

Canadian monitoring program of the surface contamination with 11 antineoplastic drugs



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BACKGROUND

- Occupational exposure to antineoplastic drugs can lead to adverse effects on workers' health.
- There are no maximum doses of antineoplastic drugs to which workers may be safely exposed.
- Environmental monitoring is mandated by many health and safety organizations once or twice a year.
- An annual Canadian monitoring program was established in 2010 to allow hospital to benchmark their contamination results with targeted concentrations based on pragmatic data.

OBJECTIVES

- Describe contamination with 11 antineoplastic drugs measured on 12 surfaces among Canadian hospitals.
- Evaluate the general practices, training methods and cleaning, practices associated with the handling of antineoplastic drugs.

METHODS

Sampling

- 12 standardized sites sampled in each hospital at the end of a workday :
 - 6 in oncology pharmacy
 - 6 in outpatient clinic

Quantification

- Non-platinum drugs: Ultra-high performance liquid chromatography-mass spectrometry
- Platinum-based drugs: inductively coupled plasma mass spectrometry (optional dosage)
- The limits of detection (LOD) and quantification (LOQ) are described in Table 1

Analysis

- Online REDCap® questionnaire about their practices related to hazardous drug handling
- Descriptive statistical analyses of practices and contamination
- Sub-analysis of the contamination of some practices was done with a Kolmogorov-Smirnov test for independent samples.
- p<0.05 was considered statistically significant.

Table 1. Limits of detection and quantification for the 11 drugs

Antineoplastic drugs	LOD (ng/cm ²)	LOQ (ng/cm ²)
Cyclophosphamide	0.0006	0.0006
Docetaxel	0.001	0.004
Doxorubicine	0.02	0.02
Etoposide	0.0037	0.0037
5-Fluorouracile	0.04	0.099
Gemcitabine	0.0004	0.0014
Irinotecan	0.0007	0.0024
Methotrexate	0.0009	0.0029
Paclitaxel	0.004	0.0042
Vinorelbine	0.009	0.0202
Platinum	0.004	0.004

RESULTS

Centers' characteristics

- 126 Canadian hospitals were recruited across Canada (Fig. 1).
- Hospitals sampled their surfaces between January 11st, 2023 and April 27th, 2023.
- 50% of participating hospitals chose the platinum option.
- Centers' size:
 - Small center (< 5000 antineoplastic drug preparations per year): 54% (68/126)
 - Large center (> 5000 antineoplastic drug preparations per year): 43% (54/126)
 - 3/126 (2%) outsourced their antineoplastic drug preparations

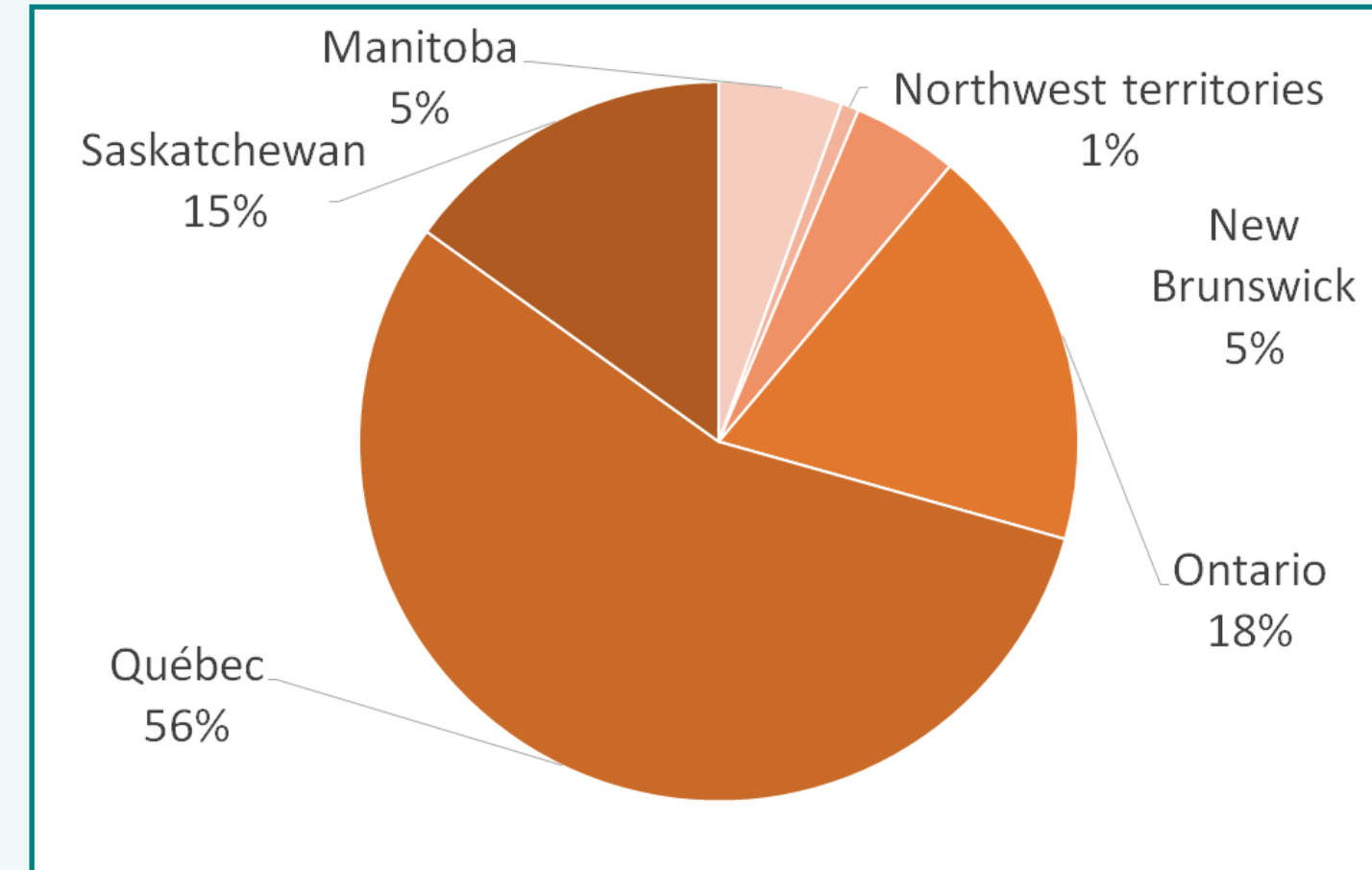


Figure 1. Participating centers

Surface contamination

- 1476 compliant samples were analyzed.
- 47% (697/1476) of surfaces had at least one positive sample.
- Most frequent antineoplastic drugs measured: **cyclophosphamide**, **gemcitabine** and platinum (Fig 1).
- 5-fluorouracile was the drug the most used but not the most frequently measured (in gram per year) (Fig.2).

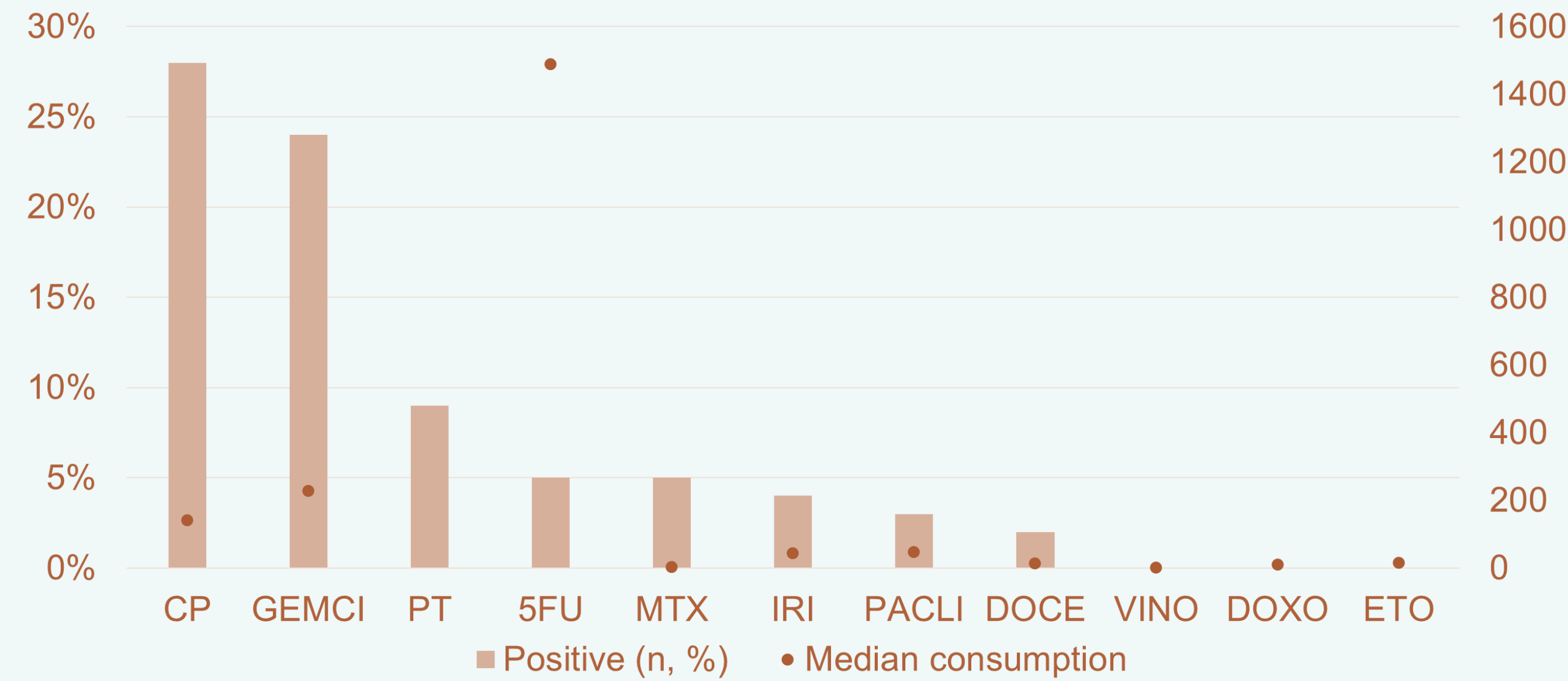


Figure 2. Proportion of contaminated sampling sites and median use for the 11 drugs

- The 90th percentile of the concentration measured on the surfaces was 0.00905 ng/cm² for cyclophosphamide and 0.004 ng/cm² for gemcitabine.
- The most frequently contaminated surfaces were the **armrest of patient treatment chair**, the **front grille inside the biological safety cabinet (BSC)**, and the **floor in front of the BSC** (Fig.3)

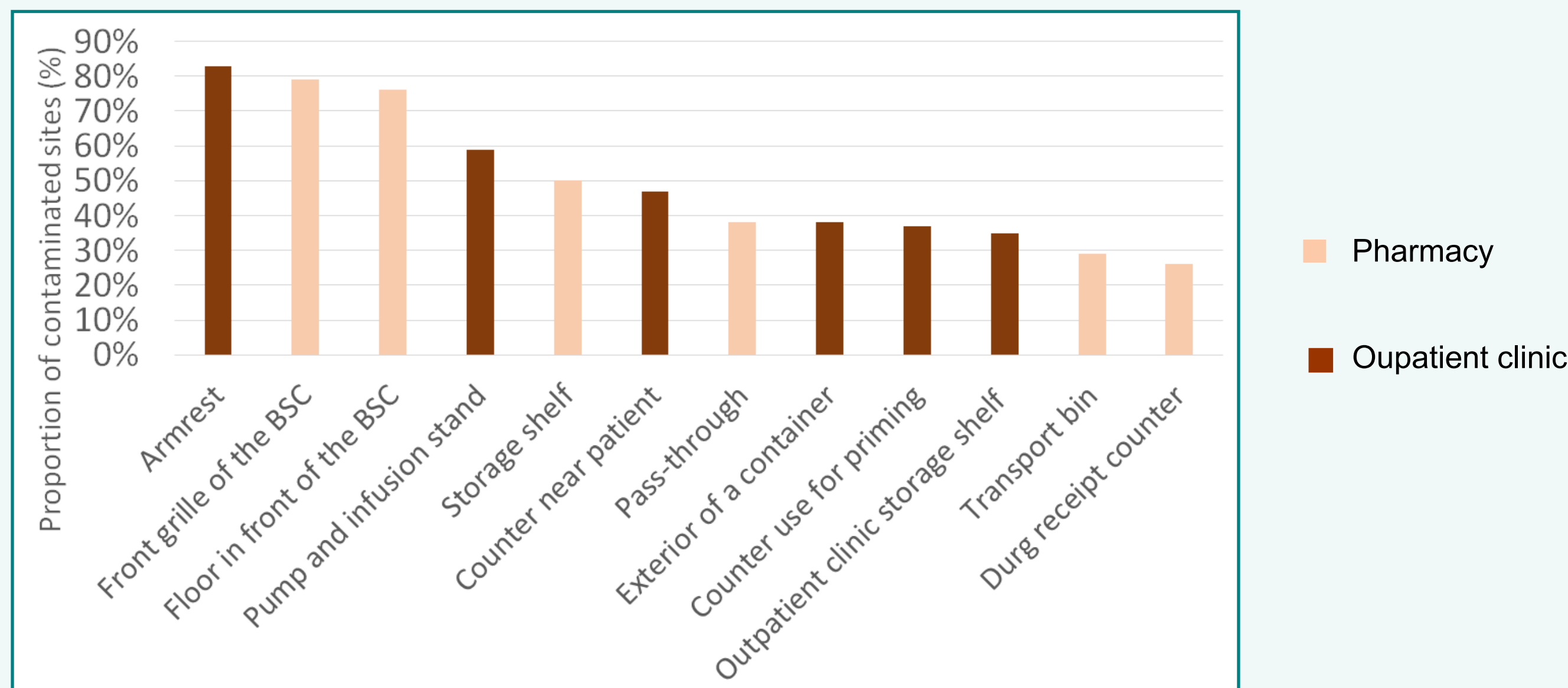


Figure 3. Proportion of sampling sites contaminated with at least one antineoplastic drug

Centers' practices

- General practices were different between Quebec centers and those in other provinces (Fig 4).

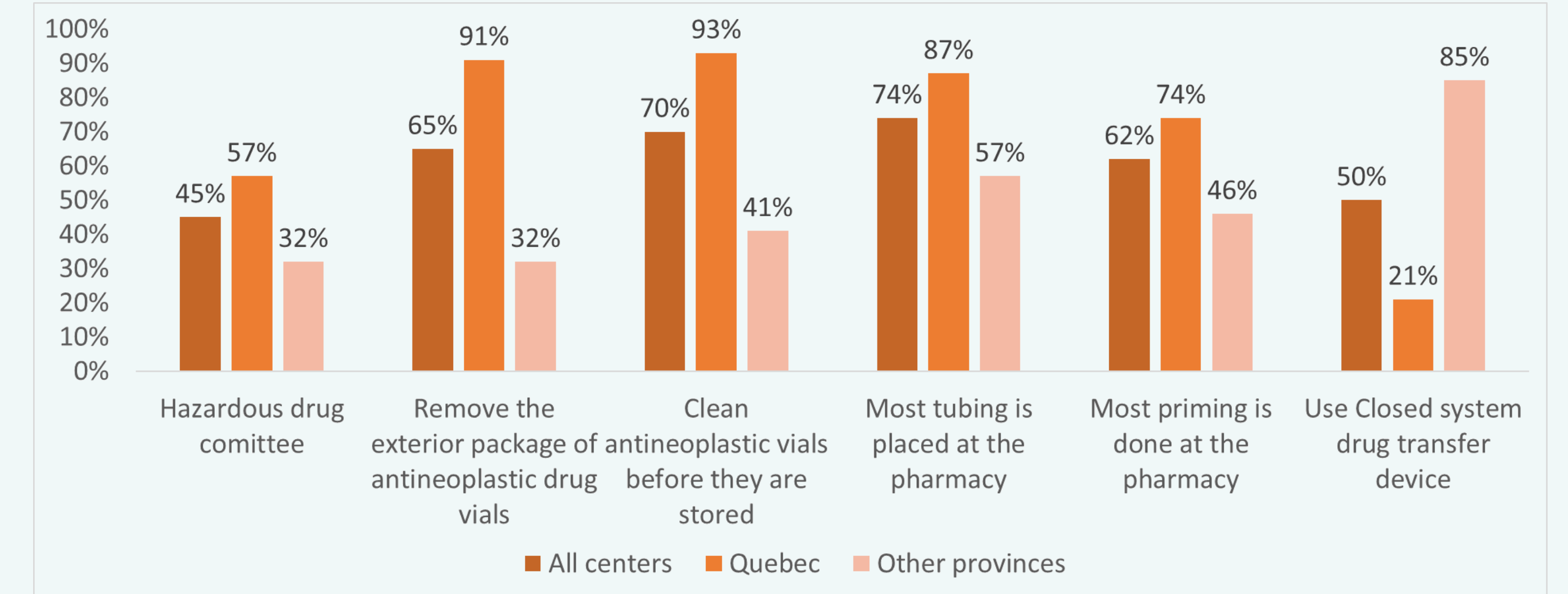


Figure 4. General practices of centers

- Most of the centers that participated last year shared their contamination results (98/120, 82%), with the pharmacy team (n=92) and the care team (n=75).
- 50% of centers (63/126) had hygiene and sanitation staff dedicated to the oncology pharmacy. Only 39% (49/126) for the oncology outpatient clinic.

Practices associated with higher contamination

- Larger centers had significantly higher cyclophosphamide concentrations than smaller centers (Fig 5).

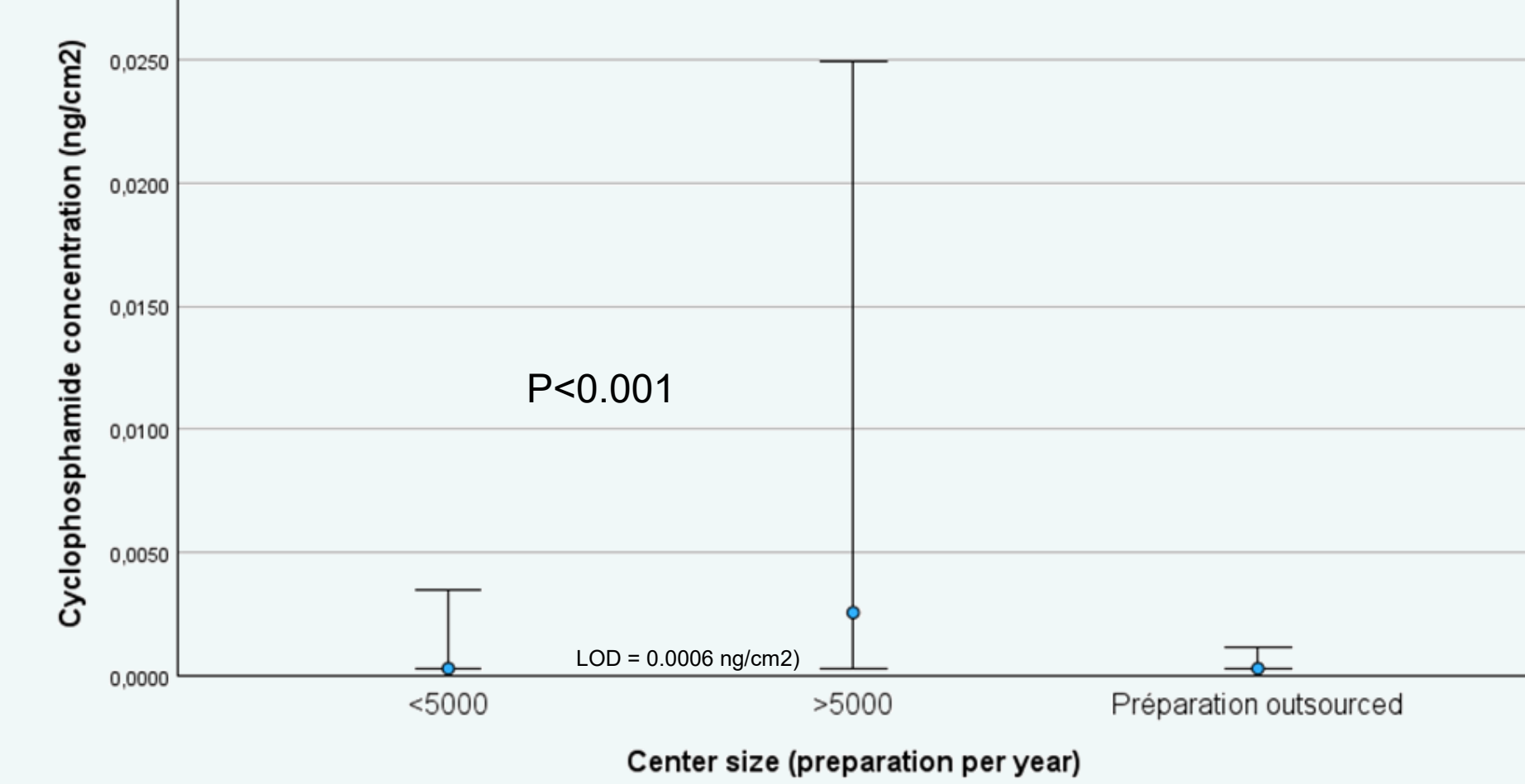


Figure 5. Distribution of cyclophosphamide concentration stratified by center size.

Legend: Bottom bar = median, circle = 75th percentile, top bar 90th percentile.

CONCLUSION

- Traces of low concentration antineoplastic drugs **persist** on the surfaces of hospitals.
- This monitoring program offers centers an opportunity to benchmark their results and identify areas of improvement. Quebec centers also participate in a community of practice that holds monthly meetings to share best practices.
- Sharing local monitoring results should also be used a mean to encourage workers to be as conscientious as possible when handling antineoplastic drugs.
- Safe handling practices and personal protective equipment remain important.

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