%), headache (from 14% to 32%), difficulty maintaining working posture (from 20% to 26%), and lack of patience (from 32% to 42%), increase significantly by the end of the workweek. Similarly, symptoms like a "clouded mind" and inability to concentrate show slight increases. In contrast, some symptoms decrease toward the end of the week, including sleepiness (from 74% to 42%), nervousness (from 48% to 42%), anxiety (from 54% to 42%), and boredom during conversations (from 40% to 36%). Difficulty in thinking remains constant at 24% throughout the week. Overall, the findings suggest that while physical fatigue and certain cognitive difficulties accumulate over the workweek, some emotional and alertness-related symptoms tend to decrease by Friday.

Conclusion: Work fatigue not only decreases work performance but also increases the risk of accidents, making it a key factor in workplace health and safety.

Keywords: This highlights the seriousness of the problem and the need for effective measures to reduce its impact. Work-related mental fatigue, Office workers, Employee well-being, Fatigue management, Productivity

GLOBAL PERSPECTIVES ON ENVIRONMENTAL MANAGEMENT SYSTEMS: EVOLUTION AND PRACTICAL IMPLICATIONS OF ISO 14001:2026

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Abstract: Environmental protection is a constantly evolving process, influenced by technological progress, the introduction of new materials and substances, increasing resource consumption, and the generation of more complex waste streams, often with uncertain long-term behavior and limited recycling options. These developments create new challenges that require organizations to continuously adapt and integrate environmental considerations into their decision-making. ISO 14001 has evolved from a focus on regulatory compliance and pollution control to a more structured, risk-based approach, where organizations are expected not only to meet requirements, but to show measurable results. Developed through the participation of 176 countries, the standard represents a shared global approach to environmental management. This paper analyses the key changes introduced in the latest revision of ISO 14001, with a focus on leadership, risk-based thinking, and system integration in practice. It also examines how these changes influence environmental protection and occupational health and safety through more structured risk management. Particular attention is given to the strengthening of lifecycle thinking and supply chain control, the clearer distinction between normal, abnormal, and emergency conditions, and the enhancement of performance evaluation through objective-based auditing and structured management review. The findings highlight the convergence between environmental management and occupational health and safety, especially in the context of risk assessment and emergency preparedness. The paper contributes by interpreting ISO 14001 as both a reflection of global environmental priorities and a practical framework for integrated, evidence-based management.

Keywords: *ISO 14001:2026; environmental management systems; risk-based approach; lifecycle thinking.*

AI FOR HEALTH RISK ASSESSMENT IN OCCUPATIONAL SAFETY SYSTEMS

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Abstract: Occupational health and safety (OHS) management still relies largely on periodic inspection, static documentation and reactive intervention, which limits the ability of OHS professionals to respond to short-term exposure events. This paper proposes a four-layer framework coupling continuous workplace monitoring to artificial-intelligence-supported health-risk assessment, automated workflow and post-intervention verification, instantiated through a construction-site PM₁₀ scenario. Three methodological issues frequently left implicit in real-time OHS monitoring are addressed explicitly: the mismatch between ambient PM₁₀ sampling conventions and the inhalable and respirable conventions on which occupational exposure limits are defined; the requirement that measured and reference concentrations share an averaging time; and the separation of verified engineering controls from respiratory protective equipment in the risk calculation. A dynamic risk index is defined that combines shift-averaged exceedance, short-term peak exceedance, hazard severity and worker vulnerability, attenuated only by verified engineering and organisational controls. A shown example depicts a task whose 8h time-weighted average exceeds an internal action level and constitutes a high-risk condition once short-term peaks are represented. The framework is a conceptual and methodological specification rather than a validated deployed system, and is intended to support rather than replace qualified OHS professionals.

Keywords: *occupational health and safety; AI agents; exposure assessment; PM₁₀; construction sites.*

CONSTRUCTION-RELATED PM₁₀ EMISSIONS AND HUMAN HEALTH RISK ASSESSMENT IN A RAPIDLY URBANIZING AREA OF NOVI SAD

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Abstract: Large-scale urban construction is an intense, spatially concentrated source of particulate matter, but it is not represented in Serbia's air pollutant registry as a distinct source, and its local exposure burden is rarely quantified. The research models PM₁₀ emissions from a 60,000 m² apartment-construction site in a rapidly urbanizing district of Novi Sad, Serbia, and translates them into ambient concentrations and human health risk. Emissions were estimated with the US EPA Tier 1 method as adopted in the EMEP/EEA Guidebook, using a soil silt content of 35.4% measured at the nearest monitored construction site. The central estimate is 24.6 t PM₁₀ over the nine-month build (range 2.5–73.7 t across the emission-factor confidence interval). Modelled 24-hour concentrations at the nearest homes, 50 m from the boundary, reached 135 µg m⁻³ - about three times - giving a residential hazard quotient of 6.2. On-site worker exposure (704 µg m⁻³ as an 8-hour mean) remained an order of magnitude below the occupational limit (HQ 0.07) while exceeding the ambient 24-hour guideline, exposing a substantial regulatory asymmetry between occupational and public-health frameworks.

Keywords: PM₁₀; construction dust; health risk assessment; urbanization.

ANALYSIS OF OCCUPATIONAL INJURIES IN CONSTRUCTION IN SERBIA FOR IMPROVING RISK ASSESSMENT AND HSE MANAGEMENT

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Abstract: This paper examines the extent to which publicly available data on occupational injuries in the construction sector of the Republic of Serbia can be used as a basis for effective risk management and the improvement of preventive action. The empirical basis consists of annual reports of the Administration for Occupational Safety and Health for the period 2022–2024, while the methodological framework includes descriptive and comparative analysis of trends, with supplementary application of the Kinney method for prioritization of hazards under conditions of limited data granularity. The results indicate an increase in the absolute number of analyzed injuries, with a relatively stable share of the construction sector in the overall structure of occupational injuries, confirming the continuity of elevated risk levels. At the same time, a key systemic issue is identified: the aggregated nature of the available data does not allow consistent correlation between causes, workplaces, exposures, and consequences, which significantly limits the operational applicability of the analyses and the accuracy of risk assessment. Based on these findings, the paper concludes that the existing record-keeping model does not provide a sufficient level of informational support for proactive safety management. A necessary direction for improvement is the introduction of an electronic, structured, and continuous record-keeping system in the field of occupational safety and health, enabling detailed analytical processing, dynamic updating of risk assessments, and more effective preventive action. The contribution of this paper is reflected in establishing the link between empirical injury indicators, the limitations of the existing record-keeping system, and the need for digitalization as a prerequisite for the development of a genuinely proactive HSE approach.

Keywords: *construction; occupational injuries; risk assessment; Kinney method; preventive action.*

ANALYSIS OF THE INTERDEPENDENCE OF REGULATORY COMPLIANCE AND SAFETY CULTURE AS KEY FACTORS IN THE PREVENTION OF OCCUPATIONAL INJURIES

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Abstract: Reducing the number of occupational injuries represents a strategic objective of the Republic of Serbia, recognized in all relevant national regulations. This paper examines the interdependence of legal regulation and safety culture as significant determinants of occupational injuries. The research analyzes the relationship between formally established rules governing the behavior of stakeholders within the occupational safety and health system and the actual behavior of employees and employers.

Drawing on a review of relevant scientific literature, the paper indicates that the effective implementation of regulations, including their consistent enforcement and sanctioning, contributes to reducing the risk of occupational injuries. However, the findings also show that the level of development of safety culture—encompassing attitudes, values, risk perception, and everyday practices of employees and employers—has a crucial impact on actual safety in the work environment.

Based on the research, it is concluded that an integrated approach, which implies alignment between the implementation of legal regulations and the development of safety culture, represents the most effective model for the prevention of occupational injuries.

Keywords: occupational safety and health, legal regulation, safety culture, occupational injuries, prevention

DESIGNING ACOUSTIC COMFORT IN THE WORKING AND LIVING SPACE

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Abstract: Acoustic comfort in the context of the harmful effect of noise on human health in an industrial or residential area of a residential building, if analyzed based on the definition of the World Health Organization (WHO), according to which health is "a state of complete physical, spiritual and social comfort". Essentially, health action does not mean only physical damage to health, but also impaired subjective comfort, which in a long period of damage can lead to physical damage to health.

This paper presents a view of one position to improve the process of establishing evidence of noise exposure in the environment of an industrial or residential building and to contribute to a more objective presentation of evidence on the consequences of disturbing acoustic comfort with content that violates privacy and human health.

The growing influx of complaints about the phenomenon of noise in the environment, as well as its impact on mental and physical health, requires a higher level of professional attitude towards a complex multi-dimensional problem and a layered analysis of the spectrum of negative effects that imply auditory and extra-auditory disturbances, above all the disruption of cognitive activities and sleep function. Achieving acoustic comfort is a complex, multi-functional problem, which includes numerous external and architectural factors such as purpose of space, nature of noise in the environment, acoustic performance of building structures and materials.

Keywords: *Noise; acoustic comfort; user satisfaction; public health.*

ASSESSING ‘REAL WORLD’ RISK: OVERVIEW OF CUMULATIVE RISK ASSESSMENT

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Abstract: The rapid expansion of chemical production and use in the twenty-first century has led to increasingly complex exposure scenarios, particularly in occupational settings where workers are routinely exposed to multiple chemical and non-chemical stressors. Traditional risk assessment approaches, based on evaluating individual substances against occupational exposure limits (OELs), are insufficient to capture the realities of combined exposures. This paper examines the concept of cumulative risk assessment (CRA) as a more comprehensive framework for evaluating health risks arising from simultaneous or sequential exposure to mixtures of chemical, physical, and psychosocial agents. CRA integrates multiple exposure routes and considers interactions such as additive, synergistic, or antagonistic effects, which may result in adverse outcomes even when individual exposures remain below established thresholds. Special attention is given to chemical mixtures, whose combined effects remain one of the major uncertainties in toxicology, as well as to non-chemical stressors such as noise and psychosocial stress, which can increase individual susceptibility through mechanisms such as allostatic load. The paper highlights practical challenges in occupational settings, including limitations in experimental data, difficulties in identifying appropriate biomarkers, and the complexity of incorporating lifestyle and individual variability into assessments.

Keywords: Cumulative risk assessment (CRA), Chemical mixtures, Occupational exposure

ASSESSMENT OF PROFESSIONAL RISK FOR FIREFIGHTERS DURING ELECTRIC VEHICLE FIRE EXTINGUISHING

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Abstract: Due to the increased number of electric vehicles (EVs), firefighting procedures and strategies for EV fires extinguishing are analysed in this paper. Besides environmental consequences, inhaling smoke, vapours and toxic gases, presence of various metals, as well as organic compounds and water soluble anions in soot and ash, pose potential danger for human health. The assessment of professional risk for firefighters is based on experimental results for toxic gases released during vehicle fire testing. Best-Worst Method (BWM), as a weighting method, is used to obtain weight coefficients for toxic gases based on their emissions (CO₂, CO, NO₂, HF, HCl, HCN) during vehicle fire tests and exposure limits for these gases. These are used as criteria for applying the PROMETHEE (Preference Ranking Organization METHod for Enrichment of Evaluations), as multi-criteria decision making method, to rank the vehicle fire hazard for firefighters and vehicle drivers.

Keywords: *Electric vehicles fires; Firefighter exposures; Occupational risk; Combustion products.*

CALCULATION AND ANALYSIS OF ELECTROMAGNETIC RADIATION FROM FIFTH-GENERATION (5G) MOBILE SYSTEMS

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Abstract: The fifth generation of mobile communication systems (5G) represents a significant technological transformation of modern wireless networks through the implementation of heterogeneous network structures, Massive MIMO antenna systems, and adaptive beamforming. This concept alters the spatial and temporal distribution of electromagnetic fields in the environment and raises new questions regarding the assessment of public exposure to radiofrequency electromagnetic radiation.

This paper presents a theoretical and engineering analysis of the electromagnetic field levels generated by 5G systems under conservative "worst-case" operating conditions. The analysis encompasses macro, micro, and small cells across characteristic 5G frequency bands, with particular emphasis on beamforming scenarios involving maximum beam direction towards the point of observation. Calculations were performed using EIRP models, coherent field summation, and propagation loss models through obstacles. Furthermore, exposure in the near-field zone of modern 5G mobile devices was specifically analysed.

The results demonstrate that actual exposure levels at locations accessible to the general public remain within the limits defined by the national regulatory framework, aligned with the ICNIRP 2020 guidelines, although high instantaneous field values may occur locally within the directed beams. The analysis also indicates that mobile devices, due to their immediate proximity to the user's body, can constitute the dominant source of local exposure compared to distant base stations.

Keywords: 5G networks, electromagnetic fields (EMF), Massive MIMO, beamforming, radiofrequency radiation, non-ionising radiation, exposure assessment, SAR, electromagnetic safety.

COMPARATIVE ANALYSIS OF CRANE INSPECTION REGULATIONS IN THE EUROPEAN CONSTRUCTION INDUSTRY

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Abstract: The safety and reliability of cranes mostly depend on adequate inspection and verification procedures. This paper presents a comparative analysis of national and international regulations in the scope of crane inspection, including the legal framework of the Republic of Serbia, the International Labour Organization (ILO), the European Union (EU), and the United Kingdom (UK). This research aims to identify key differences in the level of methodological structure and regulatory approaches to highlight the need for a standardized, comprehensive examination scheme that would improve consistency and enhance safety in crane operations. The analysis showed that international and national frameworks define basic inspection procedures but lack a fully developed, unified inspection methodology, leading to increased variability in inspection practices. Given the number of crane accidents in the construction industry and the fact that inadequate inspection can increase them, future research should focus on developing a universal, unified rulebook for crane inspection.

Keywords: *cranes, construction, crane inspection, regulations, comparative analysis.*

THE NEW REGULATION ON MACHINERY AND THE READINESS OF THE BZNR SYSTEM TO IMPROVE BUSINESS AND COMPETITIVENESS

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Abstrakt: Effective management of machine safety, as a subject in work processes, requires the need to learn from the past in order to develop the ability to predict the future. Investigations into machine accidents have been dominated by the search for causes, either as fundamental or human errors, a "*reactive approach*". That is why it is important that ZNR experts replace their traditional model of a reactive approach to security measures with a direction towards a proactive, holistic approach that addresses the "*whole personality of a person*" by integrating physical security, psychological and mental health, as well as environmental factors.

Turning challenges into opportunities requires an active approach, a change of perspective, anticipation and acceptance of change. Key opportunities are often found in problem solving, organization, learning new skills and adapting to new situations. Directive 2006/42/EC, known as the "*machinery directive*", ensures the harmonization of technical regulations for the design of machines in the European area, in order to ensure the health and safety of their users and to enable their free movement between countries.

Regulation 2023/1230 of the European Parliament and Council of 14 June 2023 clarifies the scope and certain definitions (machine, autonomous mobile machine, manufacturer, importer, distributor, etc.). The purpose of the regulation is to integrate new risks generated by digital and new technologies (collaborative robots, artificial intelligence, cyber security, etc.) while adapting requirements with regard to traditional risks and technologies (hazardous substances, vibrations of portable machines, overhead transmission lines, etc.).

Keywords: *Machine safety; Process safety; Safety at work; Risk;*

DESIGNING GREEN ENGINEERING LEARNING MATERIALS FOR SUSTAINABLE AND DIGITAL TRANSFORMATION

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Abstract: The growing importance of green and digital transition processes has increased the demand for new knowledge, skills, and educational approaches within engineering education. This paper presents the GreenTech Horizons Ecosystem as a theoretical model for the development of sustainability-oriented engineering learning resources in higher education. The proposed model integrates European educational and sustainability frameworks with learning approaches and educational outcomes relevant to green engineering education. The discussion draws upon GreenComp, DigComp, Industry 5.0, the European Green Deal, the Digital Education Action Plan, Education for Sustainable Development, and Competency-Based Education. The analysed frameworks reflect increasing integration of sustainability-related concepts, digital technologies, and applied learning within higher engineering education. Attention is devoted to AI-supported learning materials, simulations, virtual laboratories, project-based learning, and interdisciplinary educational activities. The study highlights systems thinking, environmental awareness, digital skills, lifelong learning, and problem-solving as important educational outcomes associated with green engineering education. The proposed model provides a basis for the development of sustainability-related educational resources aligned with green and digital transition processes within higher education.

Keywords: *Competency-based education; Sustainability capabilities; Digital learning; Green learning ecosystems.*

DETERMINATION OF CRITICAL CONTROL POINTS FROM A FIRE PROTECTION PERSPECTIVE IN SURFACE MINING AND COPPER PRODUCTION

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Abstract: This paper presents a comprehensive analysis of the technological process of surface copper ore exploitation and its subsequent processing, from the excavation stage to the production of high-purity refined copper. The main objective of the study is the identification of critical control points (CCPs) from a fire protection perspective across all stages of the process, including mining, ore transportation, comminution, flotation, pyrometallurgical processing, electrolytic refining, and waste management. Special emphasis is placed on the assessment of fire and explosion risks associated with flammable dust, elevated temperatures, combustible chemicals, mechanical sparks, and electrostatic discharge. Based on a systematic risk analysis, key points and mechanisms of fire initiation and propagation within the process were identified. Furthermore, appropriate preventive measures are proposed, including technical solutions, monitoring systems, organizational procedures, as well as advanced fire detection and suppression systems. The results highlight the importance of an integrated approach to risk management in complex mining and metallurgical systems, with the aim of enhancing occupational safety, fire protection, and environmental performance.

Keywords: *copper production, surface mining, critical control points (CCPs), fire protection.*

DIGITAL TWINS AS A MODERN SOLUTION FOR IMPROVING OCCUPATIONAL SAFETY AND HEALTH

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Abstract: Digital twins represent one of the key technologies of Industry 4.0, enabling the integration of physical and virtual systems through continuous real-time data exchange. In the field of occupational safety and health (OSH), this technology provides new opportunities for risk identification, simulation of hazardous scenarios, and improvement of decision-making processes.

This paper aims to analyze the application of digital twins in OSH through a review of relevant literature, identify key enabling technologies, and examine their advantages and limitations. The results indicate that digital twins enable proactive risk management, the reduction of workplace accidents, and the improvement of working conditions. However, their implementation requires significant technical and organizational resources.

Keywords: *Digital Twin, Occupational Safety and Health, Industry 4.0, Risk Management*

DIGITALIZATION OF OCCUPATIONAL SAFETY AND HEALTH ELECTRONIC TRACKING AND COMPLIANCE SOLUTION

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Abstract: In many occupational safety and health (OSH) systems, record-keeping is still predominantly based on manual or partially digital processes, resulting in fragmented, non-standardized, and analytically limited datasets. Such data structures significantly restrict the ability to perform detailed risk analysis, monitor compliance in real time, and implement truly proactive safety management. This paper addresses these limitations by proposing a comprehensive design of an electronic OSH record-keeping system aimed at transforming dispersed and static records into a structured, continuously updated digital dataset. The system is designed to integrate data on workplaces, employees, risk assessments, training, medical examinations, and protective measures into a unified information model. The proposed architecture is intended to enable automated tracking of legal obligations, real-time monitoring of compliance, and generation of key performance indicators, including incident frequency and compliance rates. In addition, the system establishes a foundation for advanced analytics, including trend analysis, risk prediction, and decision support. The main contribution of this paper is the formalization of system requirements and data structures necessary for overcoming the limitations of traditional record-keeping and enabling a transition toward data-driven, proactive OSH management. The proposed approach represents a necessary step toward the digital transformation of occupational safety systems.

Keywords: *Occupational Safety and Health; Electronic Records*

BIOMETHANE IN SERBIA: ADVANCING THE CIRCULAR BIOECONOMY AND ENERGY SECURITY

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Abstract: This paper presents proposed national targets for biomethane production in Serbia and evaluates their contribution to circular bioeconomy development and energy security across short-, medium-, and long-term horizons. The study investigates the role of biomethane in valorizing agricultural by-products and organic waste streams. In the short term (2027), biomethane could replace approximately 3.5% of final natural gas consumption primarily using manure, sequential crops, harvest residues, and kitchen waste from the HORECA sector. In the medium term (2030), expanded infrastructure and regulatory support could increase this share to approximately 18%, while in the long term (2050) biomethane could exceed 28% of final natural gas consumption through the additional utilization of municipal biodegradable waste, slaughterhouse waste, and biogenic CO₂. The results indicate that biomethane could significantly improve organic waste management, resource efficiency, and resilience to imported fossil fuel dependency. Achieving the proposed targets will depend on regulatory support, feedstock mobilization, and technological progress. Overall, biomethane represents a strategic pathway for advancing climate neutrality, circular bioeconomy principles, and energy independence in Serbia.

Keywords: *Biomethane; Serbia; Circular Bioeconomy; Energy Security.*

ECOLOGICAL risk assessment of pesticide use regarding soil contamination

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Abstract: Agricultural production worldwide has significantly increased in recent years, accompanied by greater pesticide use. The application of glyphosate, the most widely used herbicide globally, causes various changes in soil, affecting both soil quality and the quality of groundwater and/or surface water. Depending on the maximum amount of this chemical compound, it is possible to determine the volume of contaminated groundwater, with maximum and minimum values of 1.333333 and 0.041667 dm³. The maximum quantity of the substance (Q_{GW}), depending on the period of entry into groundwater flow, can range from 0 to 4 mg. The use of pesticides in agriculture leads to environmental impacts that can be classified as minimal, minor, moderate, severe and catastrophic. In assessing ecological risk caused by pesticide infiltration into groundwater, it is important to determine both the probability of release and the consequences of the released amount on environmental media. This paper analyzes the ecological risk arising from the infiltration of the pesticide glyphosate into soil, leading to groundwater contamination. A risk matrix with both quantitative and qualitative assessment is provided.

Keywords: *ecological risk; pesticides; agriculture; soil; groundwater.*

EXPOSURE TO ORGANIC SOLVENTS IN THE WORKPLACE

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Abstract: Organic solvents constitute a heterogeneous group of chemicals widely used across numerous industrial sectors, representing a persistent challenge in occupational health and safety. This review paper synthesizes current knowledge on the physicochemical properties, toxicokinetic and toxicodynamic behavior, and health effects associated with occupational exposure to organic solvents. Particular emphasis is placed on their high volatility and lipophilicity, which enable efficient absorption through inhalation and dermal routes, as well as systemic distribution and accumulation in lipid-rich tissues such as the central nervous system, liver, and adipose tissue.

The paper critically examines both acute and chronic health outcomes, including neurotoxicity, hepatotoxicity, nephrotoxicity, hematological disorders, and carcinogenic effects, with special attention to the role of oxidative stress and molecular mechanisms of toxicity. Occupational exposure scenarios are analyzed across key industrial sectors, highlighting the complexity of mixed exposures and the influence of working conditions on risk levels.

In addition, the review addresses contemporary approaches to exposure assessment, including environmental and biological monitoring, with a focus on biomarkers of exposure and effect. Preventive strategies based on the hierarchy of control measures—substitution, engineering controls, administrative measures, and personal protective equipment—are discussed in the context of their effectiveness and practical limitations.

The paper further explores emerging research directions, such as the application of modern technologies, real-time exposure monitoring systems, and the development of green solvents, which collectively contribute to a more predictive and individualized framework for occupational risk assessment.

The aim of this paper is to provide a comprehensive and integrative overview of occupational exposure to organic solvents, with a focus on health effects, risk assessment methodologies, and contemporary strategies for prevention and control.

Keywords: *Organic solvents, Occupational exposure, Protective measures, Contemporary research directions*

SAFETY AND ETHICAL CHALLENGES OF ARTIFICIAL INTELLIGENCE APPLICATION IN WASTE MANAGEMENT

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Abstract: Artificial intelligence (AI) is increasingly applied in waste management systems to enhance efficiency, optimize resource utilization, and support sustainable urban development. At the same time, the transition toward AI-driven waste management introduces new forms of vulnerability, as operational reliability, cybersecurity exposure, and ethical accountability become increasingly dependent on data quality, digital infrastructure, and automated decision-making. This paper aims to identify, systematize, and critically interpret key safety and ethical risks associated with the implementation of AI in waste management systems. The study is based on a qualitative research approach that combines literature review and conceptual analysis. Identified challenges are classified into two main categories: safety challenges, including technical, cybersecurity, and operational risks, and ethical challenges, encompassing privacy, fairness, transparency, and accountability. A socio-technical perspective is adopted to examine the interactions between technological components, human factors, and organizational structures. The results indicate that AI-based waste management systems operate as complex cyber-physical environments in which risks are interconnected and may propagate across system layers. A key contribution of the study is the development of an integrated classification framework that links safety and ethical challenges within a unified analytical structure. Furthermore, the paper introduces the concept of risk transformation, demonstrating how the implementation of AI shifts risks from traditional operational domains toward digital, systemic, and governance-related dimensions. The findings suggest that effective risk management in AI-driven waste management systems requires a multidimensional approach that integrates technical solutions, regulatory frameworks, and organizational strategies. This research contributes to a better understanding of safety and ethical challenges in AI-based waste management and provides a conceptual basis for developing resilient and trustworthy smart urban systems.

Keywords: *Artificial intelligence; Waste management; Safety risks; Ethical challenges;; Risk transformation; Socio-technical systems.*

SCENARIO-BASED ASSESSMENT OF ALTERNATIVE FUELS FOR TRANSPORT DECARBONIZATION IN SERBIA

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Abstract: The transport sector in Serbia accounts for a significant share of total final energy consumption and greenhouse gas (GHG) emissions, yet systematic national-level assessments of alternative fuel potential remain limited. This paper presents a methodology for quantifying the potential of alternative fuels and energy sources for transport decarbonization in Serbia for the 2030 horizon, with a focus on the S/SN macro-energy decarbonization scenario defined in the Integrated National Energy and Climate Plan of Republic of Serbia (INECP). Feedstock potentials were assessed across five categories: agriculture, food industry, municipal waste, forestry, and renewable electricity. A linear programming (LP) simplex model with seven objective functions was applied, yielding eight scenarios per approach under the S/SN scenario, evaluated under conservative and optimistic feedstock availability approaches. Objective function f1 (minimum GHG emissions) produced seven equally optimal solutions with negative net GHG emissions (-3,057 to -4,266 tCO_{2eq}) due to the dominant role of manure-based biomethane, which generates emission savings through avoided uncontrolled storage. Objective function f2 (minimum production cost) produced one solution with positive GHG emissions (54,935 tCO_{2eq}), illustrating the fundamental trade-off between cost and climate objectives. Scenario S2, derived from f1, achieves the minimum GHG emissions combined with the lowest production cost within the f1 group, making it the preferred pathway for transport decarbonization in Serbia.

Keywords: *Alternative fuels; Transport decarbonization; Linear programming; GHG emissions.*

REGULATORY CHANGES AND SUSTAINABILITY IMPLICATIONS OF THE NEW WASTE MANAGEMENT LAW IN SERBIA

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Abstract: Although waste generation has long been associated with human activities and economic development, its effective management remains a persistent environmental challenge, particularly in less developed countries where waste management is often insufficiently developed and infrastructure is limited. Inefficient waste management leads to significant environmental impacts, including soil, water and air contamination, resulting in associated risks to human health. In recent years, Serbia has undertaken significant regulatory reforms aimed at improving the efficiency and sustainability of its waste management system. The amendments to the Law on Waste Management introduce several important changes related to waste prevention, improved classification of waste streams, clearer responsibilities of waste management actors, and increased alignment with European Union environmental legislation. This paper analyzes the key regulatory changes introduced by the amended waste management legislation in Serbia through a regulatory and policy analysis and discusses their implications for environmental protection and sustainable resource management. Particular attention is given to new definitions, obligations for waste producers, digitalization of waste tracking, and improved regulatory control mechanisms. The results indicate that the new legislative framework strengthens the principles of circular economy and promotes more efficient waste prevention, recycling, and resource recovery. At the same time, the implementation of these changes requires improved institutional capacity and stronger cooperation between regulatory authorities, industry, and local governments.

Keywords: *Waste Management; Environmental Legislation; Circular Economy; Recycling; Environmental Policy.*

OCCUPATIONAL HEALTH AND SAFETY EDUCATION FOR EMPLOYABILITY AND SUSTAINABLE DEVELOPMENT IN SUB-SAHARAN AFRICA

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Abstract: Occupational health and safety (OHS) education is becoming increasingly relevant in the context of labour market transformation, workforce vulnerability, and sustainable development challenges in Sub-Saharan Africa (SSA). Many sectors in the region continue to face high occupational risks, limited practical training opportunities, and insufficient alignment between higher education systems and labour market needs. This paper examines the role of OHS education in supporting employability and sustainable workforce development within the SSA context. The study is based on the analysis of scientific literature, international reports, and policy documents related to occupational health and safety, higher education, employability, and sustainable development. The discussion considers practical learning, interdisciplinary education, digital learning, stakeholder cooperation, and lifelong learning as relevant elements of workforce preparation and higher education modernization. The paper examines the relationship between OHS education, workplace preparedness, and sustainability-related knowledge, while also addressing challenges affecting higher education systems in SSA countries. The proposed analytical framework emphasizes curriculum modernization, applied learning, cooperation between universities and labour market actors, and continuous professional development. Strengthening OHS education may contribute to improved workforce preparedness, stronger prevention culture, and safer and more sustainable working environments in Sub-Saharan Africa.

Keywords: *Occupational health and safety education; Employability; Workforce preparedness; Sustainable development*

PROJECT OVERVIEW - AI-ASSISTED MONITORING AND MANAGEMENT OF INVASIVE PLANT SPECIES IN CROSS-BORDER REGION

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Abstract: Invasive plant species (IPS) pose a significant ecological and economic challenge in the cross-border region, particularly within protected natural habitats. Their rapid spread threatens native biodiversity, disrupts ecosystems, and increases management costs for conservation authorities. Traditional monitoring and control methods are labour-intensive, time-consuming, and often ineffective in detecting IPS at an early stage. Additionally, existing treatment approaches lack precision, leading to unintended environmental consequences. This paper presents the aims and activities of the AInspec project, which addresses these challenges by introducing an AI-supported drone-driven enhanced spectrum sensing system for IPS detection and a drone-based spraying solution for targeted chemical treatment. By integrating remote sensing and automated treatment technologies, the project aims to improve the efficiency, accuracy, and sustainability of IPS management in protected cross-border areas.

Keywords: *Invasive plant species; Drone; Cross-border region; Chemical treatment*

RISK ASSESSMENT REGARDING TO WHOLE BODY VIBRATIONS OF DUMPER TRUCK OPERATORS IN A MINING COMPANY

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Abstract: The technological processes involved in the extraction of ore materials are highly complex and require the engagement of working resources. These processes encompass the transportation of ore from the site of extraction to the processing facilities, utilizing both continuous and discontinuous transport systems. Discontinuous transport systems include various types of vehicular transport, particularly dump trucks. Operators of dump trucks are exposed to a range of occupational hazards, including physical risks such as noise and vibration. Of particular concern are whole-body vibrations, which are transmitted to the operator through the vehicle seat during operation. Prolonged exposure to such physical agents may result in adverse effects on workers' health and their overall work capacity. Exposure to harmful factors in the workplace can lead to significant health impairments and reduced functional ability. The risk assessment process involves the systematic identification and quantification of all hazards to which workers are exposed, serving as a basis for evaluating risk acceptability and implementing appropriate occupational safety measures. Since physical hazards can be accurately measured using specialized equipment, it is possible to determine whether exposure levels exceed the limit values prescribed by relevant standards and legislation. This paper presents an analysis of vibration exposure and a corresponding risk assessment for the position of a dump truck operator within a mining company.

Keywords: *dump truck operator, whole body vibration, risk assessment*

SPECIAL WASTE AND OCCUPATIONAL SAFETY IN THE CIRCULAR ECONOMY: SERBIA CASE STUDY

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Abstract: The transition to a circular economy, while strategically aligned with sustainable development goals and EU policies, often marginalizes occupational health and safety aspects. Introducing recycling models and extending product lifespans transforms work processes but simultaneously generates new chemical, biological, and physical risks that existing safety frameworks fail to adequately address. This paper explores the intersection between circular practices and occupational hazards through an analysis of special waste stream management in the Republic of Serbia. Drawing on data from the Environmental Protection Agency (2018–2023) and spatial analysis via the NRIZ GIS system, the study identifies treatment facilities for special and hazardous waste streams (tires, batteries, waste oils, electrical and electronic equipment, and end-of-life vehicles), quantifies processed volumes, and assesses how specific treatment processes affect workers' exposure to harmful substances. Particular attention is given to risks associated with legacy substances, the unpredictable behavior of recycled materials, and the lack of specialized training. The aim of this work is to empirically demonstrate the need to integrate occupational safety measures into the regulatory and operational frameworks of the circular economy.

Keywords: *Circular economy; Occupational health and safety; Special waste streams*

HAZARDS AND HARMFUL FACTORS AT THE WORKPLACE AND IN THE WORKING ENVIRONMENT

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Abstract: Noise in the working environment represents a significant occupational hazard, especially in industrial sectors such as metal processing. The aim of this paper is to analyze noise as a risk factor at workplaces where CNC machines and other metal processing equipment are used, as well as to examine its impact on workers' health and safety.

The paper discusses the main sources of noise, methods for its measurement, and the conditions in which workers are exposed to increased noise levels. The results indicate that prolonged exposure to noise above permitted limits can lead to hearing damage, increased stress, reduced concentration, and a higher risk of workplace injuries.

Based on the analysis, it is evident that noise significantly affects both the health of employees and overall work efficiency. The discussion highlights the importance of continuous monitoring, proper risk assessment, and implementation of adequate protective measures.

In conclusion, effective noise control requires a combination of technical, organizational, and personal protective measures. Their proper application can significantly reduce risks and contribute to safer and more productive working conditions.

THE IMPACT OF ERGONOMICS ON THE HEALTH OF EMPLOYEES IN OFFICE WORK

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Abstract: Modern office work is characterized by prolonged sitting, repetitive movements, and extensive use of computer equipment, which significantly affect the health of employees. Ergonomics, as a scientific discipline, aims to adapt the working environment to human capabilities and limitations in order to improve efficiency, safety, and well-being. This paper analyzes the impact of ergonomic factors on employee health in office settings, with a particular focus on musculoskeletal disorders, visual strain, and psychosocial stress. Furthermore, the study highlights the importance of preventive measures, including proper workplace design, employee education, and regular physical activity. The implementation of ergonomic principles contributes to reduced health risks, increased productivity, and overall improvement of working conditions.

Keywords: *ergonomics; office work; health; prevention; musculoskeletal disorders*

ADVANCED TECHNOLOGIES IN FIRE PROTECTION SYSTEMS: PREVENTIVE AND EMERGENCY RESPONSE MEASURES

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Abstract: Modern technological advancements have fundamentally transformed the field of occupational safety and fire protection. This paper analyzes the integration of advanced solutions, such as Artificial Intelligence (AI), the Internet of Things (IoT), automation, and real-time data analytics into fire protection systems. Although traditional systems remain the cornerstone of safety infrastructure, their effectiveness is increasingly limited by the complexity of contemporary urban and industrial risks, characterized by high-energy loads and the presence of specific flammable materials. Unlike conventional systems that operate reactively, activating only after a fire is detected, modern technologies enable a proactive approach through continuous surveillance and early risk identification.

This research delineates the pivotal role of emerging technologies in redefining the landscape of fire safety, bridging the gap between passive prevention and active, intelligent intervention. By examining the deployment of smart sensor networks, autonomous drones, and sophisticated robotics, this study illuminates the critical trends that are currently reshaping the safety sector. Ultimately, the work serves as a strategic roadmap for the transition toward a more resilient and data-driven future, where the protection of human life and critical infrastructure is governed by unprecedented precision and technological reliability.

Keywords: *Artificial Intelligence; Emergency response; Fire protection; Internet of Things; Prevention.*

APPLICATION OF UAV TECHNOLOGY IN PESTICIDE SPRAYING: IMPLICATIONS FOR OCCUPATIONAL HEALTH AND SAFETY

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Abstract: The increasing demand for sustainable food production has intensified the need for safer and more efficient pesticide application methods. Traditional pesticide spraying techniques, such as knapsack and tractor-mounted sprayers, are associated with high levels of occupational exposure and environmental risks. In recent years, unmanned aerial vehicles (UAVs), commonly referred as drones, have emerged as a promising technology for precision pesticide application. This paper provides a comprehensive overview of UAV-based pesticide spraying, including system components, operational workflow, and comparative analysis with conventional application methods. Field studies conducted in the region of Kyiv (2018–2021) were analyzed to evaluate occupational exposure, pesticide drift, and associated health risks across different application technologies. The results indicate that UAVs significantly reduce operator exposure by minimizing direct contact with pesticides and enabling remote operation. However, certain risks remain during mixing, loading, and refueling operations. Additionally, UAVs demonstrate improved application precision and reduced pesticide usage, although limitations such as payload capacity, battery life, and weather sensitivity still restrict large-scale adoption. Overall, UAV technology represents a significant advancement in agricultural pesticide application, contributing to improved occupational safety, environmental protection, and operational efficiency.

Keywords: *Unmanned Aerial Vehicles (UAV); pesticide; exposure.*

SUSTAINABLE REUSE OF THERMAL WASTEWATER IN AGRICULTURE

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Abstract: Agriculture is the largest global consumer of water, accounting for approximately 70% to 90% of total water use for irrigation. Growing water scarcity caused by population growth, urbanization, climate change, and declining water quality highlights the need for sustainable alternatives. The reuse of treated wastewater, including mineral rich thermal spa wastewater, represents a promising solution within a circular economy framework. This paper examines the benefits and risks associated with wastewater reuse in agriculture. The findings suggest that properly treated and managed wastewater can provide a reliable irrigation source, contributing to sustainable agricultural practices while reducing pressure on freshwater resources.

Keywords: *Thermal water; Wastewater reuse; Agriculture; Sustainable irrigation.*

THE IMPACT OF DIGITALIZATION ON OCCUPATIONAL SAFETY AND HEALTH - EMERGING RISKS AND CHALLENGES

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Abstract: Contemporary processes of work digitalization and automation are significantly transforming the working environment, introducing new forms of work organization as well as emerging occupational risks that affect employees' safety and health. The aim of this paper is to analyze the impact of work digitalization on the occurrence and characteristics of occupational risks, with a particular focus on psychosocial, ergonomic, and cognitive risks. The paper examines the effects of implementing information and communication technologies, artificial intelligence, and performance monitoring systems on working conditions and employee workload. The methodological approach includes an analysis of relevant scientific literature, applicable legal regulations, and international standards, including ISO 45001, as well as a comparative analysis of traditional and digitalized work processes. Special attention is given to the identification of emerging risks, such as digital stress, burnout syndrome, increased cognitive workload, and issues related to workplace ergonomics. The results indicate that, although digitalization contributes to improved efficiency and work flexibility, it simultaneously requires the redefinition of existing approaches to occupational safety and health management. The paper highlights the need to integrate new protective measures, including the improvement of ergonomic conditions, effective management of psychosocial risks, and continuous employee training. It is concluded that effective management of occupational risks in a digital environment requires an interdisciplinary approach and the adaptation of existing safety systems to contemporary technological changes.

Keywords: *digitalization, occupational safety and health, occupational risk, psychosocial risks, ergonomics, cognitive workload, burnout.*

APPLICATION OF ENVIRONMENTAL PROTECTION SYSTEM ON THE BIOGAS SECTOR IN SERBIA

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Abstract: The development of the biogas sector in Serbia has been primarily driven by the production of renewable electricity and heat, but its environmental significance extends beyond energy production. Biogas plants are also installations for the controlled biological treatment of manure, agricultural residues and energy plants, agro-industrial by-products and, in specific cases, biodegradable waste streams. For this reason, they must be assessed as complex environmental systems rather than only as renewable energy facilities. Their operation is associated with multiple environmental aspects: air emissions from combustion units, potential methane losses, odour, water protection requirements, digestate handling, waste management obligations and, where applicable, sanitary and veterinary requirements for animal by-products. This paper analyses the environmental protection system applicable to biogas plants in Serbia, with emphasis on environmental impact assessment, air protection, water protection, soil protection and waste treatment. The analysis shows that Serbian legislation already contains a comprehensive regulatory framework for biogas projects. Its practical application requires simultaneous compliance with multiple interconnected regulatory frameworks. The paper therefore provides a structured expert overview of the key obligations of biogas plant operators and identifies the main practical points that should be considered during permitting, operation and compliance monitoring.

Keywords: *Environmental protection; Biogas; Environmental impact; Air emissions; Digestate; Waste management; Serbia.*

THE FUTURE OF WASTE MANAGEMENT: STRATEGIC DIRECTIONS AND SERBIA'S GREEN TRANSITION

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Abstract: Waste management represents one of the key environmental challenges in the Republic of Serbia, particularly in the context of aligning national legislation with the European Union acquis and moving from a linear towards a circular economy model. This paper analyses the current state of the Serbian waste management system, with emphasis on the legislative and institutional framework, infrastructure, municipal and packaging waste flows, collection, recycling and disposal practices, and the main limitations affecting the implementation of modern solutions. Particular attention is given to the Law on Waste Management, the Law on Packaging and Packaging Waste, the Decree on Waste Landfilling, and strategic documents defining development directions up to 2030 and 2035. The analysis shows that Serbia has achieved considerable progress in regulatory alignment, regionalisation and the expansion of organised waste collection. Nevertheless, the system remains strongly dependent on landfilling and is characterised by insufficient primary separation, limited recycling and treatment capacities, unreliable or non-comparable data, and uneven enforcement at the local level. Non-sanitary and illegal landfills, inadequate financial and institutional support for infrastructure development, and the slow establishment of effective systems for special waste streams remain major challenges. Further transformation requires full implementation of extended producer responsibility, economically sustainable financing, stronger regional systems, additional treatment facilities, remediation of historical pollution, and digital monitoring of waste flows to improve transparency and traceability. The success of reform will depend on integrating the infrastructural, economic and social dimensions of the green transition so that waste management becomes a basis for resource efficiency, technological innovation and employment rather than only an administrative obligation in the European integration process.

Keywords: *Waste management; Municipal waste; Circular economy; Landfills; Green transition.*

PLANNING AND IMPLEMENTING MSW SOURCE SEPARATION SYSTEMS: INSIGHTS AND CHALLENGES FROM SERBIA

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Abstract: Municipal solid waste (MSW) source separation is a key prerequisite for improving recycling performance and reducing landfill dependency within emerging circular economy systems. However, many transition countries still face significant technical, economic and institutional barriers in the implementation of separate collection systems at municipal level. This work presents experiences from the planning and implementation of municipal source separation systems in Serbia, based on activities conducted across seventeen municipalities with different demographic and spatial characteristics. A dedicated methodology was developed for estimating required bins, containers and collection vehicles using data on population structure, housing typology, waste generation and composition, collection logistics and transport distances. In parallel, investment requirements for introducing separate collection infrastructure were assessed at municipal and regional level. The implementation process revealed several operational challenges typical for transition economies, including workforce shortages, limited institutional capacity, delayed commissioning of equipment, lack of downstream treatment infrastructure and difficulties in market placement of collected recyclables. Despite these constraints, monitoring results from participating municipalities demonstrated that measurable improvements are achievable once infrastructure rollout is combined with communication activities and institutional support. The presented experiences highlight the importance of integrating technical planning, financial considerations and operational preparedness when developing municipal source separation systems in transition contexts.

Keywords: *Municipal waste, source separation, circular economy, system planning, Serbia*

APPLICATION OF IoT-BASED ENVIRONMENTAL MONITORING AND HYBRID ANN MODELING FOR AIR QUALITY AND OCCUPATIONAL SAFETY AT CONSTRUCTION SITES

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Abstract: Environmental pollution and occupational health risks resulting from construction activity is caused primarily by pollutants, such as particulate matter (PM) and nitrogen dioxide (NO₂). Traditional environmental monitoring techniques do not provide sufficient temporal resolution to adequately capture the rapidly changing levels of pollutants present at construction sites. This study utilizes an integration of Internet of Things (IoT) based environmental monitoring and hybrid Artificial Neural Networks (ANN) based predictive models to provide real-time management of air quality. Field measurements were taken from deployed IoT sensors consisting of RS-MG111-WIFI-1 air pollutant detection sensors and CC-M12 meteorological stations with a temporal resolution of 5 minutes. A hybrid modeling framework was developed, combining physical dispersion principles of pollutant emissions and the predictive capabilities of an ANN. The measured pollutant concentrations were shown to have significant temporal variability, with construction activity being the primary cause of the variability; however, meteorological variables had little impact on pollutant concentrations under steady-state conditions. The ANN model produced very high predictive accuracy ($R^2 = 0.87$), thereby demonstrating its ability to make real-time predictions regarding pollutant concentrations. The proposed method will help improve occupational health and safety, aid in the management of environmental pollutants from construction activities, and help facilitate the realization of sustainable and climate-resilient construction methods.

Keywords: *IoT, air quality; PM₁₀; ANN; construction site; occupational safety; environmental monitoring.*

OPERATIONAL FAILURE AND MICROBIOLOGICAL RISKS IN DECENTRALIZED DRINKING WATER SYSTEMS: EVIDENCE FROM TRIPOLI, LIBYA

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Abstract: Safe drinking water is a fundamental determinant of public health. However, the increasing reliance on decentralized water treatment units in public facilities may pose health risks if maintenance and monitoring are inadequate. This study aimed to evaluate the quality of drinking water produced by decentralized treatment units Reverse Osmosis (RO) Treatment Unit System in Hay Al-Andalus Municipality, Tripoli, Libya, and assess compliance with Libyan standards and World Health Organization (WHO) guidelines. A descriptive analytical study was conducted on 12 water treatment units, Randomly selected from a total of 25 treatment units. Physical (turbidity, electrical conductivity), chemical (pH, total dissolved solids), and microbiological (total coliforms, Escherichia coli, fungi, and yeasts) analyses were performed following American Public Health Association standards (APHA, 2017). Data were analyzed using SPSS with descriptive statistics, One-Sample T-test, and ANOVA (Tukey's test), correlation at ($p < 0.05$). Results showed a complete absence of maintenance practices across all units. While most physicochemical parameters were within permissible limits, microbiological contamination was detected in the majority of samples. Significant differences were observed between measured values and standard limits. The study concludes that water quality deterioration is primarily due to poor operation and maintenance rather than treatment technology. Immediate regulatory and technical interventions are recommended.

Keywords: *Drinking water quality, decentralized treatment, microbiological contamination, public health, Libya*

WORKPLACE NOISE ASSESSMENT IN A LABORATORY: A CASE STUDY FROM NOVI SAD, SERBIA

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Abstract: This study assess noise exposure in a laboratory for environmental and occupational monitoring at the Faculty of Technical Sciences, Novi Sad, Serbia. Measurements were conducted in accordance with ISO 9612:2025 at four characteristic measuring points related to typical laboratory activities, such as sample preparation, instrumental analysis and general ventilation. The equivalent continuous sound pressure levels ranged from 60.5 to 94.8 dB, with the highest value measured during sample analysis using atomic absorption spectrometer (AAS), caused by local ventilation. Daily noise exposure levels ($L_{EX,8h}$) were calculated and compared with the national regulation aligned with Directive 2003/10/EC. The results indicated that the lower action value of 80 dB(A) was exceeded only at one measuring point, with a value of 85.3 dB(A). This exposure occurs only occasionally, is short in duration and restricted to a specific area. The findings highlight that, although overall noise exposure in the laboratory is within acceptable limits, specific activities may pose an increased risk, emphasizing the importance of targeted preventive measures and continuous monitoring of noise levels.

Keywords: *Noise measurement; Laboratory; Workplace noise.*

PREVALENCE OF METABOLIC SYNDROME AMONG BANK EMPLOYEES AND THE IMPORTANCE OF WORKPLACE HEALTH PROMOTION

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Abstract: Workplace health promotion represents an important component of contemporary public health, particularly under conditions of increased exposure to stress and a sedentary lifestyle. Bank employees are especially vulnerable, as the specific conditions of their work—including prolonged sitting, a high level of responsibility, and time pressure—contribute to the development of chronic non-communicable diseases.

Metabolic syndrome (MS) is defined as a cluster of interrelated metabolic and haemodynamic disorders, including abdominal obesity, insulin resistance, dyslipidaemia, and arterial hypertension, which significantly increase the risk of developing type 2 diabetes mellitus and cardiovascular disease. Its prevalence is steadily rising, placing it among the leading public health problems of modern society.

Bank employees constitute a high-risk group owing to the combination of occupational stress and reduced physical activity, which favours the emergence of insulin resistance and abdominal obesity as key components of metabolic syndrome. Contemporary working conditions further contribute to an increased psychosocial burden and a reduction in overall work capacity.

Health promotion, grounded in the principles of the World Health Organization and the Ottawa Charter, entails integrated measures aimed at fostering healthy lifestyles, reducing risk factors, and improving the working environment. Interventions directed at increasing physical activity, promoting proper nutrition, and managing stress are of particular importance.

The application of these measures in the working environment can significantly contribute to the prevention of metabolic syndrome, a reduction in the incidence of chronic non-communicable diseases, and an improvement in employees' quality of life. At the same time, the positive effects are also reflected in increased productivity, reduced absenteeism, and overall socioeconomic progress.

Keywords: metabolic syndrome, workplace health promotion, bank employees, workplace, public health

ANALYSIS OF THE RISK OF ELECTRIC SHOCK IN PUBLIC AREAS DUE TO FAULTY ELECTRICAL INSTALLATIONS – EXAMPLES FROM PRACTICE

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Abstract: The condition of electrical installations in public areas, owing to unprofessional installation or inadequate maintenance, is in some situations such that it poses a danger to citizens' lives. The dangers are particularly pronounced in cases of atmospheric precipitation, and especially in winter, when salt is spread because of snow, further reducing the resistance of the current path through the human body. The aim of this paper is to present examples from practice that illustrate the dangers of electric shock resulting from inadequate installation and maintenance of electrical installations in public areas.

Keywords: *Electrical installations; Public areas; Electric shock; Touch voltage; Step voltage.*

CHRONIC PAIN AND ERGONOMIC INJURIES IN THE WORKPLACE

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Abstract: Apart from common colds, chronic pain is one of the most frequent reasons why the working-age population consults a primary care physician, and it represents one of the leading causes of both short-term and long-term sick leave. Among the most common causes of chronic pain are musculoskeletal disorders, including low back pain, neck pain, tendinopathies, nerve lesions and disc herniation. In addition to causing suffering for the worker and reducing work productivity, these conditions generate considerable economic losses for companies, health insurance systems and society as a whole.

According to data from the European Agency for Safety and Health at Work, low back pain is among the most common health problems associated with work. Since available pharmacological and physical therapies often provide only short-term relief, and symptoms frequently return after the worker resumes the same work process, it is necessary to consider whether the complaints may be the consequence of an ergonomic injury.

Ergonomic injuries at work result from a mismatch between the physical demands of the job and the physical capacities of the human body. They usually develop gradually through the repeated overuse of soft tissues, rather than as a consequence of a single acute event.

Ergonomics is a scientific discipline concerned with understanding interactions between humans and other elements of a system. It places the human being at the centre of its analysis. Occupational ergonomics is a specific branch of ergonomics whose task is to design work tasks and work processes in a way that does not exceed the worker's tolerance limits, meaning that the demands of the job should correspond to the worker's abilities at the workplace. Its main principles are to adapt the job to the person, to work smarter rather than harder, to make work more comfortable and to improve quality and safety.

The common goal of occupational safety and health professionals, primary care physicians and occupational medicine specialists is the prevention of injuries and diseases. Therefore, it is necessary to recognize ergonomic injuries and the importance of occupational ergonomics in the prevention and protection of workers' health. Occupational ergonomics should be acknowledged as an essential component in addressing work-related diseases and occupational diseases, together with closer and more effective cooperation between occupational safety professionals and occupational medicine specialists, as well as between occupational medicine and primary care physicians.

Keywords: chronic pain; musculoskeletal disorders; occupational ergonomics; ergonomic injuries; work-related musculoskeletal disorders; occupational medicine.

CHRONIC DISEASES AS A CAUSE OF WORK DISABILITY – NEW THERAPEUTIC POSSIBILITIES: A CASE REPORT

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Abstract: Chronic diseases, such as cardiovascular diseases, heart failure, chronic kidney disease and diabetes mellitus with complications, are, together with malignant diseases, among the most common causes of partial or complete loss of work ability. The high prevalence of chronic diseases results from population ageing and the influence of multiple risk factors. It is estimated that patients with diabetes mellitus have a twofold higher risk of developing cardiovascular disease and a markedly increased risk of developing chronic kidney disease. Cardiovascular mortality risk is also significantly increased in stage 3 chronic kidney disease, while a considerable proportion of patients with early stage 3 kidney impairment may progress to dialysis.

According to pension and disability insurance regulations, disability exists when changes in health status that cannot be eliminated by treatment result in partial or complete loss of work ability. Under the current Law on Pension and Disability Insurance, the right to a disability pension is acquired in the case of complete, 100% loss of work ability caused by injury or disease, whether work-related or non-work-related. Under previous regulations, this right could be acquired with a 75% loss of work ability. Consequently, a larger number of workers remain in the work process with varying degrees of work ability limitation.

Patient 1 was considered a candidate for disability pension in 2009 due to a sudden decrease in left ventricular ejection fraction below 35%. Since 2011, the patient has been treated with an SGLT2 inhibitor, followed later by ARNI therapy in combination with a beta-blocker and a mineralocorticoid receptor antagonist. Left ventricular ejection fraction increased to above 50% and remained stable until 2025. The therapeutic response was associated with preserved full work ability for an additional 16 years.

Patient 2 had markedly limited work ability in 2011 due to insulin-treated diabetes mellitus with multiple complications after myocardial infarction. At that time, SGLT2 inhibitor and GLP-1 receptor agonist therapy were introduced experimentally, resulting in significant body weight reduction, improved lipid profile, better glycaemic control, resolution of proteinuria and restoration of work ability. Although heavy physical work was contraindicated, the patient continued to perform physically demanding work. Work ability was lost in 2025, indicating that functional working capacity was preserved for an additional 14 years.

The development of new therapeutic options, including SGLT2 inhibitors and GLP-1 receptor agonists, together with the introduction of modern therapeutic procedures and screening for early detection of chronic kidney disease, enables better control of risk factors and prevention of complications. These advances may modify the course of chronic cardio-renal-metabolic diseases and significantly contribute to the preservation and prolongation of work ability.

Keywords: chronic disease; work disability; work ability; chronic kidney disease; SGLT2 inhibitors; occupational medicine.

BIOPHILIC DESIGN STRATEGIES AND USER PSYCHOLOGICAL RESPONSE IN CONTEMPORARY HOSPITALITY INTERIORS

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Abstract: Contemporary hospitality interiors increasingly emphasize user well-being, emotional comfort, and multisensory spatial experience. In response to the growing disconnection between humans and natural environments in urban contexts, biophilic design has emerged as an important architectural approach that integrates natural elements into interior spaces. This paper explores the application of biophilic design strategies in contemporary hospitality interiors, with a particular focus on restaurant environments and their influence on users' psychological responses.

The research analyzes how natural materials, vegetation, daylight, organic forms, water features, and spatial relationships inspired by nature contribute to stress reduction, emotional regulation, relaxation, and improved user satisfaction. Particular attention is given to the role of central natural elements, such as indoor trees and green focal points, in creating identity, atmosphere, and emotional attachment to space.

The study combines theoretical analysis of biophilic design principles with case-study evaluation of contemporary hospitality interiors. Furthermore, the paper examines the relationship between spatial perception and environmental psychology, emphasizing how nature-integrated environments can positively affect cognitive and emotional states of users.

The results indicate that biophilic strategies significantly improve perceived comfort, spatial quality, and overall user experience within hospitality environments. The findings suggest that biophilic interior architecture not only contributes to sustainability goals but also enhances psychological well-being and strengthens the human–nature connection in everyday urban life.

Keywords: biophilic design, hospitality interiors, environmental psychology, restaurant design, user experience, sustainable architecture, well-being

HIGH-CAFFEINE STIMULANT BEVERAGES IN THE OCCUPATIONAL SETTING: ACUTE EFFECTS ON VIGILANCE AND IMPLICATIONS FOR RECOVERY AND OCCUPATIONAL RISK

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Abstract: High-caffeine stimulant beverages marketed as energy drinks are increasingly used in working populations as an acute counter-fatigue measure under conditions of shift work, extended duty hours, substantial physical load, and sustained cognitive demand. Despite their widespread occupational use, their actual contribution to preserving functional work capacity and operational safety remains insufficiently established. The aim of this paper was to critically appraise the available evidence on the effects of energy drinks and caffeine on occupationally relevant outcomes, with particular emphasis on vigilance, task errors, recovery sleep, and symptom profiles with potential implications for occupational risk. Current evidence indicates that caffeine and energy drinks may transiently improve selected domains of cognitive performance, particularly attention and certain indicators of task execution, yet without convincing evidence that such effects translate into a lower incidence of occupational injuries. In a systematic review comprising 13 studies in shift workers, none assessed injuries as an endpoint. In a randomized crossover model of a simulated night shift, administration of an energy drink was associated with a 29.1-minute reduction in subsequent daytime recovery sleep and a decline in sleep efficiency from 91.8% to 84.7%. In an industrial sample of factory workers, prevalence of consumption was 68%, while recent consumers reported thirst significantly more often than non-consumers, 35% versus 5%. Collectively, these findings suggest that high-caffeine stimulant beverages should not be regarded as a validated strategy for optimizing work performance, but rather as a short-lived stimulatory response of limited functional range, potentially accompanied by impaired recovery, dehydration-related symptom burden, and increased occupational risk.

Keywords: high-caffeine stimulant beverages; work capacity; shift work; recovery sleep; occupational risk

SMOKING AS A MODIFIABLE RISK FACTOR IN THE PREVENTION OF CHRONIC NON-COMMUNICABLE DISEASES - HARM REDUCTION IN FOCUS

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Abstract: Cardiovascular diseases remain a leading public health concern and are strongly associated with both modifiable and non-modifiable risk factors. Modifiable factors include smoking, harmful alcohol use, physical inactivity, poor diet, obesity, elevated cholesterol and blood glucose, while age, sex, genetic predisposition and family history cannot be changed. General practitioners have a central role in cardiovascular prevention through patient education, early identification of risk factors, regular health monitoring and individualized support. Among modifiable factors, smoking is particularly important because tobacco combustion generates numerous toxic substances associated with inflammatory processes, hypoxia, vascular damage and carcinogenesis. Complete cessation of tobacco and nicotine products remains the most effective strategy for reducing smoking-related health risks. Behavioural counselling and approved pharmacotherapy should therefore be prioritized and adapted to each patient. For smokers unable or unwilling to quit, harm-reduction approaches involving non-combustible products may be considered cautiously, temporarily and under medical supervision, while avoiding dual use. Effective prevention should emphasize understanding and motivation rather than fear alone. Electronic health records should also distinguish between different tobacco and nicotine product categories, enabling systematic monitoring of exposure, cessation outcomes and long-term health effects.

Keywords: cardiovascular disease; risk factors; primary prevention; smoking cessation; general practice.