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Improving the Healthcare Workforce in Croatia

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Introduction

The American Chamber of Commerce in Croatia (AmCham) considers the protection of healthcare workers from occupational risks, including needlestick and sharps injuries and exposure to hazardous medicinal products, a key priority for the Croatian healthcare system. Despite the existing regulatory framework, regulatory gaps, underreporting, and inconsistent implementation of preventive measures continue to undermine adequate and equal protection across healthcare settings.

AmCham believes that strengthening occupational health and safety standards, improving reporting practices, and ensuring consistent implementation of preventive measures are essential to protecting healthcare professionals and reducing long-term health risks.

AmCham therefore calls for a strengthened and consistently implemented framework that ensures effective protection of healthcare workers across all healthcare settings and supports a safer, more sustainable, and resilient healthcare system in Croatia.

Protecting Healthcare Workers from Occupational Risks

Addressing Needlestick Injuries and Exposure to Hazardous Medicinal Products in Croatia

Healthcare professionals routinely face occupational risks, including needlestick and sharps injuries as well as exposure to hazardous medicinal products, including cytotoxic medicines. While needlestick and sharps injuries rarely result in serious mechanical injury, they pose a **severe occupational health risk due to the potential transmission of blood-borne pathogens**, including those with the most serious health consequences, such as HIV and hepatitis B and C viruses. In contrast, the risks associated with hazardous medicinal products are often less immediately apparent, but repeated or prolonged occupational exposure to these medicines can lead to severe **cumulative health effects due to their carcinogenic[1], mutagenic[2], and reprotoxic[3] properties.**

Although Croatia has established a regulatory framework governing the prevention of sharps injuries and the handling of hazardous medicinal products, certain regulatory gaps remain, while persistent underreporting and inconsistent implementation of preventive measures suggest that the actual scale of occupational exposure remains significantly underestimated. Existing differences in organisational practices, staff education, and reporting culture create unequal of protection for healthcare workers.

In a healthcare system facing workforce shortages and increasing service demands, protecting the health and safety of healthcare workers is a prerequisite for ensuring quality and resilient healthcare delivery. Strengthening healthcare worker safety should therefore be recognised as a strategic priority for the Croatian healthcare system, helping to ensure consistent standards of protection across all healthcare settings.

[1] McDiarmid MA, Oliver MS, Roth TS, Rogers B, Escalante CP. (2010). Chromosome 5 and 7 abnormalities in oncology personnel handling anticancer drugs. Journal of Occupational and Environmental Medicine, Available at: https://doi.org/10.1097/JOM.0b013e3181f4387b Accessed on: October 9, 2026.
[2] Cavallo D, Ursini CL, Perniconi B, et al. (2005). Evaluation of genotoxic effects induced by exposure to antineoplastic drugs in lymphocytes and exfoliated buccal cells of oncology nurses and pharmacy employees. Mutation Research, Available at: https://doi.org/10.1016/j.mrgentox.2005.08.004 Accessed on: October 9, 2026.
[3] Fransman W, Roeleveld N, Peelen S, de Kort W, Kromhout H, Heederik D. (2007). Nurses with dermal exposure to antineoplastic drugs: Reproductive outcomes. Epidemiology, Available at: https://doi.org/10.1097/01.ede.0000249423.33814.3c Accessed on: October 9, 2026

Current situation

Data and evidence

Needlestick and sharps injuries remain one of the most common occupational incidents in healthcare settings. Occupational exposure may occur through puncture or injury caused by contaminated needles and sharp objects, contact of blood or body fluids with mucous membranes or damaged skin, and other incidents involving potentially infectious biological material.

International evidence estimates that the annual prevalence of needlestick injuries among healthcare workers at approximately 44.5%[4]. A survey among healthcare workers and students in the United States found that 59% of respondents experienced at least one sharps injury during their career, while only 54% reported the injury[5]. Applying this estimate to Croatia's healthcare workforce of approximately 80,000 professionals[6] suggests that more than 35,000 sharps injuries could occur annually.

Official reporting figures, however, are substantially lower. Croatian legislation requires employers to report all exposure incidents to the Croatian Institute of Public Health (HZJZ), and electronic reporting has been available since the adoption of the Ordinance on the Implementation and Protective Measures for the Prevention of Sharps Injuries (NN 39/20)[7]. Nevertheless, reporting remains incomplete. For example, **available HZJZ data show only 761 sharps injuries and occupational exposure incidents have been reported in 2025.** Hospitals account for the vast majority of reported incidents (84%), while 59% of all reported exposures involve needle-stick injuries[8]. In 2025, only 58% of Croatian hospitals submitted sharps injury reports to HZJZ[9].

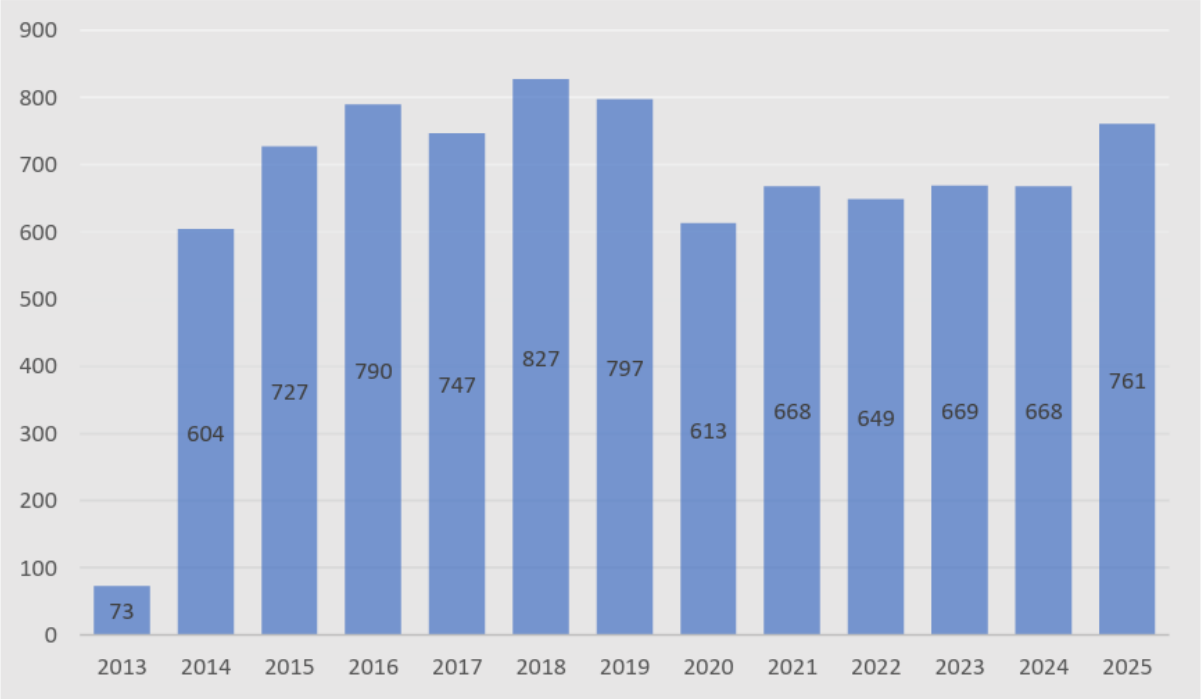


Figure 1. Number of reported incidents by year in Croatia (August 2013 – December 2025). Source:HZJZ[10]

[4] Bouya, S., Balouchi, A., Rafiemanesh, H., et al. (2020). *Global Prevalence and Device Related Causes of Needle Stick Injuries among Health Care Workers: A Systematic Review and Meta-Analysis*. *Annals of Global Health*, 86(1), 35. Available at: https://doi.org/10.5334/aogh.2698 Accessed on: October 9, 2026.
[5] Yun, J., Umemoto, K., Wang, W., & Vyas, D. (2023). *National Survey of Sharps Injuries Incidence Amongst Healthcare Workers in the United States*. *International Journal of General Medicine*, 16, 1193–1204. Available at: https://doi.org/10.2147/IJGM.S404418 Accessed on: October 9, 2026.
[6] Source available at: https://www.hzjz.hr/hrvatski-zdravstveno-statisticki-ljetopis/hrvatski-zdravstveno-statisticki-ljetopis-za-2025-g-tablicni-podaci/?utm_ Accessed on: October 9, 2026.
[7] Pravilnik o načinu provođenja i mjerama zaštite radi sprječavanja nastanka ozljeda oštrim predmetima (NN 39/2020). Narodne novine. Available at: https://narodne-novine.nn.hr/clanci/sluzbeni/2020_04_39_831.html Accessed on: October 9, 2026.
[8] Source available at: https://www.hzjz.hr/wp-content/uploads/2026/07/UBODNI-2025..pdf Accessed on: October 9, 2026.
[9] HZJZ data, presented at Panel discussion "Zdravstvena sigurnost zdravstvenih radnika – temelj stabilnog sustava," 129th Congress of the Croatian Association of Employers in Healthcare (Udruga poslodavaca u zdravstvu Hrvatske – UPUZ), Panelists: M. Bubaš, A.Antolović-Amidžić, D. Krišto, and T. Šarić. Vodice, May 21-22, 2026.
[10] Source available at: https://www.hzjz.hr/wp-content/uploads/2026/07/UBODNI-2025..pdf Accessed on: October 9, 2026.

This discrepancy suggests that underreporting remains one of the most significant barriers to understanding occupational risk in Croatian healthcare settings. A lower number of reports should not be interpreted as a lower level of risk. Rather, the data indicate a challenge of visibility: when incidents are not reported, the healthcare system loses the opportunity to analyse risks, identify contributing factors and implement preventive measures. Incident reporting should therefore be viewed not only as a regulatory obligation but as a key patient and worker safety tool.

Information generated through reporting could then serve as a basis for an effective preventive action. This includes the consistent use of safety-engineered sharps devices, which are recognised by HZJZ as a key measure for preventing sharps injuries by reducing the risk of accidental needle exposure[11].

Evidence from the literature further supports this approach. **A systematic review and meta-analysis by Ballout et al. (2016)[12], which evaluated the effectiveness of safety-engineered devices used for intravenous and phlebotomy procedures across healthcare settings, found that their use significantly reduces needlestick injury rates among healthcare workers.** These findings support the use of safety-engineered devices as an effective engineering control for preventing needlestick injuries and occupational exposure to blood-borne pathogens.

Finally, equally important is the provision of continuous education and training to ensure that healthcare workers are familiar with safe working practices, including the correct handling, use and disposal of sharps, and appropriate responses following an exposure incident.

Exposure to Hazardous Medicinal Products

Occupational exposure to hazardous medicinal products, particularly cytotoxic drugs, represents another major but less visible threat to healthcare workers**. The exposure can occur throughout the entire medication pathway**, beginning with storage, preparation of infusion solutions in hospital pharmacies or clinical departments, administration of treatment to patients, and ultimately the handling of cytotoxic waste and cleaning of areas and equipment that have come into contact with patients.

Understanding the true scale of this occupational risk remains challenging. At EU level, the scale of occupational exposure is significant, with European Commission guidance estimating that almost 1.8 million workers are exposed to hazardous medicinal products, 88% of whom work in hospitals, clinics and pharmacies[13]. In Croatia, available national data provide further insight into occupational exposure but also highlight significant gaps in reporting. HZJZ maintains a registry of workers occupationally exposed to cytotoxic medicines, yet available data indicate that only 35 of 62 contacted healthcare institutions responded to the HZJZ survey, corresponding to a response rate of 56%[14]. This limited institutional participation suggests that existing data provide only a partial picture of the true extent of exposure across the Croatian healthcare system.

Based on the data collected, approximately 1,050 workers are currently registered as occupationally exposed to cytotoxic medicines, with more than 75% reporting exposure to cytotoxic medicines for between four and eight hours per day. Given the frequency and duration of exposure, consistent implementation of protective measures is critical to reducing occupational risk.

However, available evidence suggests that recommended protective measures are not always applied consistently in practice. Namely, a study examining the use of personal protective equipment among nurses and technicians at University Hospital Centre Zagreb (KBC Zagreb) found **one in three respondents (33%) did not use personal protective equipment every time they handled cytotoxic medicines.** Of particular concern, 11% reported using personal protective equipment only rarely or not at all, indicating that a proportion of healthcare workers remain routinely exposed

[11] Available at: https://www.hzjz.hr/wp-content/uploads/2026/07/UBODNI-2025..pdf Accessed on: October 9, 2026.
[12] Ballout, R. A., Diab, B., Harb, A. C., Tarabay, R., Khamassi, S., & Akl, E. A. (2016). *Use of safety-engineered devices by healthcare workers for intravenous and/or phlebotomy procedures in healthcare settings: A systematic review and meta-analysis. BMC Health Services Research, 16*, 458. Available at: https://doi.org/10.1186/s12913-016-1705-y Accessed on: October 9, 2026.
[13] European Commission, Directorate-General for Employment, Social Affairs and Inclusion. (2023). *Guidance for the safe management of hazardous medicinal products at work*. Publications Office of the European Union. DOI: 10.2767/361444.
[14] HZJZ data, presented at Panel discussion "Zdravstvena sigurnost zdravstvenih radnika – temelj stabilnog sustava," 129th Congress of the Croatian Association of Employers in Healthcare (Udruga poslodavaca u zdravstvu Hrvatske – UPUZ), Panelists: M. Bubaš, A.Antolović-Amidžić, D. Krišto, and T. Šarić. Vodice, 21–22 May 2026

without consistent protection[15]. Given the potential health consequences associated with long-term exposure, these findings underline **the importance of implementing engineering controls that do not depend solely on individual behaviour, such as Closed System Transfer Devices (CSTDs)**, as part of a comprehensive approach to reducing occupational exposure.

The benefits of implementing CSTDs have been demonstrated in practice. A study by Hon et al. (2025)[16], conducted across four healthcare facilities in Canada, evaluated the effectiveness of implementing closed-system drug transfer devices (CSTDs) in reducing occupational exposure to hazardous drugs. Using repeated surface wipe sampling before and after implementation, the study found a statistically significant reduction in hazardous drug surface contamination following CSTD implementation, with contamination levels continuing to decline five months after implementation.

Finally, the abovementioned study from KBC Zagreb found that healthcare workers who had received training on safe handling practices were substantially more familiar with adverse event reporting procedures than those who had not undergone such training (95% versus 77%). The difference between the two groups highlights the important role of education not only in promoting safe working practices, but also in improving awareness of occupational risks and strengthening reporting culture.

Regulatory overview

Croatia has established a legislative framework for protecting healthcare workers from occupational exposure to sharps injuries and hazardous medicinal products, to a large extent through the transposition of relevant European Union legislation into national law. This framework defines employers' responsibilities for risk assessment, prevention, worker protection and reporting, providing the legal basis for improving healthcare worker safety across the healthcare system.

Needlestick and Sharps Injuries

The prevention of needlestick and sharps injuries in Croatia is primarily based on Council Directive 2010/32/EU implementing the Framework Agreement on prevention from sharp injuries in the hospital and healthcare sector[17]. The Directive introduces requirements to employers to eliminate or minimize the risk of injuries through risk assessment, implementation of preventive measures, staff education and training, use of safety-engineered medical devices where appropriate, vaccination where indicated, and clear procedures for reporting and managing occupational exposure incidents.

The Directive has been transposed into Croatian legislation through the Ordinance on the Method of Implementing Protective Measures to Prevent Sharp Injuries (NN 84/13, 17/17) and the updated Ordinance on the Method of Implementation and Protective Measures to Prevent Sharp Injuries (NN 39/2020). The latter introduced electronic reporting of occupational exposure incidents to HZJZ, requiring employers to notify HZJZ of every sharp injury and occupational exposure incident using the prescribed reporting form. Subsequently, HZJZ submits a monthly electronic summary report on all needlestick injuries, sharps injuries and other occupational exposure incidents to the Ministry of Health and the Croatian Health Insurance Fund (HZZO).

The same Ordinance also requires employers, where risk assessment identifies a residual risk of sharps injuries, to provide medical instruments equipped with safety mechanisms (safety-engineered medical devices). However, the broader occupational safety legislation (Occupational Safety Act (NN 39/20)[18], Ordinance on the Protection of Workers from Risks Related to Exposure to Biological Hazards at Work (NN 129/20)[19] does not establish detailed criteria for determining when such measures should be implemented. **While the legislation requires employers to assess occupational risks and adopt appropriate preventive measures, it leaves considerable**

[15] Islamčević S, Brborović H, Knežević B, Milošević M. *Upotreba osobne zaštitne opreme među medicinskim sestrama i tehničarima KBC Zagreb u radu s citostaticima.* Sigurnost. 2024;66(3):189–199. doi:10.31306/s.66.3.1
[16] Hon, C. Y., Ellis, J., Chiang, T. I. E., Jeronimo, M., Ciconte, R., & Ménard, A. D. (2025). *Adoption of Closed-System Drug Transfer Devices: Effectiveness in Reducing Occupational Exposure to Hazardous Drugs and the Change Management Process*. Canadian Journal of Hospital Pharmacy, 78(3), e3676. Available at: https://doi.org/10.4212/cjhp.3676 Accessed on: October 9, 2026.
[17] Council Directive 2010/32/EU of 10 May 2010 implementing the Framework Agreement on prevention from sharp injuries in the hospital and healthcare sector concluded by HOSPEEM and EPSU (Text with EEA relevance), OJ L 134, 1.6.2010, pp. 66–72. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0032 Accessed on: October 9, 2026.
[18] Ordinance on Procedures and Protective Measures to Prevent Injuries Caused by Sharp Instruments, Narodne novine, br. 39/2020. Available at: https://narodne-novine.nn.hr/clanci/sluzbeni/2020_04_39_831.html Accessed on: October 9, 2026.
[19] Ordinance on the Protection of Workers from Risks Related to Exposure to Biological Agents at Work, Narodne novine, br. 129/2020. Available at: https://narodne-novine.nn.hr/clanci/sluzbeni/2020_11_129_2459.html Accessed on: October 9, 2026.

discretion regarding the interpretation of risk assessment results and the selection of safety-engineered devices. As a result, implementation is largely left to individual employers, which may vary in practice between healthcare institutions.

Exposure to Hazardous Medicinal Products

Occupational exposure to hazardous medicinal products is governed by a broader regulatory framework addressing exposure to carcinogenic, mutagenic and reprotoxic substances in the workplace.

At the European level, the legal basis is provided by Directive 2004/37/EC on the protection of workers from risks related to exposure to carcinogens, mutagens and reprotoxic substances at work[20]. The Directive requires employers to assess occupational risks, minimize worker exposure, apply the hierarchy of preventive measures and ensure appropriate health surveillance of exposed workers.

These requirements are reflected in Croatian legislation through the Occupational Safety and Health Act (NN 71/14, 118/14, 94/18, 96/18), The Ordinance on the Protection of Workers from Exposure to Hazardous Chemicals at Work, Occupational Exposure Limit Values and Biological Limit Values (NN 91/18, 1/21, 148/23 and 135/25)[21] and the Order on Handling Medicines Containing Cytotoxic Substances (NN 30/91)[22]. Together, these legal instruments establish employer obligations related to risk assessment, implementation of protective measures, worker education, occupational health surveillance and maintenance of records of workers exposed to hazardous medicinal products.

Although the Occupational Safety Act establishes a clear hierarchy of preventive measures for work involving hazardous chemicals and requires that, wherever possible in light of the nature of the work and the state of the art, hazardous substances be handled in closed systems, the implementing framework does not operationalize this obligation in the context of hazardous medicinal products. Specifically, the Ordinance on the Protection of Workers from Exposure to Hazardous Chemicals at Work, Occupational Exposure Limit Values and Biological Limit Values recognizes the concept of a closed system but neither defines it in the context of hazardous medicinal products nor specifies that compliance with this requirement should be achieved through the use of closed-system drug transfer devices (CSTDs).

As a result, healthcare institutions retain considerable discretion in interpreting these requirements, leading to inconsistent implementation of protective measures for healthcare workers against occupational exposure to hazardous medicinal products. Finally, the sector-specific Order on Handling Medicines Containing Cytotoxic Substances has remained largely unchanged since its adoption in 1991, limiting its relevance in addressing current occupational safety standards.

Differences between hospitals

In practice, the way healthcare worker safety is organized, monitored and enforced varies considerably between institutions. This variation is visible in the prevention and management of needlestick and sharps injuries and in the handling of hazardous medicinal products, meaning that the level of protection available to healthcare workers can depend heavily on the hospital in which they work.

Needlestick and sharps injuries provide a clear example of this institutional variation. Although employers are required to report occupational exposure incidents, HZJZ data show that 42% of Croatian hospitals did not submit sharps injury reports[23]. Similarly, while Croatian legislation requires employers to introduce safety-engineered medical devices were indicated by risk assessment and to

[20] Directive 2004/37/EC of the European Parliament and of the Council of 29 April 2004 on the protection of workers from the risks related to exposure to carcinogens, mutagens or reprotoxic substances at work *Official Journal of the European Union*, L 158, 30 April 2004, pp. 50–76. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32004L0037 Accessed on: October 9, 2026.
[21] Ordinance on the Protection of Workers from Exposure to Hazardous Chemicals at Work, Occupational Exposure Limit Values and Biological Limit Values, NN 91/2018, 1/2021, 148/2023 i 135/2025
[22] Order on the Procedures for Handling Medicinal Products Containing Cytotoxic Substances, NN 30/1991. Available at: https://narodne-novine.nn.hr/clanci/sluzbeni/1991_06_30_867.html Accessed on: October 9, 2026.
[23] Panel discussion "Healthcare Worker Safety – The Foundation of a Resilient Healthcare System" at 129th Congress of the Croatian Association of Employers in Healthcare (Udruga poslodavaca u zdravstvu Hrvatske – UPUZ), Panelists: M. Bubaš, A.Antolović-Amidžić, D. Krišto, and T. Šarić. Vodice, 21–22 May 2026.

provide regular staff education and training, the implementation of these measures is not consistent across healthcare institutions.

Furthermore, following the transposition of relevant EU legislation into Croatian law, the scope of hazardous medicinal products requiring occupational risk management has expanded in line with evolving European standards. As regulatory expectations regarding protection from carcinogenic, mutagenic and reprotoxic substances continue to increase, implementation across Croatian healthcare institutions has not progressed at the same pace. This is particularly relevant in larger clinical hospital centers, where the volume of oncology patients and hazardous medicinal products handled is highest, yet systematic monitoring of occupational exposure and implementation of comprehensive safety measures remain inconsistent[24].

University Hospital Centre Osijek (KBC Osijek), however, provides an example of more structured organization of cytotoxic medicine preparation. KBC Osijek has had centralized preparation of cytotoxic medicines in place since 2010[25]. The hospital's oncology department also states that since 2015 it has used an integrated electronic system for prescribing and preparing cytostatic therapy, linked to the central preparation of cytostatic[26]. Cytotoxic medicines are prepared under dedicated laboratory conditions, with closed-system equipment used as part of the preparation process[27].

KBC Osijek has also implemented dedicated education on the safe handling of cytotoxic medicines. In 2022, the hospital organized a specialized training course attended by nurses and technicians from oncology and internal medicine units, as well as pharmacy technicians working in the central cytostatic preparation unit. The training covered safe preparation and administration, measures for preventing and responding to incidents and spills, the proper handling of cytotoxic waste, the employer's legal obligations and the importance of personal protection and quality management[28]. This provides an example of how technical safeguards, centralized preparation and staff training can be combined at institutional level to reduce occupational risks associated with hazardous medicinal products.

This approach is also aligned with the European Commission's guidance on the safe management of hazardous medicinal products at work, which recommends following the hierarchy of control measures to reduce occupational exposure and identifies closed systems and Closed System Transfer Devices (CSTDs) as technical measures for limiting exposure during the handling of hazardous medicinal products. The guidance further recommends regular workplace monitoring and assessment of occupational exposure, including assessment of workers' exposure and risks at least annually and more frequently when changes are introduced in workplace procedures, techniques or the hazardous medicinal products used[29]. At the same time, the Croatian context shows that this level of organization is not yet uniform across hospitals. Some institutions have well-developed protocols for reporting, exposure follow-up and safe handling of hazardous medicines, while others rely more heavily on local practice and individual initiative. The regulatory framework allows for institutional variation in procedures, but that variation can create uneven protection for healthcare workers. For this reason, the example of KBC Osijek is important not only as a model of good practice, but also as evidence that stronger standardization is possible, efficient and necessary across the healthcare system.

[24] HZJZ data, presented at Panel discussion " Healthcare Worker Safety – The Foundation of a Resilient Healthcare System" at 129th Congress of the Croatian Association of Employers in Healthcare (Udruga poslodavaca u zdravstvu Hrvatske – UPUZ), Panelists: M. Bubaš, A.Antolović-Amidžić, D. Krišto, and T. Šarić. Vodice, 21–22 May 2026
[25] Source available at: https://www.medicina-danas.hr/interview/uloga-klinickog-farmaceuta-u-zdravstvenom-sustavu/a/2568 Accessed on: October 9, 2026.
[26] Source available at: https://www.kbco.hr/klinika/zavod-za-onkologiju/ Accessed on: October 9, 2026.
[27] Source available at: https://glas-slavonije.hr/osijek/0000/00/00/laboratorij-u-kojem-se-cuva-svaka-kap-skupih-citostatika-59288/ Accessed on: October 9, 2026.
[28] Source available at: https://www.kbco.hr/tecaj-o-sigurnom-rukovanju-citotoksicnim-lijekovima/ Accessed on: October 9, 2026.
[29] European Commission, Directorate-General for Employment, Social Affairs and Inclusion. (2023). Guidance for the safe management of hazardous medicinal products at work. Publications Office of the European Union. DOI: 10.2767/361444.

Recommendations

1) Strengthen the current regulatory framework to ensure consistent use of closed systems and safety-engineered medical devices

Although the current regulatory framework recognizes the importance of closed systems in reducing occupational exposure to hazardous medicinal products and safety-engineered medical devices in preventing needlestick and sharps injuries, it leaves significant room for interpretation regarding their implementation. As a result, the use of CSTDs and safety-engineered medical devices varies considerably between healthcare institutions, leading to unequal levels of protection for healthcare workers. This is particularly important given that the general principles of occupational safety prioritize technical and engineering controls over reliance solely on workers' behavior or personal protective equipment. The existing regulatory framework should therefore be strengthened to remove ambiguity and establish clear, enforceable requirements.

Regarding occupational exposure to hazardous medicinal products, the Ordinance on the Protection of Workers from Exposure to Hazardous Chemicals at Work, Occupational Exposure Limit Values and Biological Limit Values should be amended to operationalize the existing legal requirement to use closed systems. The Ordinance should **define the concept of a closed system in the context of handling hazardous medicinal products and recognize closed-system drug transfer devices (CSTDs) as the appropriate engineering control to ensure compliance with the Occupational Safety Act.** This would ensure the consistent application of the existing legal framework across all healthcare institutions. Furthermore, the outdated 1991 Order on Handling Medicines Containing Cytotoxic Substances should be reviewed and either comprehensively updated or replaced with a modern guidance document reflecting current evidence and best practice for the safe handling of hazardous medicinal products.

In addition, regarding the prevention of needle-stick injuries, the current regulatory framework should be strengthened by amending the Ordinance on the Method of Implementation and Protective Measures to Prevent Sharp Injuries to **establish clear criteria for when safety-engineered medical devices must be introduced following workplace risk assessments.** While the Ordinance requires employers to provide medical instruments equipped with safety mechanisms where a risk is identified, it does not define the level of risk that triggers this obligation, leaving considerable discretion to individual healthcare institutions.

Together, these amendments would ensure more consistent implementation of engineering controls across healthcare institutions, reduce variation in occupational safety practices, and provide a higher and more uniform level of protection for healthcare workers throughout Croatia. In addition to establishing clearer regulatory requirements, **both Ordinances should provide systematic monitoring and documentation of compliance with the prescribed engineering controls.** The Ordinance on the Protection of Workers from Exposure to Hazardous Chemicals at Work should require healthcare institutions to periodically monitor and document compliance with the required use of closed systems/CSTDs.

Similarly, the Ordinance on the Method of Implementation and Protective Measures to Prevent Sharp Injuries should explicitly require healthcare institutions to monitor and document compliance with the prescribed use of safety-engineered medical devices, building on its existing framework for monitoring, evaluation and quality assurance. This should include monitoring and documentation of whether safety-engineered medical devices are consistently used in procedures in which their use is required, including the identification and follow-up of cases of non-compliance. Relevant compliance records should be made available to the competent inspection authority upon request, supporting effective external oversight and enforcement.

- ***Recommendation:***

The regulatory framework should be strengthened to establish clear, enforceable requirements for the consistent use of closed-system drug transfer devices (CSTDs) and safety-engineered medical

devices across healthcare institutions, including defined criteria for their implementation, systematic monitoring and documentation of compliance, and effective inspection and enforcement mechanisms.

2) Educational campaigns and training for HCW to cut underreporting and increase awareness about safety at work

In 2024, Croatia had no reported occupational exposure incidents involving hazardous medicinal products[30], despite available evidence showing that a substantial number of healthcare workers are occupationally exposed to cytotoxic medicines and that protective measures are not applied consistently in practice. Given the health risks associated with prolonged exposure to hazardous medicinal products, the absence of reported incidents is unlikely to reflect an absence of occupational exposure. Rather, it suggests that such incidents remain largely unrecognized or unreported.
Similarly, available data on needlestick and sharps injuries indicate that incident reporting remains incomplete despite the high estimated prevalence of such injuries among healthcare workers. Taken together, these findings suggest that the problems are not only exposure and injuries themselves, but also poor visibility of risks.

Educational campaigns should therefore be implemented as a priority to improve the reporting of both occupational exposure to hazardous medicinal products and needlestick and sharps injuries, while strengthening healthcare workers' knowledge of safe working practices. Such campaigns should focus on reporting procedures and safe handling protocols throughout the medication pathway. Better awareness and reporting would improve the quality of surveillance data, support earlier interventions and ultimately strengthen healthcare worker safety.

- ***Recommendation:***

Educational campaigns and regular training for healthcare workers should be implemented to increase awareness of occupational risks, promote safe handling practices, and improve the reporting of occupational exposure to hazardous medicinal products and needlestick and sharps injuries, thereby strengthening workplace safety and the reliability of incident surveillance.

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[30] HZJZ data, presented at Panel discussion "Healthcare Worker Safety – The Foundation of a Resilient Healthcare System", at 129th Congress of the Croatian Association of Employers in Healthcare (Udruga poslodavaca u zdravstvu Hrvatske – UPUZ), Panelists: M. Bubaš, A.Antolović-Amidžić, D. Krišto, and T. Šarić. Vodice, 21–22 May 2026