



INCORPORATING LIFE CYCLE ASSESSMENT (LCA) INTO THE HOSPITAL EVALUATION OF MONOCLONAL ANTIBODIES: CHALLENGES AND PRACTICAL ISSUES ILLUSTRATED BY THE CASE OF ADALIMUMAB

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BACKGROUND

- The **carbon footprint of biological drugs** remains poorly documented.
- In situations of market exclusivity, these drugs are often associated with high costs. When competition arises, however, price differences between products may be limited.
- Incorporating **environmental impact** as an **additional criterion in hospital drug evaluation** could provide a meaningful basis for differentiation.

AIM AND OBJECTIVES

To assess the feasibility of applying life cycle assessment (LCA) to adalimumab, including its carbon footprint and considering its integration into hospital referral decisions.

MATERIAL AND METHODS

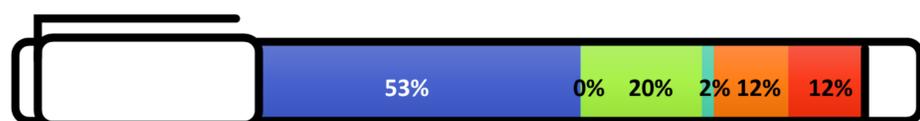
- 7 adalimumab products** in **prefilled pen** presentations were analysed: 1 **originator** and 6 **biosimilars (40 mg and 80 mg)**
- Data were collected** from regulatory databases and from documentation provided by pharmaceutical companies.
- Carebone[®] tool*** was used to perform a **LCA** including the production of the active substance, excipients, packaging materials, energy consumption during formulation and packaging, transport, and end-of-life of packaging.

RESULTS

Table 1. Carbon footprint of the different adalimumab products

Pharmaceutical	Product 1		Product 2	Product 3		Product 4		Product 5		Product 6	Product 7		
Dosage (mg)	40	80	40	40	80	40	80	40	80	40	40	40	
Pens / box	2	1	2	1	1	1	1	1	1	2	1	2	
Carbon footprint (gCO ₂ e)	Active ingredient	363	727	363	363	727	363	727	363	727	363	363	
	Excipients	<1	<1	<1	<1	<1	2	4	<1	<1	<1	<1	
	Packaging and leaflets	157; 165	175; 182	86 (Carebone [®] default value)	196; 201	196; 201	169	169	150; 155	150; 155	205	143; 190	135; 182
	Formulation and packaging	21	42	7	10	20	18	36	15	29	7	9	9
	Transport	20 (truck + boat); 318 (airplane)	35 (truck + boat); 631 (airplane)	22 (truck)	24 (truck)	33 (truck)	36 (truck + boat); 398 (airplane)	56 (truck + boat); 781 (airplane)	17 (boat); 399 (airplane)	27 (boat); 782 (airplane)	17 (boat); 18 (airplane)	22; 24 (truck)	19; 21 (truck)
	End of life of packaging	57; 59	84; 86	36 (Carebone [®] default value)	161; 163	163	169	169	172; 173	172; 173	69	47; 60	36; 49
	TOTAL	618; 926	1064; 1 669	515	754; 761	1 137; 1 144	753; 1 120	1 161; 1 887	718; 1 105	1 106; 1 867	662; 663	584; 647	563; 625
Uncertainty	9-26%	7-30%	13%	10-15%	9-10%	13-29%	9-32%	13-29%	9-33%	10-12%	11-12%	11-12%	

■ API synthesis ■ Excipients ■ Packaging and package leaflet ■ Galenic formulation ■ Transport ■ End of life



*API = active pharmaceutical ingredients

Figure 1. Average carbon footprint of adalimumab pens

Carbon footprint of adalimumab: **[515 and 1.887 gCO₂e]**

depending on the product / dosage, type of transport

→ **API and transport = major source of emissions**

→ excipients = negligible impact

The estimates are consistent with available industrial data and with results reported for other injectable devices.

CONCLUSION AND RELEVANCE

- This study provides the **first comprehensive life cycle assessment of adalimumab**.
- It confirms technical feasibility using the Carebone[®] tool, while highlighting **challenges** related to the **lengthy analysis time** and to the **collection of industrial data**.
- It supports the **inclusion of environmental criteria in the evaluation and selection of medicines in hospitals**, alongside established clinical and economic considerations.

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