Comparative Environmental Impact of Intravenous Versus Oral Chemotherapy in France: A 1,000-Patient Model-Based Assessment

HSD43

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Background and objective

- In their 2021 report, the shift project established that the overall healthcare sector is responsible for about 46 million tons of carbon equivalent (CO_2e) in France[1].
- Oncology is one of the main area representing in 2023[2] :
  - 8.1 M of hospitalizations , and
  - 1.3 M of patients treated including 387,440 with a systemic treatments.
- Two main forms of systemic treatments exist - Intravenous (IV) and oral - either used in monotherapy or in combination.
- As environmental sustainability becomes a priority, it prompts a reflection on the **impact of the administration route (oral vs IV) on carbon emissions and waste production.**

Method

- A model was developed to simulate the patient's treatment pathways and quantify the carbon emissions and the waste production
- It follows for a period of **6 months** a cohort of **1,000 patients** treated under one of the following hypothetical scenarios (Figure 1):
  - IV treatment every 3 weeks ; or
  - Daily oral treatment.

Figure 1. Scenarios tested for patient's pathway

	Prescription	Dispensing	Administration
	At hospital, every 3 weeks		
	At hospital, every month *Scenario : dispensed in pharmacy*		N/A

Inputs and sources

- The model accounts for transportation (for patients and health care workers), facility operations, excipients, medical supplies, and packaging materials.
- Inputs were sources from institutional reports, public sources, and literature whenever possible (Table 1.)

Table 1. Main sources considered

Carbon emission	Sources
Transportation hospital / home for patients	Distance : PASODOBLE study[3] CO_2 emissions: report from the French Automobile Manufacturers Committee[4]
IV administration at hospital	Carebone® database[5]

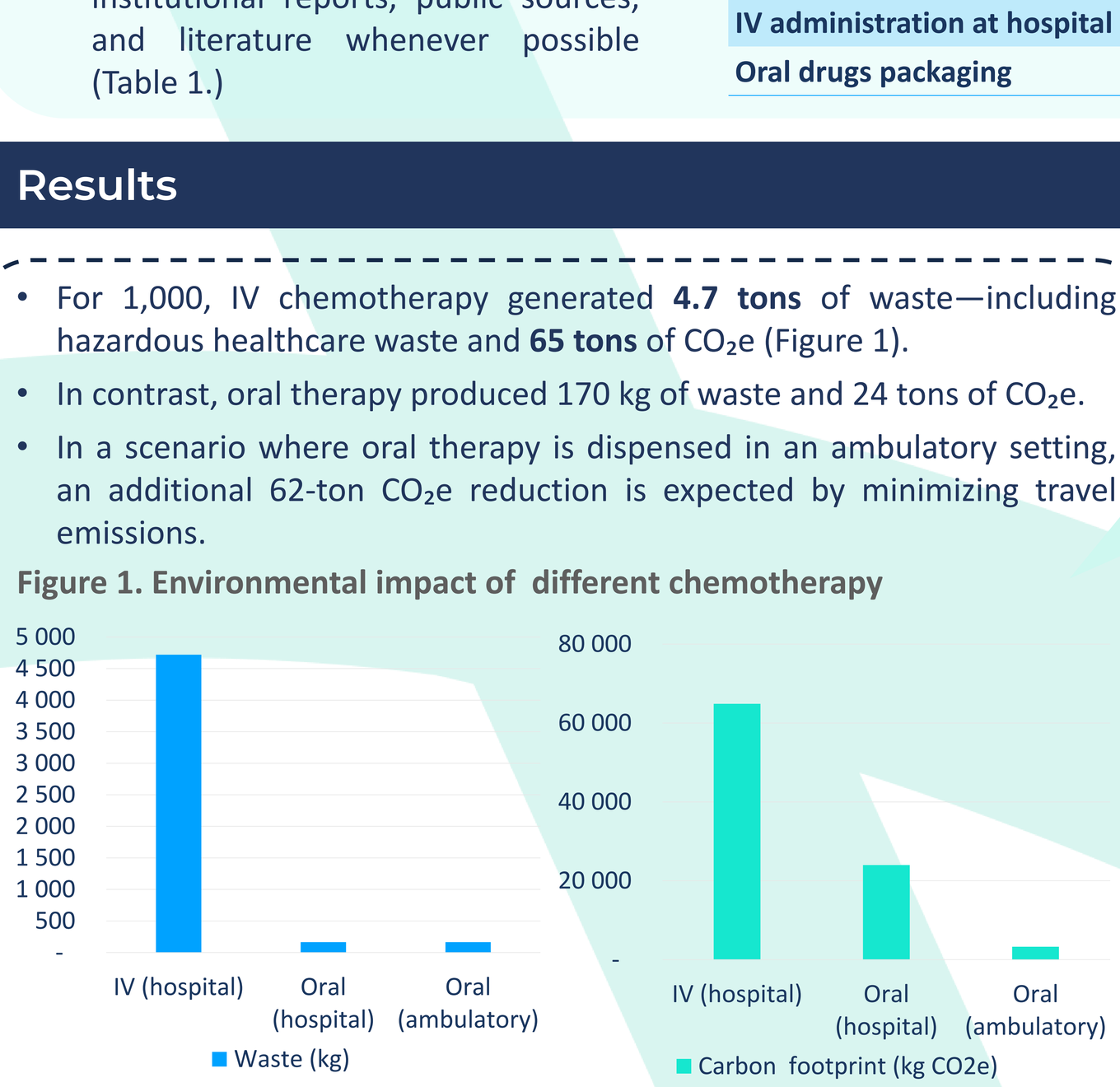
**It was assumed that car as the main transportation and an average speed of 50 km/h*

Waste	Sources
IV administration at hospital	Carebone® database[5] and WHO report[6]
Oral drugs packaging	Carebone® database[5]

Results

- For 1,000, IV chemotherapy generated **4.7 tons** of waste—including hazardous healthcare waste and **65 tons** of CO_2e (Figure 1).
- In contrast, oral therapy produced 170 kg of waste and 24 tons of CO_2e.
- In a scenario where oral therapy is dispensed in an ambulatory setting, an additional 62-ton CO_2e reduction is expected by minimizing travel emissions.

Figure 1. Environmental impact of different chemotherapy



- These estimates are likely conservative, as they do not account for the environmental impact of active pharmaceutical ingredient (API) manufacturing and relied on a minimalistic approach to IV-related materials and actors, excluding, for instance, the reconstitution phase.

This represents a reduction of 4.6 tons of waste and 41 tons of CO_2e the equivalent to :

- ~ annual carbon footprint of 4/5 average French households
- >275,000 km in a typical gasoline car
- ~10 round-trip flights from Paris to New York for 1 person

Discussion and conclusion

- Oral chemotherapy already offers significant environmental advantages over IV. administration when delivered in hospitals.
- Shifting dispensing to ambulatory settings could amplify these benefits, supporting more sustainable and efficient care pathways.
- Further developments to reduce environmental impact include dose optimization of oral formulations.
- While chemotherapy serves as the model, these findings more broadly support the expansion of oral regimens when clinically appropriate, aligning ecological performance with therapeutic value.

1. The Shift Project's report "Decarbonizing Healthcare for Sustainable Treatment", 2. InCa. Panorama des cancers en France 2025.3. PASODOBLE study ; 4. French Automobile Manufacturers Committee, 5. Carebone®- Outil pour décarbonner le soin. AP-HP