

# Bulletin de veille n° 76

1<sup>er</sup> janvier 2026 – 28 février 2026

## ***Surveillance biologique de l'exposition professionnelle aux médicaments cytotoxiques. Etude de terrain.***

Objectif : *Disposer d'une connaissance actualisée du sujet en accompagnement des demandes d'assistance qui découlent de la valorisation de l'étude sur la surveillance biologique de l'exposition aux médicaments cytotoxiques en milieu hospitalier.*

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

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- *Articles de périodique (PREPRINT)*

Elluard M., Cirtiu C.M., Caron N., Bussièrès J.F. and Tanguay C.

**Antineoplastic drug contamination and safe handling practices in Canadian healthcare centres: Results from the 2025 monitoring program.**

Journal of Oncology Pharmacy Practice, 27 janvier 2026

*Résumé: Introduction Occupational exposure to antineoplastic drugs remains a significant concern for healthcare workers. Surface contamination is a key indicator of exposure risks and reflects the effectiveness of practices. This study aimed to describe contamination with 11 antineoplastic drugs on 12 surfaces in Canadian healthcare centres participating in the 2025 monitoring program and to examine practices implemented by these centres, including the potential influence of hazardous drug committees. Methods Each centre sampled six standardized sites in oncology pharmacies and six in outpatient clinics. Ultra-performance liquid chromatography-tandem mass spectrometry quantified cyclophosphamide, docetaxel, doxorubicin, etoposide, 5-fluorouracil, gemcitabine, irinotecan, methotrexate, paclitaxel and vinorelbine. Inductively coupled plasma mass spectrometry quantified platinum-based drugs. The Kolmogorov-Smirnov test assessed differences in contamination, and chi-square tests compared practice implementation. Results A total of 127 centres participated. Overall, 35% (504/1 453) of surfaces were contaminated, most frequently cyclophosphamide (22%, 90(th) percentile 0.0052 ng/cm(2)) and gemcitabine (14%, 0.0017 ng/cm(2)). The most contaminated sites were the front grille inside the biological safety cabinet (70%) and the armrest of the treatment chair (67%). More than half of centres (67/122, 55%) reported having a hazardous drugs committee. Cyclophosphamide surface contamination differed by committee presence and meeting frequency ( $p = 0.034$ ). Centres with a committee were more likely to implement certain handling practices, including cleaning vials before storage ( $p = 0.004$ ). Conclusions Surface contamination remains frequent but at low concentrations, with evidence of improvement over time. Multidisciplinary committees, continuous monitoring and broader staff engagement are essential to strengthen safety culture and reduce occupational exposure.*

<https://doi.org/10.1177/10781552261416401>

- *Articles de périodique*

Riestra A.C., Urretavizcaya M., Ferro Uriguen A., Olariaga Sarasola O., Iglesias A., Camba Y., Asensio Bermejo A. and Tames M.J. (Préprint dans Bulletin n° 70)

**Monitoring of occupational exposure to hazardous medicinal products in robotic compounding.**

European Journal of Hospital Pharmacy, Volume 33, Numéro 1, janvier 2026, page 37-44

*Résumé: OBJECTIVE: This study aims to evaluate the risk of occupational exposure to hazardous medicinal products (HMPs) when utilising robotic compounding systems for the preparation of antineoplastic sterile medications. Specifically, it assesses the levels of HMPs present on the surfaces of ready-to-use preparations and on the gloves worn by personnel involved in the compounding process. METHODS: The study was conducted over three consecutive days during routine production with a robotic compounding system. Each day, wipe samples were collected from the surfaces of 20 HMPs preparations and from the gloves of the operator involved in the compounding process. Analyses were*

performed using an Ultra-High Performance Liquid Chromatography (UHPLC) system to detect and quantify 25 commonly used anticancer molecules in hospital pharmacies. **RESULTS:** Throughout the study, the robot compounded 60 bags of 19 different drugs, including 5-fluorouracil, bevacizumab, carboplatin, cisplatin, cyclophosphamide, docetaxel, doxorubicin, eribulin, etoposide, gemcitabine, irinotecan, nivolumab, oxaliplatin, paclitaxel, panitumumab, pembrolizumab, pemetrexed, trastuzumab, and vinorelbine. Only negligible amounts of gemcitabine, below the quantification limit ( $<0.0025 \text{ ng/cm}^2$ ), were detected on the surfaces of 10 out of the 60 bags and on two of the operator's gloves. **CONCLUSION:** The results demonstrate that surface contamination levels of HMPs in robotic compounding are exceedingly low and, in most cases, undetectable. Occupational exposure to HMPs remains consistently below  $0.1 \text{ ng/cm}^2$ , a threshold deemed safe according to various studies. These findings assure the safety of compounding personnel and other hospital staff involved in cancer treatment.

<https://doi.org/10.1136/ejhpharm-2024-004294>

Sessink P.J.M., Barry B., Dunbar L., Cameron L.T., Kirkness T. and Campbell K. (Préprint dans Bulletin n° 69)

**Workflow evaluation of environmental contamination with hazardous drugs during compounding and administration in an UK hospital.**

Journal of Oncology Pharmacy Practice, Volume 32, Numéro 1, janvier 2026, page 43-55

**Résumé:** *Introduction* Exposure of healthcare workers to hazardous drugs may result in adverse health effects underscoring the importance of validating working procedures and safety precautions to minimise the risk. The objective was to monitor environmental contamination caused by the hazardous drug workflow: from drug vials, compounding process, to patient administration. *Methods* Surface wipe samples were collected from potentially contaminated surfaces in the compounding department and in the administration department. The outside of drug vials, compounded syringes, bags, elastomeric pumps, and gloves used by the nurses for administration were also monitored. Stationary air samples were collected near the isolators and above the bench top. Personal air samples were collected from pharmacy technicians, pharmacists, and nurses. Monitoring was performed in three trials during two-months. Samples were analysed for cyclophosphamide, 5-fluorouracil, docetaxel, and paclitaxel using liquid chromatography tandem mass spectrometry. *Results* Contamination was mainly found for 5-fluorouracil and cyclophosphamide on isolator surfaces, bench top, trays, and compounded products. Lower levels of contamination were measured in the administration department on trays, trolley arms and gloves of the nurses. Paclitaxel and docetaxel were incidentally detected. Air contamination was found for paclitaxel in the compounding department in one trial, and 5-fluorouracil was detected once in front of an isolator. Docetaxel was found in one air sample of a nurse. *Conclusions* Contamination was mainly found for 5-fluorouracil and cyclophosphamide on the products compounded in the isolators. Contamination was further spread along the workflow towards the administration department causing surfaces in between being contaminated too.

<https://doi.org/10.1177/10781552241285138>

Speranza E. D., Jeronimo M., Colombo M. (Préprint dans Bulletin n° 62)

**Initial assessment of multi-compound antineoplastic drug surface contamination in Argentinean healthcare centers: Insights into occupational exposures in South America.**

Journal of Oncology Pharmacy Practice, Volume 32, Numéro 1, janvier 2026, page 14-23

Résumé : *INTRODUCTION: Antineoplastic drugs (ADs) are commonly used pharmaceuticals for anticancer treatments. It has previously been shown that the external surface of drug vials frequently is contaminated with ADs. More than a decade ago methods to prevent occupational exposure were introduced by using plastic coverage of the glass vials or packing vials in a secondary plastic container. The aim of the pilot study was to determine contamination levels of ADs on different parts of AD packaging of two different commercially available drug vials on the Swedish market and to investigate the occurrence of cross contamination of ADs. METHODS: Packagings of gemcitabine (GEM) and 5-fluorouracil (5-FU) were tested by wipe sampling. Five ADs; GEM, 5-FU, cyclophosphamide (CP), ifosfamide and etoposide were quantified using liquid chromatography mass spectrometry. RESULTS: AD contaminations were detected in 69% and 60% of the GEM and 5-FU packaging samples. Highest levels, up to approximately 5 µg/sample, were observed on the glass vials. The protective shrink-wrap of 5-FU vials and the plastic container of GEM were contaminated with low levels of 5-FU and GEM, respectively, and furthermore the 5-FU vials with shrink-wrap were cross-contaminated with GEM. Cross-contamination of CP and GEM was detected on 5-FU vials with plastic shrink-wrap removed. CONCLUSIONS: External contamination of ADs are still present at primary drug packagings on the Swedish market. Protection of AD vials by plastic shrink-wrap or a secondary plastic container does not remove the external contamination levels completely. The presence of cross contamination of ADs on drug packagings was also observed.*

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Ursini C.L., Di Gennaro G., Buresti G., Maiello R., Fresegna A.M., Ciervo A., Gentile M., Di Basilio V., Beltramini S., Gaggero D., Rigamonti N., Maccari E., Zorzetto G., Maiolino P., Di Filippo P., Bilancio M.C., Baldo P., Martinello V., Di Mattia A., Esposito C., Nardulli P., Laforgia M., Visconti M.V., Vitali M., Omodeo-Salè E. and Cavallo D.

**Cross-Sectional Multicenter Biomonitoring Study on Genotoxicity and Oxidative DNA Damage in Oncology Healthcare Workers from Seven Italian Hospitals.**

Journal of Xenobiotics, Volume 16, numéro 1, 13 janvier 2026, article 12

Résumé: *Cancer cases have been estimated that will increase in the next years with consequent increase of antineoplastic (AD) drug treatments and workers handling these hazardous chemicals. We aimed to evaluate genotoxic/oxidative effects of AD exposure by fpg-comet assay on a large size sample of workers (214 exposed and 164 controls) involved in preparation; administration, including Hyperthermic intraperitoneal chemotherapy (HIPEC) and pressurized intraperitoneal aerosol chemotherapy (PIPAC); and disposal. With the final aim to identify suitable early biomarkers of genotoxic effect useful to health surveillance, we correlated fpg-comet assay (blood) and Buccal Micronucleus Cytome (BMCyt) assay data. Fpg-comet parameters resulted higher in the exposed group vs. controls, demonstrating direct and oxidative DNA damage in workers handling ADs. Fpg-comet direct DNA damage and genotoxic parameters of BMCyt assay demonstrated a weak statistically significant correlation. This cross-sectional study is one of the few available evaluating both direct and oxidative DNA damage due to ADs on a large sample size of workers and correlating fpg-comet and BMCyt assay results. It highlights the need to evaluate genotoxic effects by both the biomarkers and furnishes a contribution to their validation. Moreover, we demonstrate for the first time oxidative DNA damage on workers performing HIPEC and PIPAC administration.*

<https://doi.org/10.3390/jox16010012>

Filis Özbay N. and Çiçeklioğlu M.

**Assessed the effectiveness of an educational program for nurses administering antineoplastic drugs; comparative intervention research before and after.**

BMC Nursing, Volume 25, Numéro 1, 27 janvier 2026, article 161

*Résumé: BACKGROUND: Occupational exposure of healthcare workers to antineoplastic drugs can be prevented through the consistent use of protective measures. Despite clear scientific evidence of exposure risks, adherence to safety standards and use of personal protective equipment remain insufficient. The most frequently cited barriers include lack of training, weak safety culture, and inconsistent institutional policies. Training interventions have been shown to improve knowledge, attitudes, and performance related to safe handling. METHODS: This study evaluated the effectiveness of an educational intervention on factors influencing the use of personal protective equipment among nurses who administer antineoplastic drugs, guided by the "Factors Predicting Use of Hazardous Drug Safe Handling Precautions" model. A single-group, before-and-after comparative design was applied. The study included 67 nurses from internal medicine, adult oncology, and pediatric oncology departments of a university hospital in western Turkey. Data were collected using the Hazardous Drug Handling Questionnaire before and three months after the intervention. The program was structured according to national and international guidelines and based on Pender's Health Promotion Model. Statistical analyses were conducted using paired sample t-tests and McNemar's test. RESULTS: The intervention led to significant improvements in knowledge of hazardous drug risks, self-efficacy, perceived risk, interpersonal modeling, and frequency of personal protective equipment use ( $p < 0.05$ ). No significant changes were observed in perceived barriers, interpersonal norms, or perceived conflict of interest. Nurses' perceptions of workplace safety climate declined slightly after training ( $p = 0.047$ ). Reports of the presence of written procedures and spill kits in units increased significantly. Moreover, the proportion of nurses associating health problems with occupational exposure nearly doubled after the intervention. CONCLUSION: The educational intervention effectively enhanced individual-level determinants of safe handling behaviors. However, the limited impact on organizational-level factors indicates that training alone cannot ensure sustained behavior change. These findings highlight the need for institutional strategies that include leadership engagement and supportive policies. Strengthening nurses' competencies and self-efficacy in personal protective equipment contributes to building a safety-oriented workplace culture and supports the delivery of safe, high-quality nursing care.*

<https://doi.org/10.1186/s12912-026-04307-6>

Lama N. and Saca-Hazboun H.

**Nurse compliance with personal protective equipment when handling chemotherapy: a multicenter cross-sectional study in Palestine.**

BMC Health Services Research, Volume 26, Numéro 1, 3 février 2026, article 235

*Résumé: Background Occupational exposure to chemotherapy poses acute and long-term health risks, including cancers. Personal protective equipment is fundamental to reducing these risks; however, compliance among nurses is still inadequate worldwide. Most existing studies have occurred in industrialized countries, and no published studies have examined compliance with personal protective equipment by oncology nurses in Palestine. This study aimed to assess compliance with personal protective equipment and identify factors influencing compliance. Methods A cross-sectional descriptive design was employed. One hundred oncology nurses (68.5% response rate) from six Palestinian hospitals completed the Hazardous Drug Handling Questionnaire. A Pearson correlation analysis explored relationships between compliance with personal protective equipment and independent variables. Results*

*Nurses demonstrated moderate compliance with personal protective equipment (mean = 2.3, standard deviation [SD] = 0.67), with the highest compliance during chemotherapy administration (mean = 2.41, SD = 0.68) and the lowest during disposal (mean = 2.2, SD = 0.90). Influencing factors included insufficient knowledge of chemotherapy exposure risks, perceived barriers to using personal protective equipment, low self-efficacy, moderate perceived exposure risk, and a moderate workplace safety climate. Compliance improved among those with oncology certification ( $p = 0.005$ ) and those who received on-the-job training ( $p = 0.03$ ). Conclusions Moderate compliance with personal protective equipment indicates that oncology nurses remain at risk of exposure to chemotherapy. Targeted interventions are required, including continuous education, structured training in safe handling, and developing a supportive workplace culture through monitoring and reinforcement of safety measures. These findings present evidence to guide policymakers and healthcare leaders in strengthening chemotherapy safety standards in Palestinian healthcare centers.*

<https://doi.org/10.1186/s12913-026-14132-x>

Verscheure E., Vandervoort D., Deruyck E., Poels K., Ghosh M., Vanoirbeek J. and Godderis L.  
**Method validation for quantification of five antineoplastic agents in urine using UPLC-ESI-MS/MS.**  
Archives of Toxicology, Volume 100, Numéro 2, février 2026, page 515-523 (Préprint dans Bulletin n° 74)

*Résumé: Antineoplastic agents are hazardous compounds frequently used in cancer treatment. It is already known that the hospital environment poses a risk of occupational exposure to these agents. However, recent years, the rise of outpatient treatment and at-home treatment has introduced an additional risk including also cohabitants of patients. We identified a clear need for highly sensitive monitoring methods to assess exposure to high-risk compounds in a home setting. This study presents two validated methods for quantifying five high-risk antineoplastic agents in urine: one for cyclophosphamide, etoposide, mitomycin C and imatinib, and one for alpha-fluoro-beta-alanine. Liquid-liquid extraction with ethyl acetate was used for extraction of cyclophosphamide, etoposide, mitomycin C and imatinib from urine. Alpha-fluoro-beta-alanine was extracted using solid-phase extraction with Oasis HLB cartridges. All samples were analysed using ultra-performance liquid chromatography coupled to tandem mass spectrometry. During method validation, selectivity, extraction efficiency, matrix effect, process efficiency, linearity, sensitivity, precision and accuracy were established. The lower limits of quantification were determined to be 0.1 ng/mL (cyclophosphamide and mitomycin C), 0.7 ng/mL (etoposide), 1 ng/mL (alpha-fluoro-beta-alanine) and 10 ng/mL (imatinib). The methods were fully validated and are now ready for application in the field.*

<https://doi.org/10.1007/s00204-025-04220-y>

Razi M., Ramezanzade Tabriz E., Golmakani N., Khosravi F. and Kavooosi F.  
**Occupational safety performance in handling chemotherapy drugs and their association with self-efficacy, risk perception, workplace safety, and work-related barriers among oncology nurses: A multicenter cross-sectional study.**

European Journal of Oncology Nursing, Volume 80, février 2026, article 103112

*Résumé: BACKGROUND: Chemotherapy drugs, due to their cytotoxic properties, pose significant occupational health risks to nurses. Despite the availability of established safety guidelines, evidence suggests that adherence to protective standards among oncology nurses remains suboptimal. This study*

*aimed to assess safe handling practices and their associated factors among oncology nurses working in hospitals in Mashhad, Iran. METHODS: This multicenter cross-sectional descriptive study was conducted among 252 nurses employed in oncology wards of six hospitals in Mashhad, Iran, between May and December 2024. Data were collected using a structured questionnaire covering demographic characteristics, safe performance, knowledge, self-efficacy, workplace safety, and work-related barriers. Statistical analyses were performed using SPSS version 25, including independent t-tests, one-way ANOVA, Pearson correlation coefficients, and multivariate regression analyses. RESULTS: Overall, 81.7% of nurses reported having experienced skin contact with chemotherapy drugs, while only 23% demonstrated optimal safe performance. Significant positive correlations were observed between safe performance and psychological factors, including self-efficacy ( $r = 0.516$ ,  $p < 0.001$ ) and workplace safety ( $r = 0.493$ ,  $p < 0.001$ ). In contrast, work-related barriers showed significant negative correlations with all dimensions of performance. The association between knowledge and safe performance was weak and statistically significant only in the domains of safety in the drug preparation room and cytotoxic waste management. CONCLUSION: The findings indicate a substantial gap in the safe handling of chemotherapy drugs among oncology nurses. Theoretical training alone, without addressing self-efficacy, organizational support, environmental infrastructure, and workplace barriers, is insufficient to improve safety performance. Implementing comprehensive training programs, strengthening organizational and managerial support, and enhancing psychological factors may contribute to improved occupational safety among nurses.*

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