



# Multicenter Study of Environmental Contamination With Hazardous Drugs in 33 Canadian Hospitals



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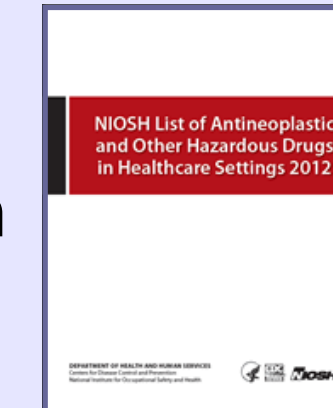
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## Introduction

Occupational exposure may occur on many levels when handling, compounding or administering a drug considered to be hazardous, from storage to waste management

No safe occupational exposure limit exists

A National Institute for Occupational Safety and Health (NIOSH) Alert on Hazardous Drugs was published in 2004 and updated in 2010 and 2012



In Quebec, a previous multicenter study of environmental contamination was conducted between 2008 and 2010

## Objectives

To describe environmental contamination with cyclophosphamide (CP), ifosfamide (IF) and methotrexate (MTX) in Quebec healthcare centers in 2012

To compare the 2012 environmental monitoring results with the 2008-2010 results

## Methods

### Study sites

- Descriptive, comparative study
- Directors of pharmacy departments from hospitals with at least 50 acute care beds were contacted on December 2011 (n=61)
- Standardized sampling sites (standardized surface of 600 cm<sup>2</sup>):
  - Six sites in pharmacy areas
  - Six sites in patient care areas
- Samples collected on February 2012 at the end of a day or in the morning before surfaces were washed

### Analytical procedure

- Adapted from Larson et al. (2002)<sup>1</sup> and validated by the INSPQ
- Samples were analysed for the presence of the cytotoxic agents by UPLC-MS-MS
- A sample was considered positive if the value was above the LOD
- Limits of detection (LOD) and limits of quantification (LOQ)

	LOD (pg/cm <sup>2</sup> )	LOQ (pg/cm <sup>2</sup> )
<b>Cyclophosphamide (CP)</b>	1.8	6.0
<b>Ifosfamide (IF)</b>	2.2	7.0
<b>Methotrexate (MTX)</b>	8.0	30

### Comparison

- Comparison of surface contamination between the 2008-2010 and 2012 studies was made with the 75th percentile of cyclophosphamide concentration for 21 hospitals that participated in both studies

## Results

- 33/31 Quebec hospitals participated in the study (54% response rate)
- 363 samples were collected
- CP:** Median [range] concentration was <LOD [<LOD-14 000]; Highest concentration was 14 000 pg/cm<sup>2</sup> on the exterior surface of a drug container
- IF:** Median [range] concentration was <LOD [<LOD-2 600]; Highest concentration was 2 600 pg/cm<sup>2</sup> on the arm rest
- MTX:** Median [range] concentration was <LOD [<LOD-51 000]; Highest concentration was 51 000 pg/cm<sup>2</sup> on a tray used for drug delivery

**Table 1. Number of CP, IF and MTX positive samples in pharmacy and patient care areas in the 2012 study (n=33)**

Sample site (n samples)	Positive samples n (%)		
	Cyclophosphamide	Ifosfamide	Methotrexate
<b>Pharmacy areas</b>			
Shipment reception counter (33)	7 (21)	2 (6)	3 (9)
Storage shelf (32)	12 (38)	7 (22)	3 (9)
Front grille inside the hood (32)	26 (81)	12 (38)	8 (25)
Floor in front of the hood (31)	19 (61)	9 (29)	0 (0)
Service hatch or counter for post-preparation validation (33)	7 (21)	6 (18)	0 (0)
Trays used for drug delivery (30)	3 (10)	2 (7)	2 (7)
<b>Total (191)</b>	<b>74 (39)</b>	<b>38 (20)</b>	<b>16 (8)</b>
<b>Patient care areas</b>			
Storage shelf (32)	9 (28)	6 (19)	0 (0)
Counter used for priming or validation (27)	7 (26)	2 (7)	1 (4)
Arm rest (33)	25 (76)	9 (27)	0 (0)
Patient room counter (23)	7 (30)	4 (17)	0 (0)
Outpatient clinic counter (27)	15 (56)	6 (22)	0 (0)
Exterior surface of hazardous drugs container (30)	10 (33)	3 (10)	0 (0)
<b>Total (172)</b>	<b>73 (42)</b>	<b>36 (17)</b>	<b>1 (0.6)</b>
<b>Total (363) (pharmacy &amp; patient care areas)</b>	<b>147 (40)</b>	<b>68 (18)</b>	<b>17 (5)</b>

  Sampling sites with more than 50% of positive samples

### Comparison 2012 environmental monitoring results with 2008—2010 results

- Proportion of positive samples
  - Reduced for CP from 2008-2010 to 2012 (54% vs. 42%)
  - Similar for IF (20% vs. 19%)
  - Similar for MTX (3% vs. 4%)
- The four sampling sites with the highest proportion of positive samples were identical
- The 75<sup>th</sup> percentile value in 2012 was four times lower than the 2008-2010 study
- In both studies, the 75<sup>th</sup> percentile for IF and MTX concentration were lower than the LOD

**Table 2. Cyclophosphamide concentration on surfaces in pharmacy and patient care areas in the 2008-2010 and 2012 studies (n=21)**

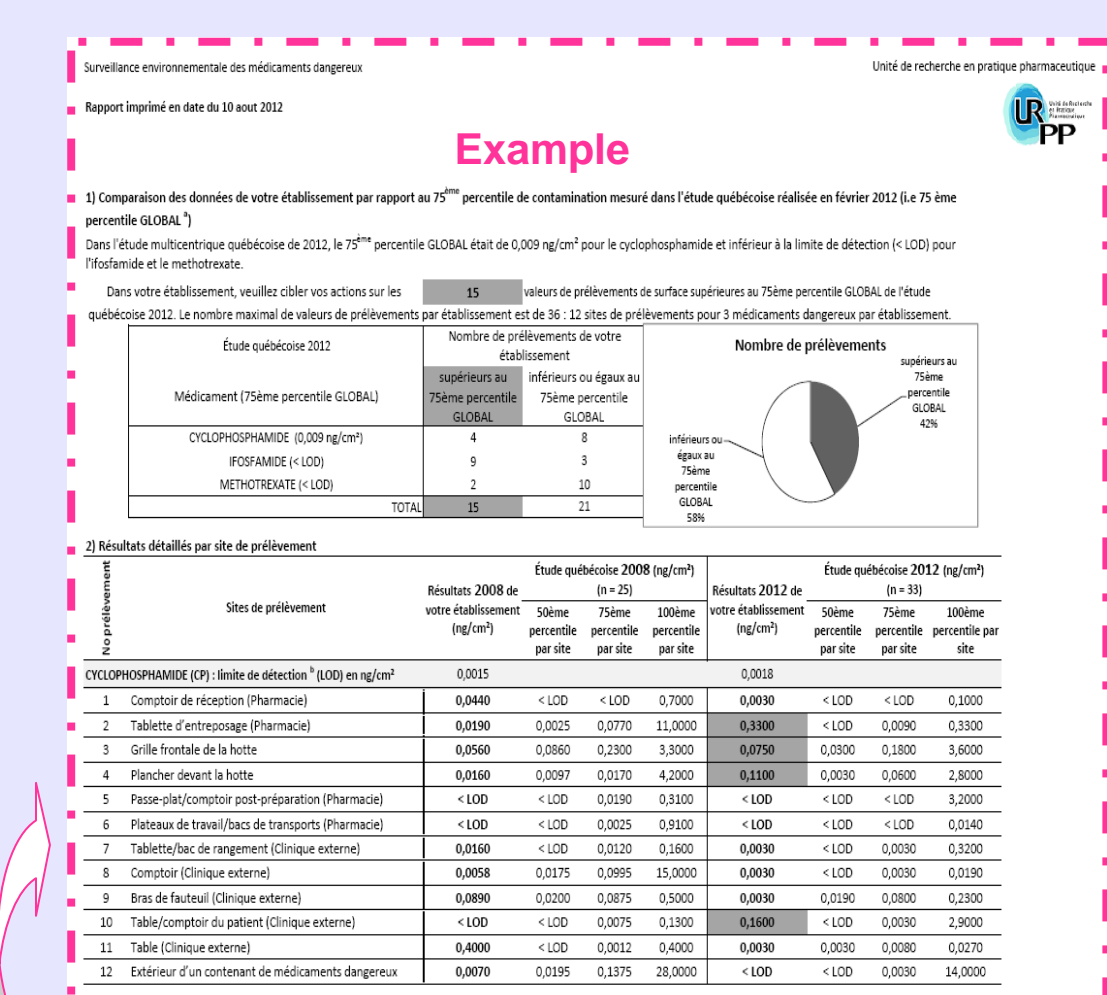
Sample sites	Concentration (pg/cm <sup>2</sup> ) 75 <sup>th</sup> percentile (n samples)	
	2008-2010 study	2012 study
<b>Pharmacy area</b>	<b>52 (125)</b>	<b>9.2 (123)</b>
<b>Patient care areas</b>	<b>26 (106)</b>	<b>9.8 (112)</b>
<b>Total (pharmacy &amp; patient care areas)</b>	<b>44 (231)</b>	<b>9.4 (235)</b>

## Discussion

- Proportion of 40% of CP positive samples in our 2012 study is comparable with other North American studies, regardless of the use of a CSTD.
- Improvement is related to the publication of the prevention guide (ASSTSAS 2008) and its implementation in Quebec hospitals
- The use of a local 75<sup>th</sup> percentile can help pharmacists and other stakeholders target their key actions for further improvement

## Conclusions

Over the next years, a personalized report with a yearly updated local 75<sup>th</sup> percentile value and recommendations for corrective measures will be sent to healthcare centers following their periodic environmental monitoring, which should help limiting occupational exposure to hazardous drugs.



Sites with a level of contamination higher than the overall Quebec 75th percentile are highlighted; corrective actions should be focused on these sites