

# CARBON FOOTPRINT OF A HOSPITAL PHARMACY DEPARTMENT USING THE CIRAIG ASSESSMENT TOOL : A DESCRIPTIVE STUDY



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## INTRODUCTION

Climate change is a major public health challenge. Although healthcare aims to improve health, it contributes significantly to greenhouse gas (GHG) emissions, representing

**4 - 5%** of total GHG emissions are produced by the Healthcare Systems

**20 - 35%** of total GHG emissions are produced by University Hospitals

In Qu bec, several healthcare facilities conducted institutional GHG inventories between 2020 and 2024 but results remain largely unpublished.

In 2025, the Ministry of Health introduced a standardized calculation tool developed by The International Reference Centre for the life Cycle of Products, Processes and Services (CIRAIG) to harmonize carbon footprint assessments across the provincial health network.

The tool is an [Excel calculator](#) designed to standardize GHG inventories across all healthcare facilities in Qu bec.

This study is **the first to quantify the carbon footprint of a hospital pharmacy department** in a Canadian university hospital using official Qu bec methodology to identify targeted strategies for emission reduction and support the ecological transition of healthcare.

## OBJECTIVE

Quantify the carbon footprint of a university hospital pharmacy department.

## METHODS

### STUDY DESIGN:

- Retrospective study (2024-2025)

- Setting & Team : CHU Sainte-Justine
  - 120 staff members
    - 45 Pharmacists
    - 45 Seniors Pharmacy Technicians
    - 10 Research and Administrative Professionals
    - 20 Students

### VARIABLE:

Carbon footprint assessed using a 29-module procedure :

**Scope 1:** Stationary fuel combustion and fugitive emissions from equipment :

- Cold room
- Freezers
- Refrigerators

**Scope 2:** Energy purchases

- Energy
- Steam
- Heating
- Cooling

**Scope 3:** Procurement of goods and services

- Pharmaceuticals
- 70% isopropyl alcohol
- Disinfectants/cleaners
- Metered-dose inhalers
- ...

NB : For each source, users may enter either physical data (e.g quantities of fuel consumed, waste mass, kilometers travelled) or financial data (e.g expenditure on goods and services).

Emissions are automatically calculated using integrated factors from official sources like Hydro-Qu bec and the IPCC's Sixth Assessment Report (GWP100).

### ANALYSIS PLAN:

Carbon Footprint Analysis – Pharmacy Department

- As early adopters of the tool, a literature review was conducted to **compare calculated emissions with published data**.
- Metrics included: 1-year period, number of beds, admissions, inpatient days, outpatient visits, drug expenditures (in million CAD), administered doses, digital transactions, compounded preparations, and staff count.
- Descriptive statistics were applied to interpret results.

## RESULTS

**13 459,4 Tonnes of CO<sub>2</sub>e**

The carbon footprint of the pharmacy department of CHU Sainte-Justine is estimated at **13 459,4 tonnes of CO<sub>2</sub>e**.

The distribution by scope is **98,2%** for scope 3, less than **0,1%** for scope 2 and less than for **1,8%** scope 1.

Emission category	Calculation method	Data quality	CO2 (kg)	CH4 (kg)	N2O (kg)	HFC (kg)	tCO <sub>2</sub> e	Contribution (%)
<b>Scope 1</b>								
Stationary combustion	1	Good	98278,9	1,9	2,1		98,9	0,70%
Mobile combustion	x	x	x	x	x	x	x	x
Fugitive emissions (cooling systems)	2	Poor	0,3	x	x	1,7	6,6	-0,0%
Fugitive emissions (anaesthetic and medical gases)	1	Good	x	x	x	x	131,8	1%
<b>Subtotal</b>			98279,2	1,9	2,1	1,7	237,3	1,80%
<b>Scope 2</b>								
Purchased electricity, steam, heat, and cooling	1	Good	441,8	x	x	x	0,4	-0,1%
<b>Scope 3</b>								
Purchased goods and services	2	Good	x	x	x	x	12 044,40	89,50%
Capital goods	1	Good	x	x	x	x	44,7	0,30%
Other energy-related emissions	1	Good	x	x	x	x	47,3	0,40%
Upstream transport	1	Moderate	x	x	x	x	3,4	0,03%
Waste generated in operations	2	Poor	x	x	x	x	26,6	0,20%
Business travel	1	Moderate	x	x	x	x	8,2	0,06%
Employee commuting	2	Moderate	x	x	x	x	897,6	6,67%
Inhaler use	1	Good	x	x	x	x	144	1,07%
Product end-of-life	1	Good	x	x	x	x	5,5	0,04%
<b>Subtotal</b>							13 221,60	98,20%
<b>TOTAL</b>							<b>13 459,40</b>	<b>100%</b>

Legend: tCO<sub>2</sub>e = tonnes of carbon dioxide equivalent.

**Table 1:** Carbon footprint profile of the Pharmacy department of CHU Sainte-Justine April 1, 2024 to March 31, 2025, based on the use of calculator proposed by CIRAIG

Given the scarcity of published studies reporting absolute departmental carbon footprints, comparisons remain difficult. We consider it essential to **explore multiple emission ratios** in order to **benchmark** pharmacy departments and identify best practices.

This study identified **ten such ratios** (table 2), relating tCO<sub>2</sub>e to **activity indicators** such as beds, admissions, expenditures or staff.

Ratios (noms)	Unit�e de mesure utilis�ees (ann�ee de r�eference)	Ratios (valeurs)
tCO <sub>2</sub> e / year	1 year	13 459,40
tCO <sub>2</sub> e / bed	500 beds (2023-2024)	27,1
tCO <sub>2</sub> e / 1000 admissions	17 397 (2023-2024) (11)	778,83
tCO <sub>2</sub> e / 1000 inpatient days	97 009 (2021-2022)	139,67
tCO <sub>2</sub> e / 1000 outpatient visits	234 448 (2023-2024) (11)	57,79
tCO <sub>2</sub> e / millions CADs of drug expenditure	38 471 301 (2021-2022)	352,19
tCO <sub>2</sub> e / 1000 administered medication doses	2 697 564 (2024-2025)	5,02
tCO <sub>2</sub> e / 1000 digital transactions	1 192 565 (2021-2022)	11,36
tCO <sub>2</sub> e / 1000 compounded preparations	531 274 (2021-2022)	25,5
tCO <sub>2</sub> e / department employee	120 (2024-2025)	112,91

Legend : tCO<sub>2</sub>e = tonnes of carbon dioxide equivalent

**Table 2:** Exploratory ratios of tonnes of CO<sub>2</sub>e relative to different operational indicators relevant to hospital pharmacy practice

The total time required for the full process – including data collection from multiple sources, data validation, input, analysis and manuscript preparation was estimated at approximately **168 hours**.

Table 2 presents tCO<sub>2</sub>e ratios linked to pharmacy operations.

Ratios help contextualize emissions based on workload, spending, and clinical activity.

## DISCUSSION

This first Canadian study estimated the carbon footprint of a hospital pharmacy department at **13 459,4 tCO<sub>2</sub>e** (2024-2025) for CHU Sainte-Justine. Pharmacy activities are likely a major contributor to hospital emissions.

### KEY FINDINGS:

- Purchases goods and services (**89,5%**) were the main emission source largely driven by pharmaceuticals
- Other contributors : employee commuting (**6,7%**) and metered-dose inhalers (**1,1%**)
- Emissions intensity (**112,9 tCO<sub>2</sub>e/employee**) exceeded overall hospital averages consistent with global data
- Further work is needed to refine emissions by molecule and therapeutic class

### ACTION LEVERS:

- Green procurement : integrate environmental criteria into drug purchasing
- Eco-Responsible Prescribing: favour lower-emission formulations and reduce waste
- Local innovation : centralised compounding, recycling, eco-substitution programs

### STRENGTHS:

- First Canadian carbon footprint of a hospital pharmacy → New benchmark
- Use of CIRAIG standardized tool ensures reliable and comparable data
- Identifies targeted, actionable mitigation areas
- Department-level analysis highlights overlooked emissions sources.

### LIMITATIONS:

- Estimates based partly on financial proxies → limited precision
- Some sources excluded (e.g. medical devices, food) → possible underestimation
- Variable data quality for minor sources
- Single-centre study → limited generalisability

**This work provides a foundation for future pharmacy carbon assessments and supports the integration of sustainability into health practice.**

## CONCLUSION

Carbon footprint assessment of a hospital pharmacy using the CIRAIG tool (implemented in Qu bec since June 2025) is **feasible and practical**.

**Pharmaceutical procurement and use** represented 89,5% of total greenhouse gas emissions, identifying the **main target** for action.

**Such assessments are valuable to guide prioritization of sustainable and corrective measures in healthcare settings.**

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