

# Waste anaesthetic gases in Quebec hospitals

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## Recommendations

### Recommendations that applies to managers

- Acquisition:** Choose products that limits risks of exposure.
- Training:** Create a program of information about the risks of exposure.
- Installations:** Install a gas recovery system to remove the waste anaesthetic gases from the operating room. Install a ventilation system with an adequate number of air changes per hour.
- Reception:** Make sur anesthetic gases containers are identified. Receive and remove outer packaging in a designated area. Have a policy and procedure on the reception.
- Storage:** Choose a storage space that limits risks.
- Transportation:** Avoid exposure during transportation.
- Maintenance:** Make sure the ventilation of the operating room, and anesthesia machines are regularly maintained.
- Surveillance:** Developp a surveillance program and keep your air sampling results.
- Waste management:** Have a policy and procedure on waste management.
- Accidents:** Have a policy and procedure on accidental exposures.

### Recommendations that applies to workers

- Working practices:** Have good working practices, such as:
  - Check anaesthesia machines before use for breaks, negative pressure, etc
  - Start the ventilation before any manipulation
  - Start the gas recovery system before any manipulation, and make sure it is connected
  - Wait for the mask or laryngeal tube to be correctly connected before starting gas flow
  - Fill vaporisers in a hood
  - Use the lowest possible infusion rate
  - Make sure all waste gases are eliminated before disconnecting
  - Stop gas flow before disconnecting the patient
  - Use the right personal protection equipment

## Conclusions

- Few studies exist about environmental monitoring of waste anaesthetic gases in North-America.
- Waste anaesthetic gases concentrations were low in workers' breathing zones.
- The post-operative care unit was the location where the highest concentrations of sevoflurane and desflurane were found.
- Sevoflurane was still exhaled more than five hours post-operation in the intensive care unit.
- This study highlights the importance of adequate ventilation throughout the anaesthetic gases use process, including storage areas and post-operative care areas.
- Scavenging of anaesthetic gases should also be done also in intensive-care units.
- Pharmacists must be involved in optimal anaesthetic gases use throughout the hospital.

**References :** Tanguay C, Legris M, Bussi res JF, Exposition professionnelle aux gaz anesth siques pour inhalation - partie 2. Bulletin d'information toxicologique 2013;29(3):98-121.

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## Introduction

- In Quebec, Canada, there exists no concentration ceiling value for at least two anaesthetic gases: sevoflurane and desflurane.
- The National Institute for Occupational Safety and Health recommends a 2 ppm ceiling value for halogenated gases.
- There exists a risk of occupational exposure to waste anaesthetic gases at many steps of the drug-use process, namely at the reception, storage, administration and waste management steps.

## Objectives

- The purpose of this study was to describe the airborne concentration of two anaesthetic gases in Quebec hospitals: sevoflurane and desflurane.

## Methods

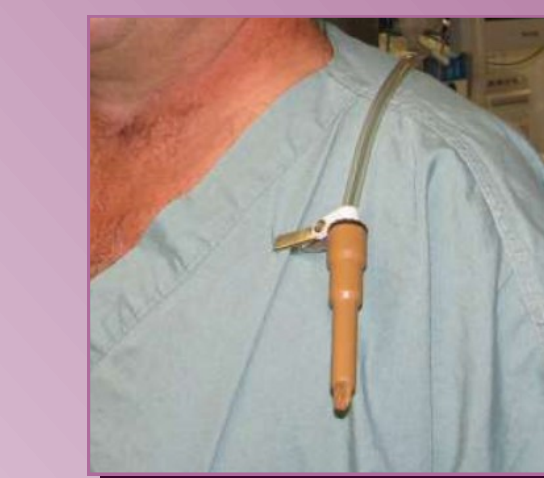
- Sevoflurane and desflurane air concentration were measured in three Quebec hospitals in 2011 and 2012.

- Air concentration was measured near the workers' **breathing zones** and in **fixed** locations on the following care units:

- Pre-operative
- Operating rooms
- Intensive-care
- Day surgery
- Post-operative



Near the patient's breathing zones



Near the worker's breathing zones

- Sevoflurane air sampling was performed in fixed locations near the patients' breathing zones in **pre-operative care units, intensive-care units and post-operative care units.**

- Sevoflurane air sampling was also performed near the workers' breathing zones in **pre-operative care units, operating rooms, day surgery units, intensive-care units and post-operative care units.**

- Sevoflurane concentration was also measured directly at the exit of the ventilator for four patients in an **intensive care unit.**



Directly at the exit of the ventilator

- Desflurane air sampling was performed in fixed locations near the patients' breathing zones in **pre-operative care units and post-operative care units.**
- Desflurane air sampling was also performed near the workers' breathing zones in **pre-operative care units, operating rooms, day surgery units and post-operative care units.**

- Air sampling duration varied between two and eight hours.

- The limit of detection (LOD) varied between 0.07 ppm and 0.10 ppm for sevoflurane and between 0.03 ppm and 0.04 ppm for desflurane.

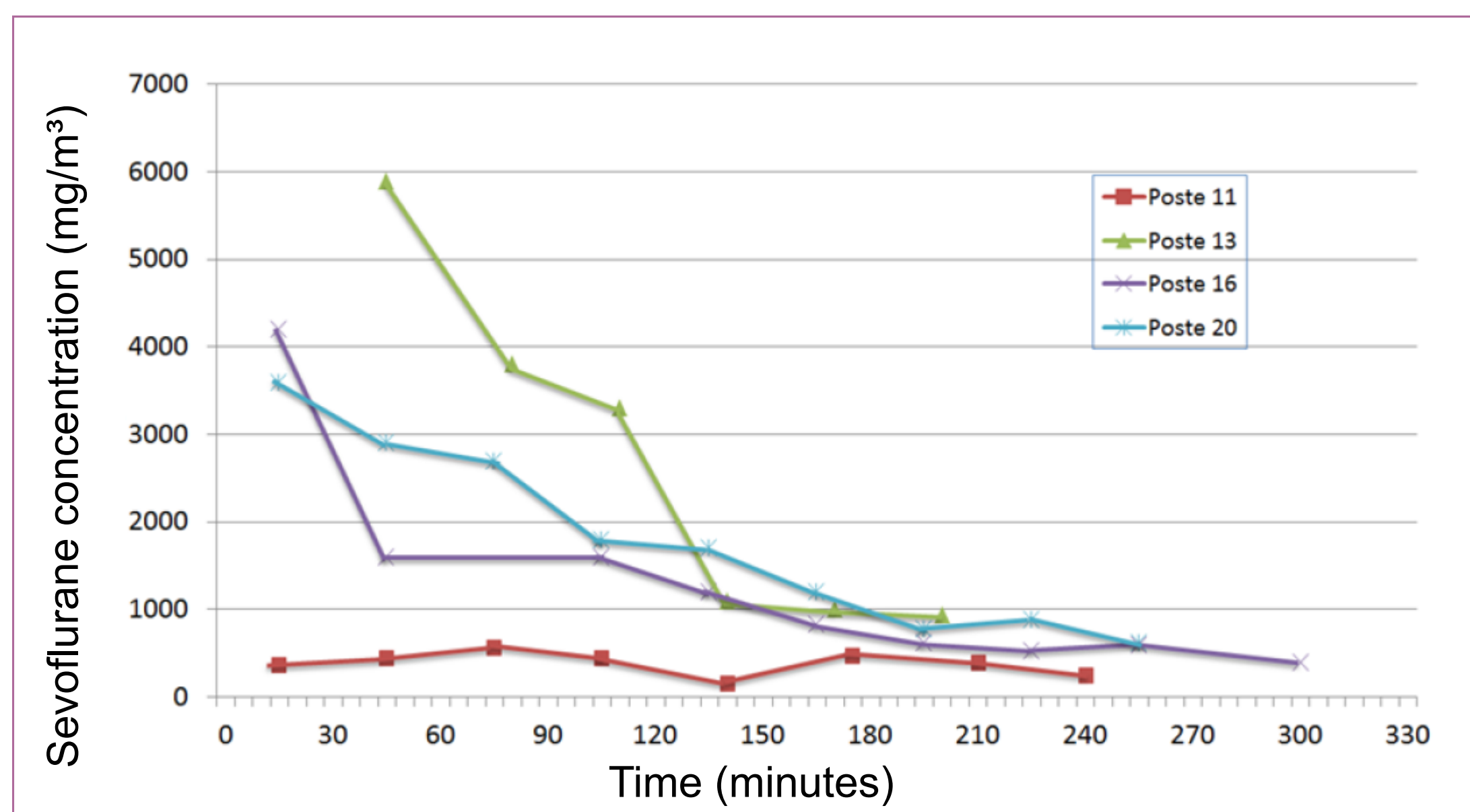
## Results

**Table I. Sevoflurane exposure**

Location	Method (year)	Sevoflurane concentration
Pre-operative	Patient's breathing area (2011)	< 0.07 ppm
	Workers' breathing area (2011)	< 0.10 ppm
	Workers' breathing area (2011)	1 sample at 0.08 ppm
Operating rooms	Workers' breathing area (2011)	1 sample at 0.08 ppm, 2 samples < LOD
	Intensive care	Patient's breathing area (2012)
	Workers' breathing area (2012)	Mean[min-max]: 0.16[0.11-0.29] ppm
Day surgery	Workers' breathing area (2011)	2 samples < 0.08 ppm
Post-operative	Patient's breathing area (2011)	Overall mean: 0.48 ppm
	Workers' breathing area (2011)	Mean[min-max]: 0.24[0.15-0.41] ppm

LOD: Limit of detection

- After a 30-minute period post-operation, sevoflurane concentrations measured at the exit of the ventilator were of 440, 512 and 720 ppm.
- Three hours post-operation, the mean concentration was 123 ppm.
- Sevoflurane was still exhaled by the patients five hours post-operation (Fig.1).



**Figure 1. Sevoflurane concentration at the exit of the ventilator in an intensive care unit in 2012**

**Table II. Desflurane exposure**

Location	Method (year)	Desflurane concentration
Pre-operative	Workers' breathing area (2011)	1 sample at 0.029 ppm
	Patient's breathing area (2012)	< 0.029 ppm
	Workers' breathing area (2012)	< 0.04 ppm
Operating rooms	Workers' breathing area (2012)	1 sample at 0.029 ppm, 2 samples < LOD
Day surgery	Workers' breathing area (2012)	< 0.04 ppm
Post-operative	Patient's breathing area (2012)	Mean[min-max]: 7.79[0.25-21.6] ppm
	Workers' breathing area (2012)	Mean[min-max]: 0.43[0.33-0.68] ppm

LOD: Limit of detection