

In Vitro Evaluation of Decontamination Efficacy of Cleaning Solutions on Stainless Steel and Glass Surfaces Contaminated by 10 Antineoplastic Agents.

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Abstract

Objectives: The handling of antineoplastic agents results in chronic surface contamination that must be minimized and eliminated. This study was designed to assess in vitro the potential of several chemical solutions to decontaminate two types of work surfaces that were intentionally contaminated with antineoplastic drugs.

Methods: A range of solutions with variable physicochemical properties such as their hydrophilic/hydrophobic balance, oxidizing power, desorption, and solubilization were tested: ultrapure water, isopropyl alcohol, acetone, sodium hypochlorite, and surfactants such as dishwashing liquid (DWL), sodium dodecyl sulfate (SDS), Tween 40, and Span 80. These solutions were tested on 10 antineoplastic drugs: cytarabine, gemcitabine, methotrexate, etoposide phosphate, irinotecan, cyclophosphamide, ifosfamide, doxorubicin, epirubicin, and vincristine. To simulate contaminated surfaces, these molecules (200ng) were deliberately spread onto two types of work surfaces: stainless steel and glass. Recovered by wiping with a specific aqueous solvent (acetonitrile/HCOOH; 20/0.1%) and an absorbent wipe (Whatman 903®), the residual contamination was quantified using high-performance liquid chromatography (HPLC) coupled to mass spectrometry. To compare all tested cleaning solutions, a performance value of effectiveness was determined from contamination residues of the 10 drugs.

Results: Sodium hypochlorite showed the highest overall effectiveness with 98% contamination removed. Ultrapure water, isopropyl alcohol/water, and acetone were less effective with effectiveness values of 76.8, 80.7, and 40.4%, respectively. Ultrapure water was effective on most hydrophilic molecules (97.1% for cytarabine), while on the other hand, isopropyl alcohol/water (70/30, vol/vol) was effective on the least hydrophilic ones (85.2% for doxorubicin and 87.8% for epirubicin). Acetone had little effect, whatever the type of molecule. Among products containing surfactants, DWL was found effective (91.5%), but its formulation was unknown. Formulations with single surfactant non-ionics (tween 40 and span 80) or anionic (SDS) were also tested. Finally, solutions containing 10(-2) M anionic surfactants and 20% isopropyl alcohol had the highest global effectiveness at around 90%. More precisely, their efficacy was the highest (94.8%) for the most hydrophilic compounds such as cytarabine and around 80.0% for anthracyclines. Finally, the addition of isopropyl alcohol to surfactant solutions enhanced their decontamination efficiency on the least hydrophilic molecules. Measured values from the stainless steel surface were similar to those from the glass one.

Conclusions: This study demonstrates that all decontamination agents reduce antineoplastic contamination on work surfaces, but none removes it totally. Although very effective, sodium hypochlorite cannot be used routinely on stainless steel surfaces. Solutions containing anionic surfactant such as SDS, with a high efficiency/safety ratio, proved most promising in terms of surface decontamination.