

INTRODUCTION

Many professionals are exposed on a daily basis, as part of their work, to antineoplastic drugs (ADs) which are hazardous to handle. Exposition route is mainly cutaneous, notably via contaminated work surfaces. Surface monitoring allows to assess the effectiveness of professional practices and cleaning procedures, and to guide efforts towards targeted preventive measures, particularly in chemotherapy reconstitution units (CRUs). This study aims to assess the current status of ADs residual contamination (RC) on surfaces within various CRUs in France and to compare these results with international data.

MATERIALS AND METHODS

- Standardized sampling across 11 healthcare facilities
 - Sampling kits containing a standardized protocol (Figure 1).
 - Sampling of a 100-cm² surface using a gauze swab and a wiping solvent.
- Simultaneous screening and quantification of 14 ADs by ultra-high-performance liquid chromatography coupled with tandem mass spectrometry (UHPLC–MS/MS; Table 1).
- Results expressed as pg/cm² of wiped surface area.

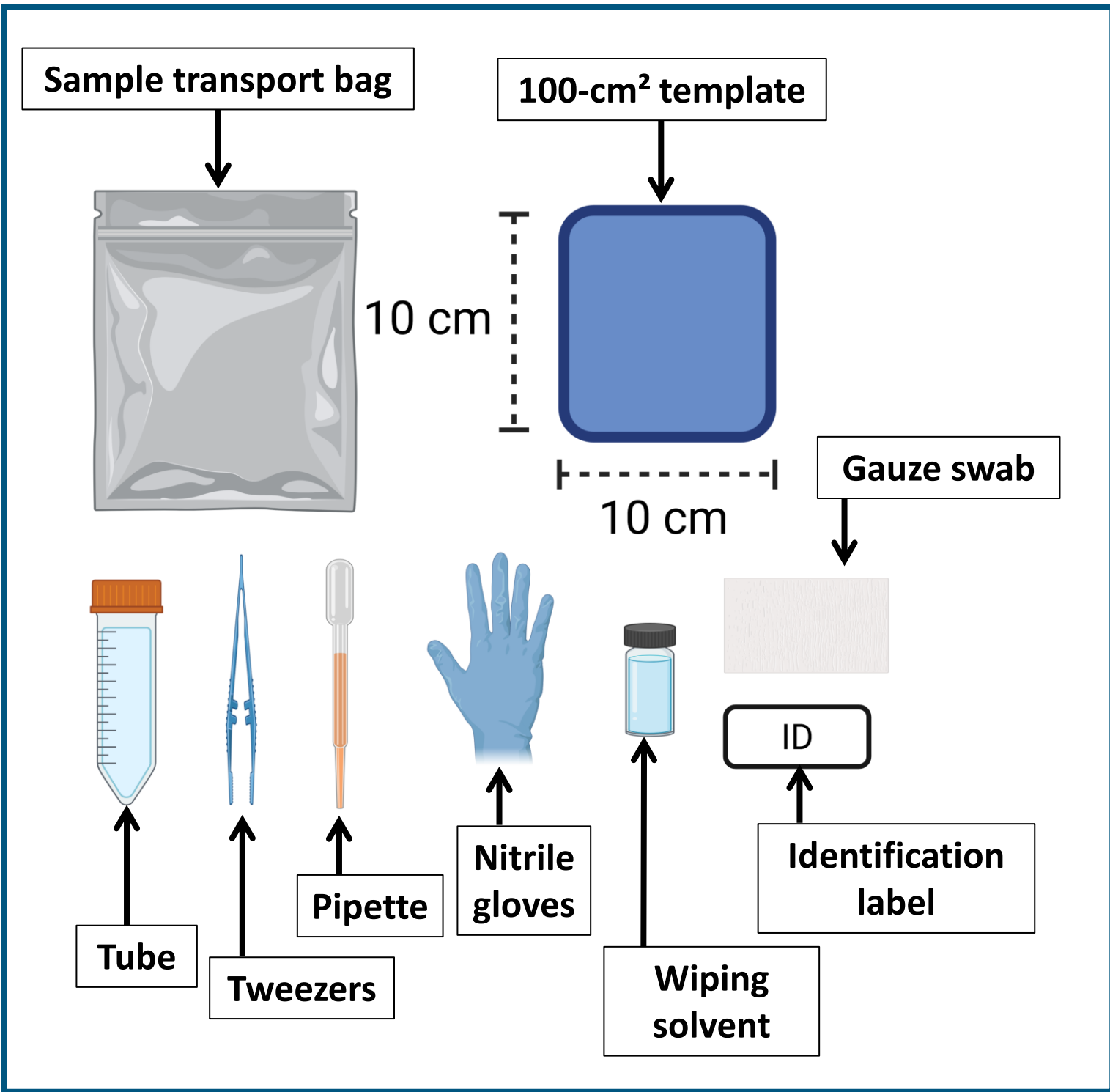
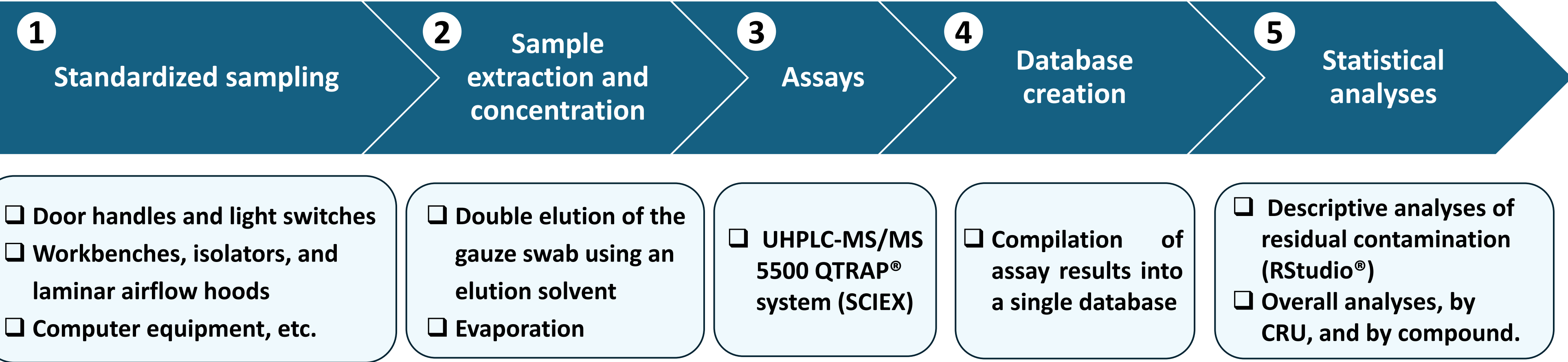


Figure 1. Contents of the sampling kit

AD	LOQ (pg/cm ²)	AD	LOQ (pg/cm ²)
Methotrexate	0.025	Etoposide	0.1
Cyclophosphamide	0.05	Paclitaxel	0.5
Doxorubicin	0.05	Vincristine	0.5
Gemcitabine	0.05	5-Fluorouracile (5-FU)	1
Ifosfamide	0.05	Cytarabine	1
Daunorubicin	0.1	Dacarbazine	1
Epirubicin	0.1	Pemetrexed	5

Table 1. Compounds screened by UHPLC–MS/MS and their limits of quantification (LOQs)



RESULTS - DISCUSSION

- 225 surface samples collected
- 3 150 assays performed, of which 2,493* results were included in the analyses, according to the data on hazardous-drug handling in the different CRUs.

Qualitative (Fig 2-3) and quantitative (Table 2) data on residual contamination

- Percentage of samples testing positive for at least one AD :
 - All CRUs combined : **80 %** (n=180/225)
 - By CRU: **mean of 83% (range: 29%–100%)** (Figure 2).
- Most frequently detected ADs, accross all CRUs (Figure 3)
 - **Gemcitabine** (67%), **cyclophosphamide** (55%) and **5-FU** (44%)

	90 th Percentile (pg/cm ²)	Median [Q1 - Q3] (pg/cm ²)	Number of assay results included*	Positivity rate (%)
Cytarabine	264.60	15.14 [5.23 - 168.53]	190	16%
5-FU	238.61	5.50 [0.71 - 34.29]	225	44%
Vincristine	54.43	3.36 [0.86 - 19.11]	160	4%
Cyclophosphamide	27.46	1.23 [0.2 - 4.28]	225	55%
Gemcitabine	27.38	0.68 [0.22 - 4.96]	190	67%
Paclitaxel	21.01	1.42 [0.57 - 5.59]	195	32%
Dacarbazine	7.96	4.78 [1.71 - 4.9]	185	3%
Methotrexate	4.74	0.17 [0.04 - 0.27]	160	16%
Etoposide	4.51	0.99 [0.33 - 1.82]	205	14%
Ifosfamide	3.13	0.19 [0.09 - 0.5]	135	28%
Epirubicin	0.22	0.16 [0.11 - 0.19]	185	8%
Doxorubicin	0.12	0.09 [0.06 - 0.1]	205	2%
Daunorubicin	NA	NA	43	0%
Pemetrexed	NA	NA	190	0%

Tableau 2. Qualitative and quantitative residual contamination by ADs

- For the three most frequently detected hazardous drugs, the 90th percentiles were of the **same order of magnitude as those reported in the literature** (Quartucci et al., 2023; Sottani et al., 2022; Palamini et al., 2020).

OBJECTIVES

- Qualitative and quantitative assessment of residual contamination** by fourteen ADs, on **work surfaces** of eleven CRUs in France.
- Comparison of the results with recent international data.**

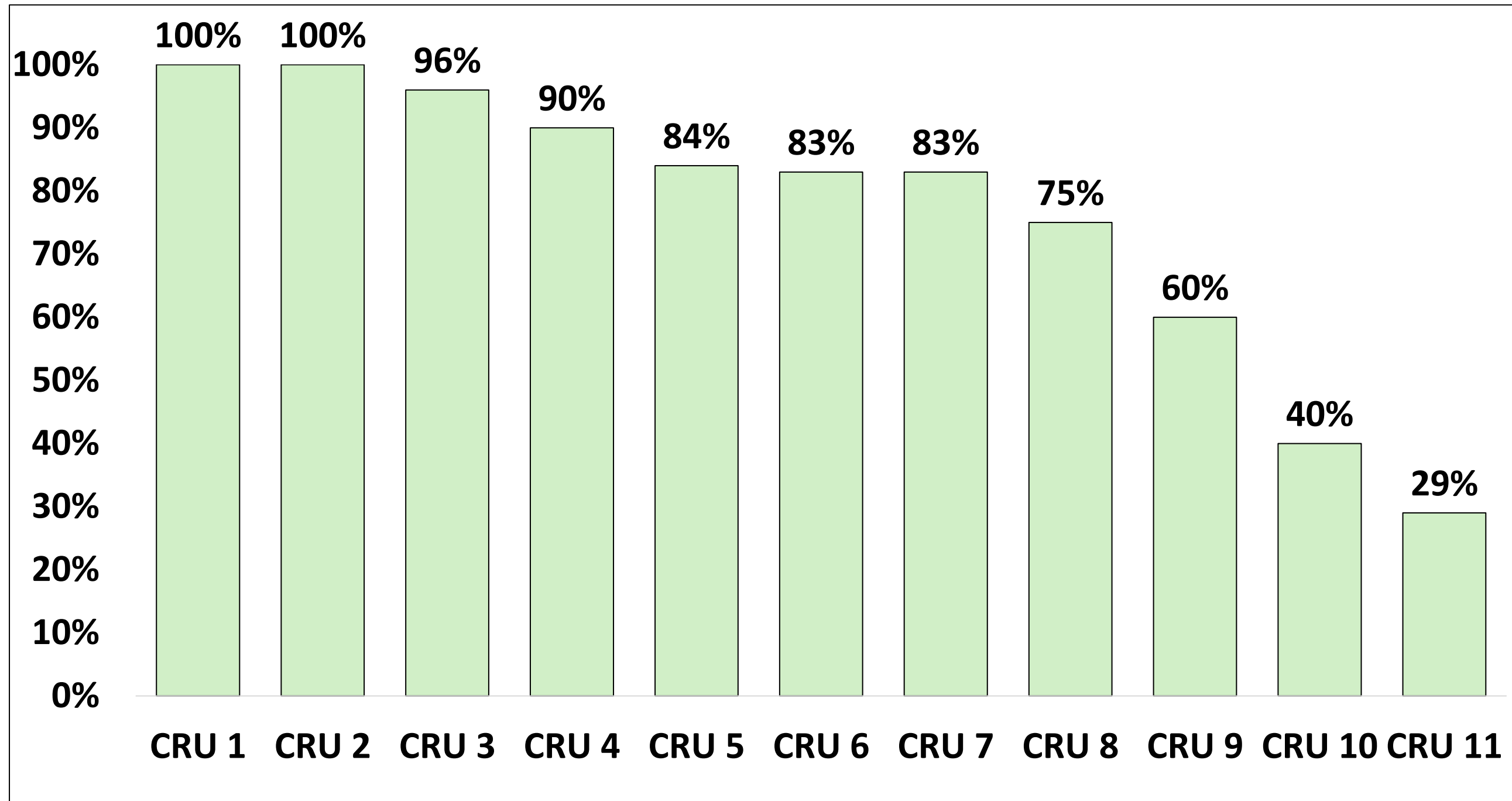


Figure 2. Qualitative residual contamination with at least one AD, by center

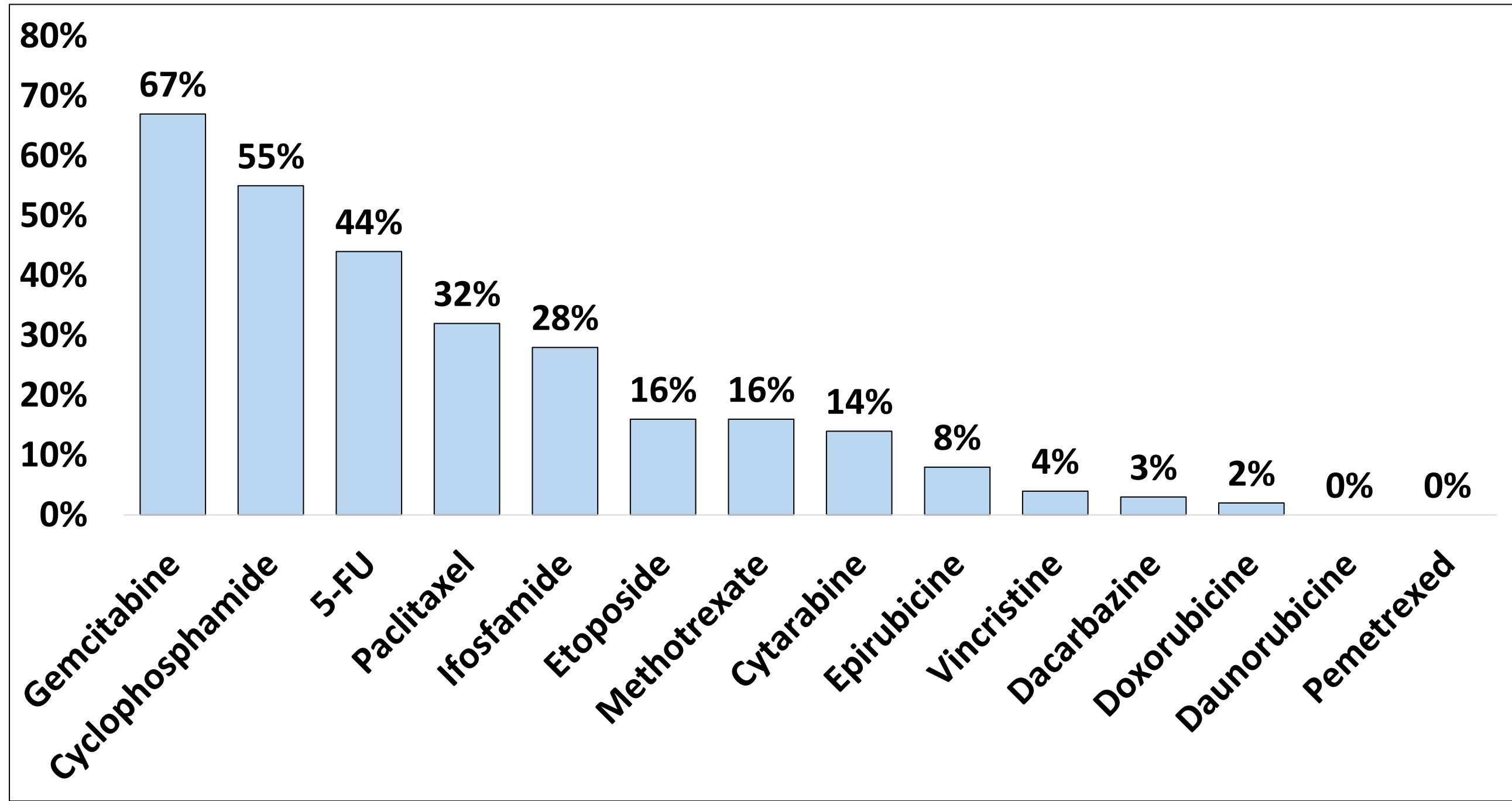


Figure 3. Qualitative residual contamination by ADs, across all centers.

CONCLUSION

Residual contamination with ADs is widespread on work surfaces, with marked variability between healthcare facilities, suggesting room for improvement in current practices. The results are consistent with recent international literature regarding the types of drugs most frequently detected and their residual quantities (90th percentile). Although the overall quantities detected were generally low, these findings highlight the need to implement effective cleaning procedures and monitor occupational practices through surface sampling. These recent French field data could provide a baseline for future monitoring campaigns in healthcare facilities, in order to track changes in contamination levels and help reduce occupational exposure to hazardous drugs as much as possible