# Comparison of the environmental impact of subcutaneous versus Oral Therapies

EE144

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## Background and objective

- Reducing the environmental footprint of healthcare is an emerging priority. According to The Shift Project[1], the French healthcare system generated approximately **49 million** tons of $CO_2e$ in 2023, representing around **8% of the national carbon footprint.**
- Within this context, the **route of drug administration** significantly contributes to a medicine's overall environmental impact, influencing factors such as manufacturing, packaging, logistics, and waste management.
- This study aims to **assess and compare the ecological impact of subcutaneous (SC) and oral drug administration**, both administered in an **ambulatory setting**, to identify opportunities to reduce carbon emissions and resource consumption throughout the therapeutic pathway.

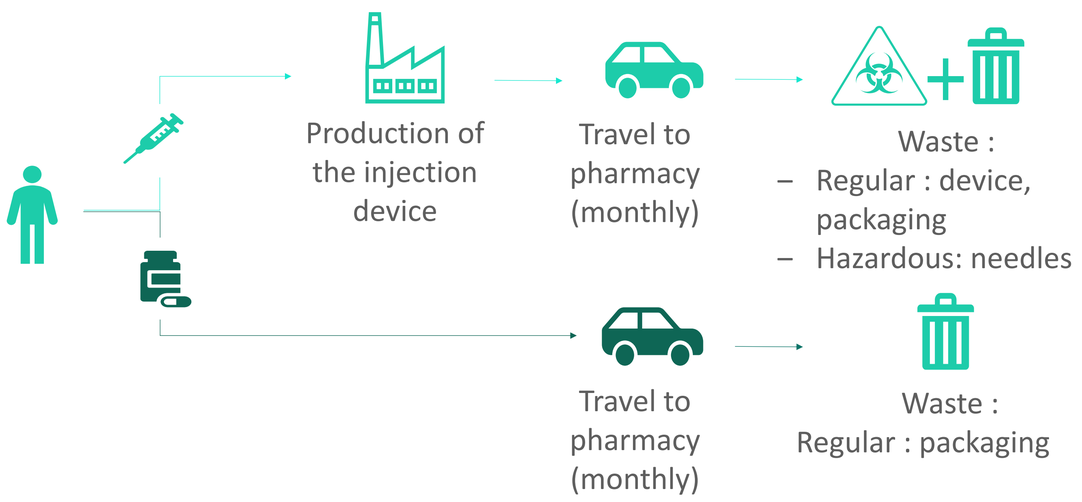
**Table 1. Main sources considered**

| Carbon emission | Sources |
|---|---|
| **Transportation pharmacies / home for patients** | Distance : PASODOBLE study[2]<br>Emission : report from the French Automobile Manufacturers Committee[3] |
| **Auto-injectors production** | Manufacturer Carbon Footprint reports[4] |
| **Waste** | **Sources** |
| **Auto-injectors** | Manufacturer Carbon Footprint reports[4] |
| **Oral drugs packaging** | Carbone®[5] |

## Method

- A one-year model was developed to compare waste production and carbon emissions ($CO_2e$) for 1,000 patients receiving either monthly SC or oral treatment in ambulatory care.
- The analysis focused on emissions from patient travel to community pharmacies and the manufacturing of auto-injectors, needles, and packaging. Waste included medical disposables and secondary packaging (Figure 1)
- Input parameters were drawn from manufacturers' environmental reports, institutional databases, and the literature.
- The model excluded emissions from active pharmaceutical ingredient production and includes a sensitivity analysis assuming quarterly oral treatment delivery, reducing logistical and packaging burdens.

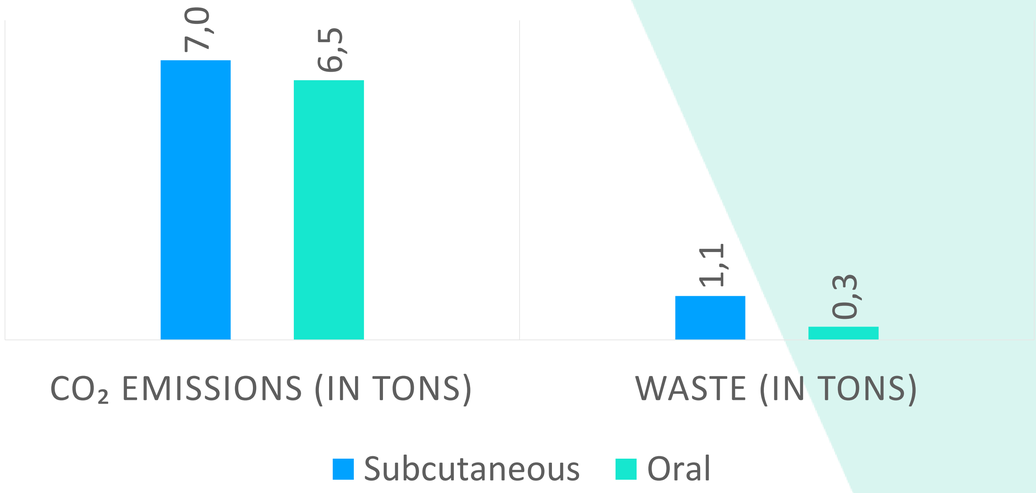
**Figure 1. Scenarios tested for patient's pathway**




## Results

- The SC route has a **higher environmental impact** than the oral route, mainly because it relies on **single-use** injection devices.
- Annually, SC treatments are responsible for **7 tons of $CO_2e$** emission due to **device production** and patients' **travel.**
- SC administration produces considerable waste (including both infectious medical waste and household waste is estimated to **1.1 tons of waste per years for 1,000 patients.**
- In comparison, oral therapy (1-month dispensation) reduced waste production to **331 kg *(a 69% reduction)*** and **$CO_2e$ emissions to 6.5 tons *(a 7% reduction),*** highlighting the environmental advantage of the oral route.

**Figure 2. Annual $CO_2e$ emissions and waste by the two administration routes**




- Beyond its carbon footprint, SC administration also generates **specific waste management costs**.
- Each injection produces infectious healthcare waste, which must be collected and treated through dedicated channels.
- In France, the cost of treating **1 ton of infectious medical waste ranges from €500 to €1,000, approximately 3 to 5 times higher than for household waste (€150 to €200 per ton)[6].**
- This recurring cost, incurred with each injection, adds an **additional environmental and economic burden** specific to the subcutaneous route.
- Additionally, a sensitivity analysis assuming **quarterly** oral dispensation projected further reductions: **1 ton of waste avoided versus SC** and a **decrease of 5.4 tons of $CO_2e$ versus SC,** equivalent to driving **36,000 km by car** or **10 round-trip flights between Paris and Rome.**

## Conclusion and Discussion

Oral treatments are associated with **lower environmental footprint** compared to SC administration, particularly when dispensed **quarterly.** From an environmental standpoint, these results **contribute highlight the interest in the rational use of oral therapies in long-term management strategies** where clinically appropriate, to align therapeutic value with environmental responsibility.

1. The Shift Project's report "Decarbonizing Healthcare for Sustainable Treatment", 2. PASODOBLE study ; 3. French Automobile Manufacturers Committee, 4. Novo Nordisk Carbon Footprint reports 5. Carebone® 6. Report from the Regional Health Agency in Ile-de-France

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