Reducing the climate impact of care pathways

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Integration of carbon footprint in health technology assessment

Max Piffoux, PhD, resident in medical oncology

In collaboration with Dr Coline Ducrot, Chloé Dupraz, Dr David Ali and Dr Sébastien Taillemite

Centre Léon Bérard / Hospices civils de Lyon

DECLARATION OF INTERESTS

Shareholder and co founder of Everzom and Therafast Bio

Collaboration (no financial support) with Ecovamed

Context

- Mean carbon footprint of a european citizen
  - 7.8 tCO2eq/year *(EU)*
- Objective :
  - Zero net carbon *(IPCC)*
  - 2 tCO2eq/person/year
- European healthcare system => ≈8% of CO2eq emissions *(the shift project)*
  - 600 kgCO2eq/person/year
- Mostly related to purchases *(the shift project)*
  - Drugs, medical devices, etc

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~~Reducing the climate impact of care pathways~~

Is the carbon footprint of care that bad ?

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What are the damages induced by healthcare?

US healthcare system

Calculated using Huijbregts et al, ReCiPe model, 2016

What are the damages induced by healthcare?

US healthcare system

Every year

Leads to the loss (in the future) of :

- **7,620,000 years in good health (DALYs)**

- **Extinction of 14.1 terrestrial species**

Calculated using Huijbregts et al, ReCiPe model, 2016

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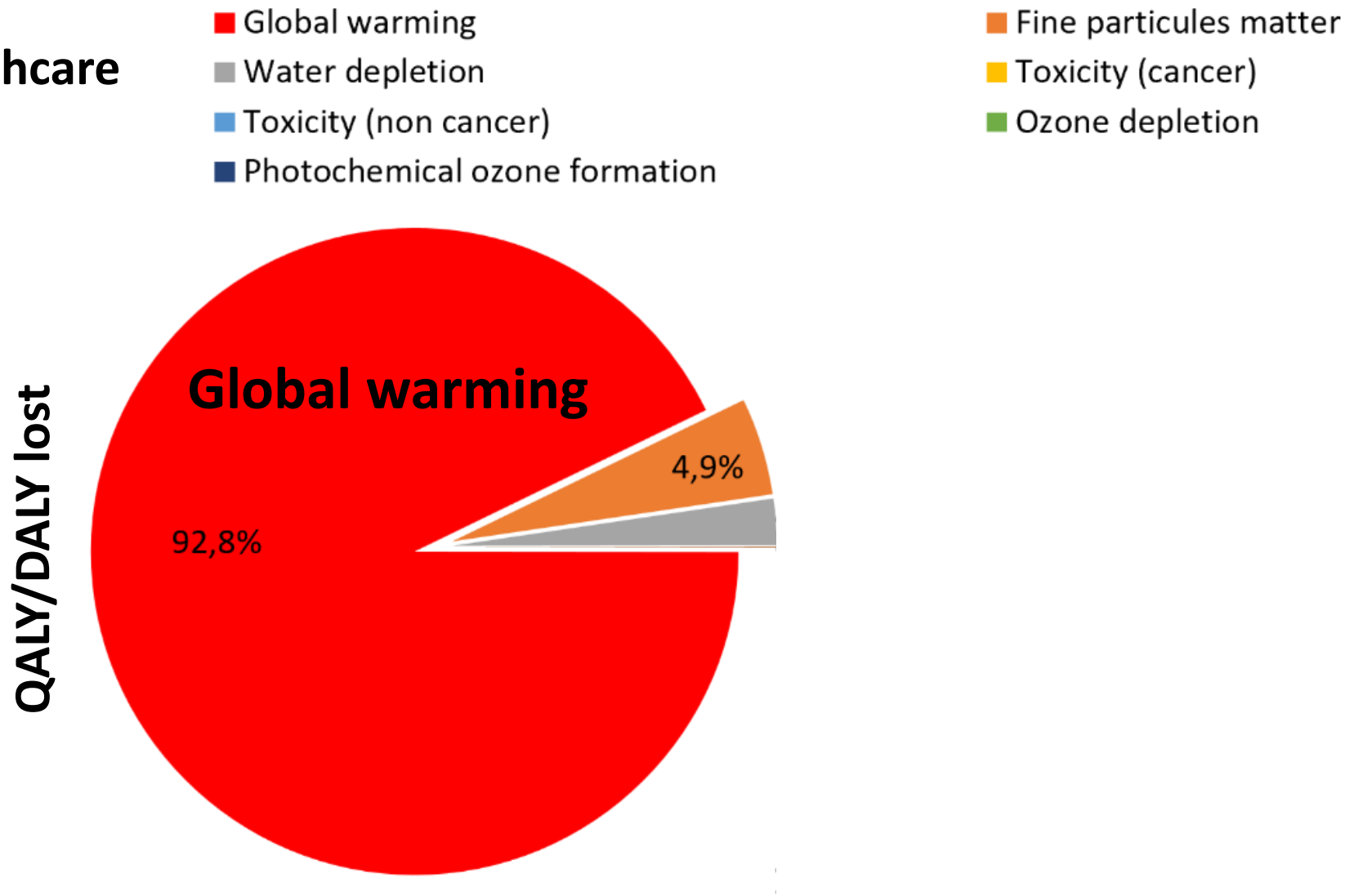
US healthcare system



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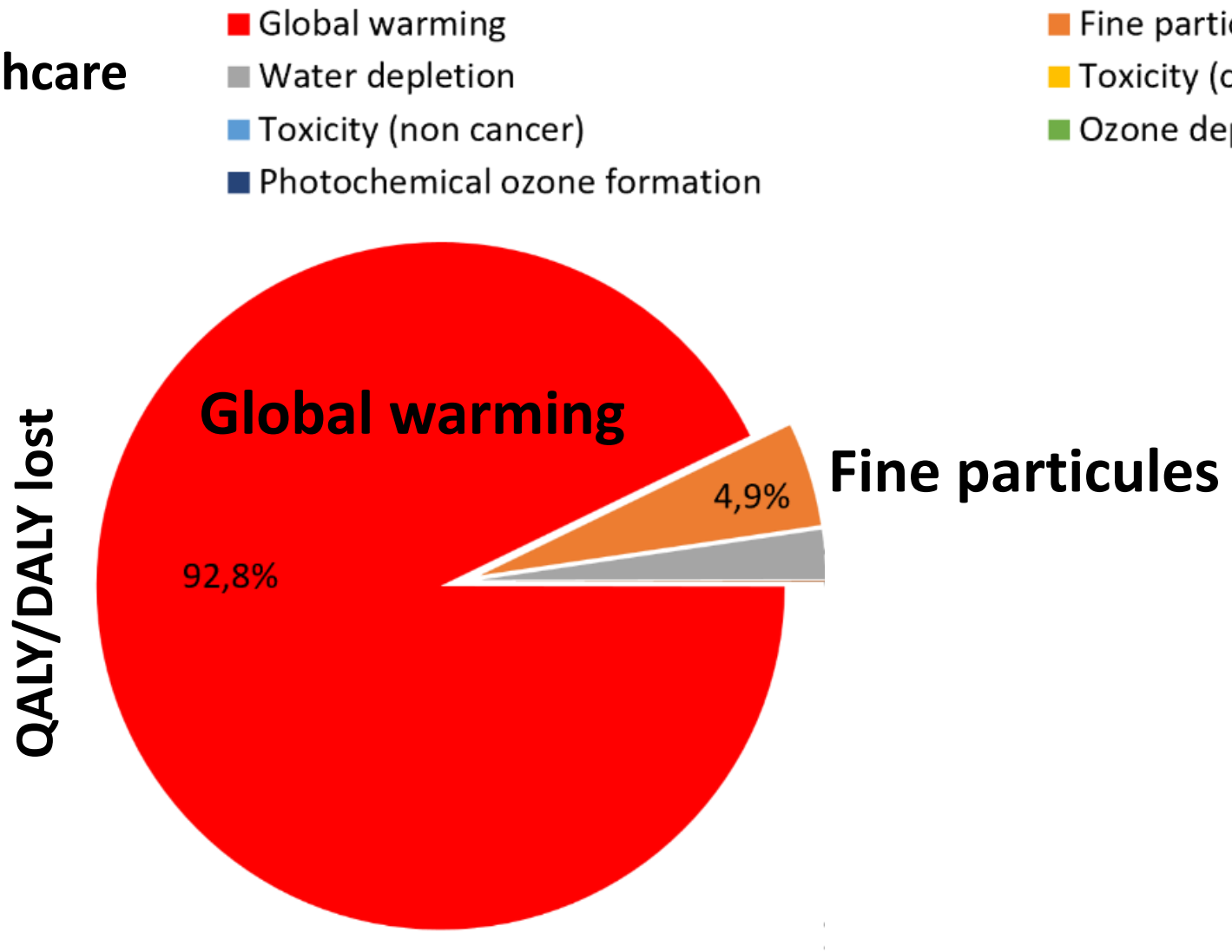

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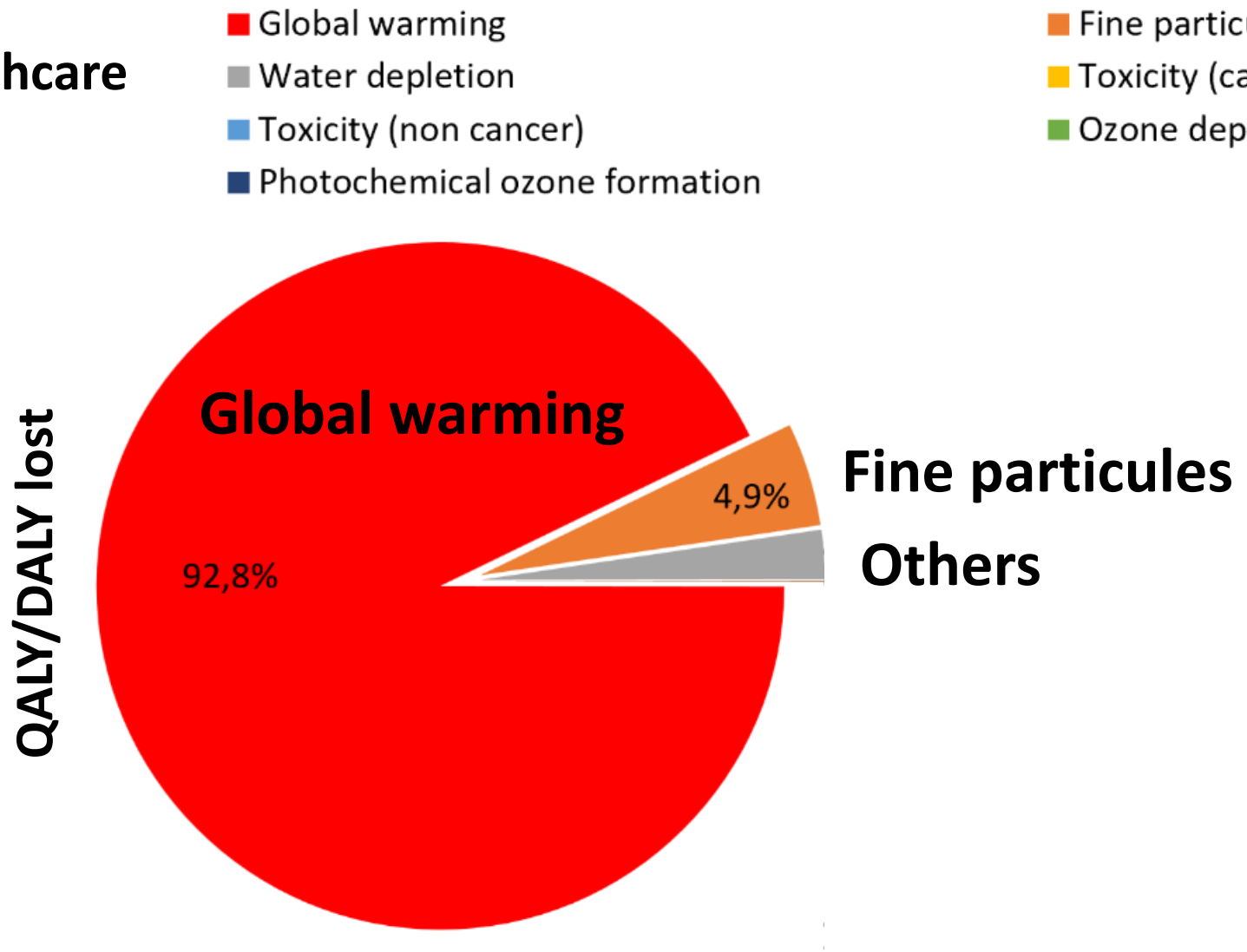

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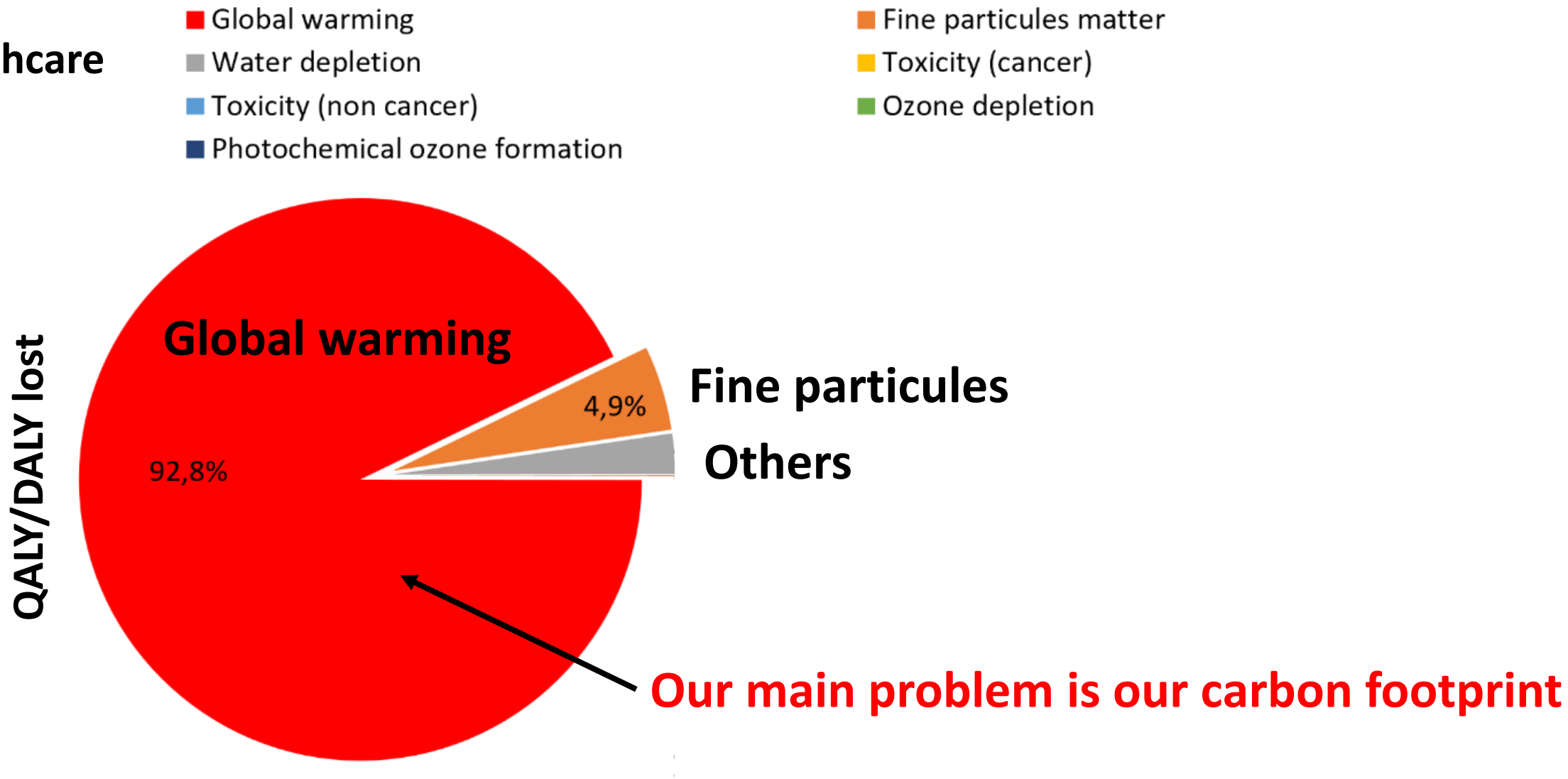

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Reducing the carbon footprint of care pathways

- Reducing emissions for a given care pathway ?
- Changing our care pathways ?

Reducing the carbon footprint of care pathways

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} Probably both !

Reducing the carbon footprint of care pathways

- Reducing emissions for a given care pathway ?
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} Probably both !

- **Requirements :**
  - **1) Estimating care pathways carbon footprint**
  - **2) Integrating carbon footprint in health technology assessment**

How to estimate care pathways carbon footprint ?

Data available :

- **Transport :** 0.27 $kgCO_2$/km in car *(France, ADEME)*
- **Building construction :** 1 147 $kgCO_2/m^2$ *(France, ADEME)*
- **Electricity :** 0.06 $kgCO_2$/kWh *(France, ADEME)*
- **Gas :** 0.227 $kgCO_2$/kWh *(France, ADEME)*
- **Biology :** 0.01 $kgCO_2$/€ *(estimated from McAlister et al, 2020)*
- **Pathology :** 0.79 $kgCO_2$/biopsy *(Gordon et al, 2020)*
- **Imaging :** 9.2 $kgCO_2$/CT scan, 17.5 $kgCO_2$/MRI
- **Waste :** 0.35 $kgCO_2$/kg *(*normal*)* to 0.95 $kgCO_2$/kg *(*hazardous*,France, ADEME)*
- **Information technology :** 0.4 kgCO2/€ *(France, ADEME)*

How to estimate care pathways carbon footprint ?

When things are too complex :

- **Emission factors (kgCO2/€)**

x Emission factor = carbon footprint

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- **Drugs :** 0.5 kgCO2/€ *(France, ADEME)*

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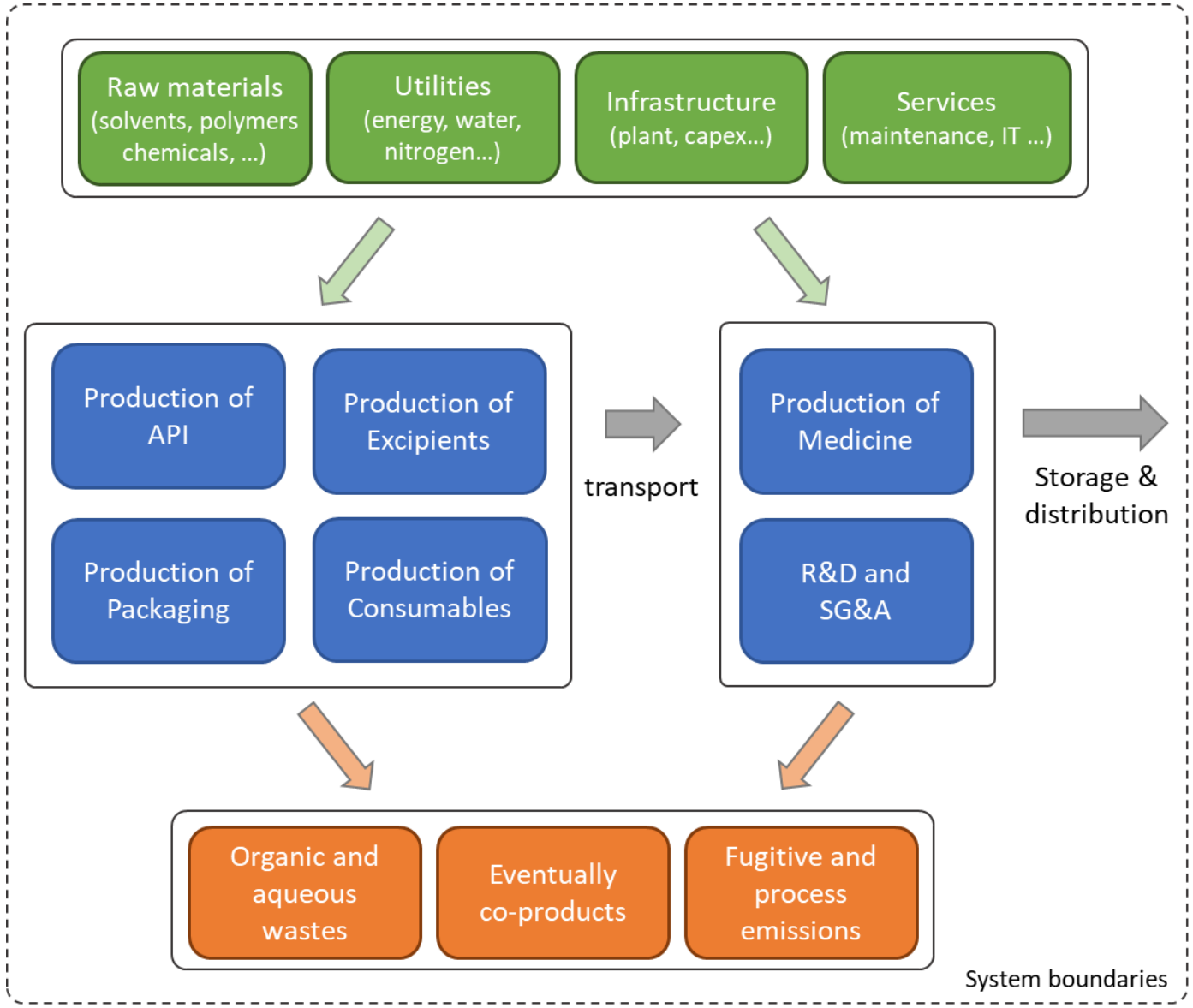
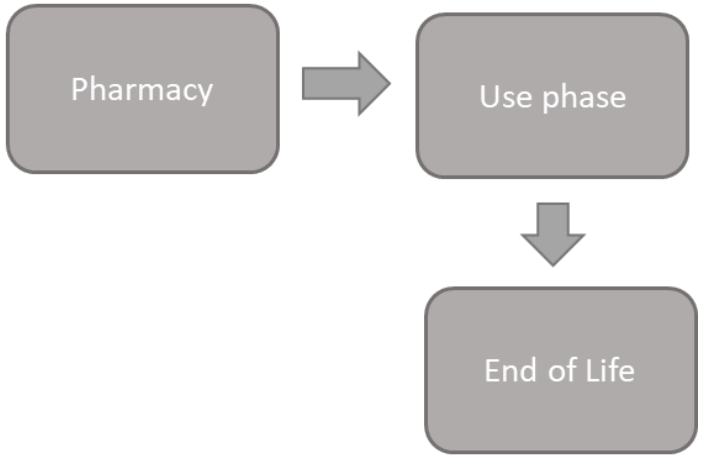
We cannot use these estimates for specific care pathways

Drug carbon footprint database



From cradle to pharmacy gate

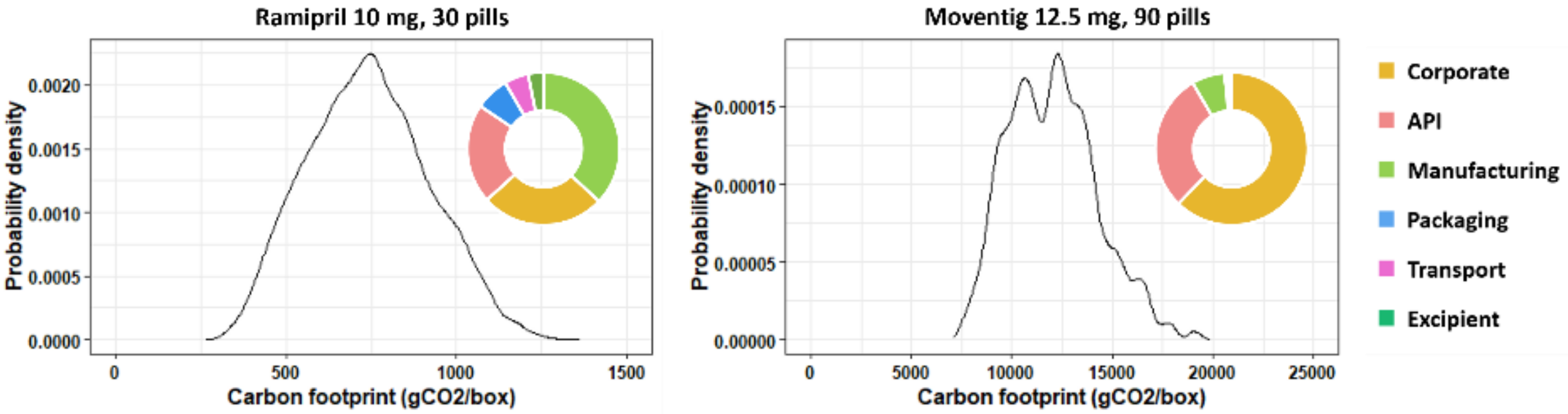


Contains 12,316 drugs at the moment

In collaboration with EcovaMed

In Press, M. Piffoux et al, Journal of Cleaner Production

Drug carbon footprint database



Available for all *PO* drugs in the *pharmacopia*
(work ongoing for other drugs)

Freely available for academics on :
www.ecovamed.com

In Press, M. Piffoux et al, Journal of Cleaner Production

Oncology drugs may have large carbon footprints

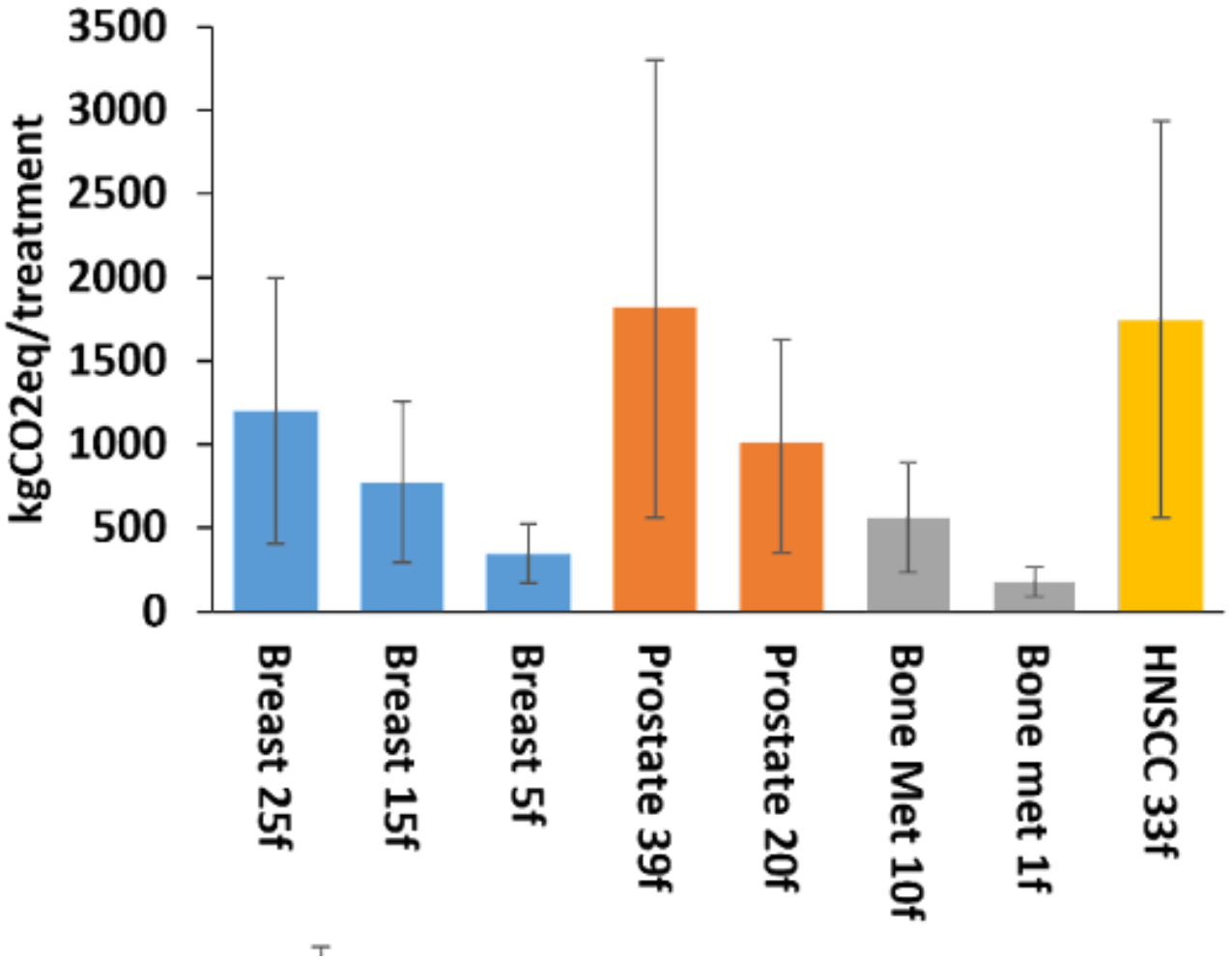
- A typical immunotherapy (30 days) : ± **322 kgCO2eq** *(unpublished)*
- A typical anti-VEGF (30 days) : ± **270 kgCO2eq** *(unpublished)*
- Imatinib 400 mg (30 days) : **43.2 kgCO2eq**
- Axitinib 5mg BID (30 days) : **109.8 kgCO2eq**
- Tamoxifen (30 days) : **1 kgCO2eq**
- Abiraterone (30 days) : **43.5 kgCO2eq**

In Press, M. Piffoux et al, Journal of Cleaner Production

Take home messages (1)

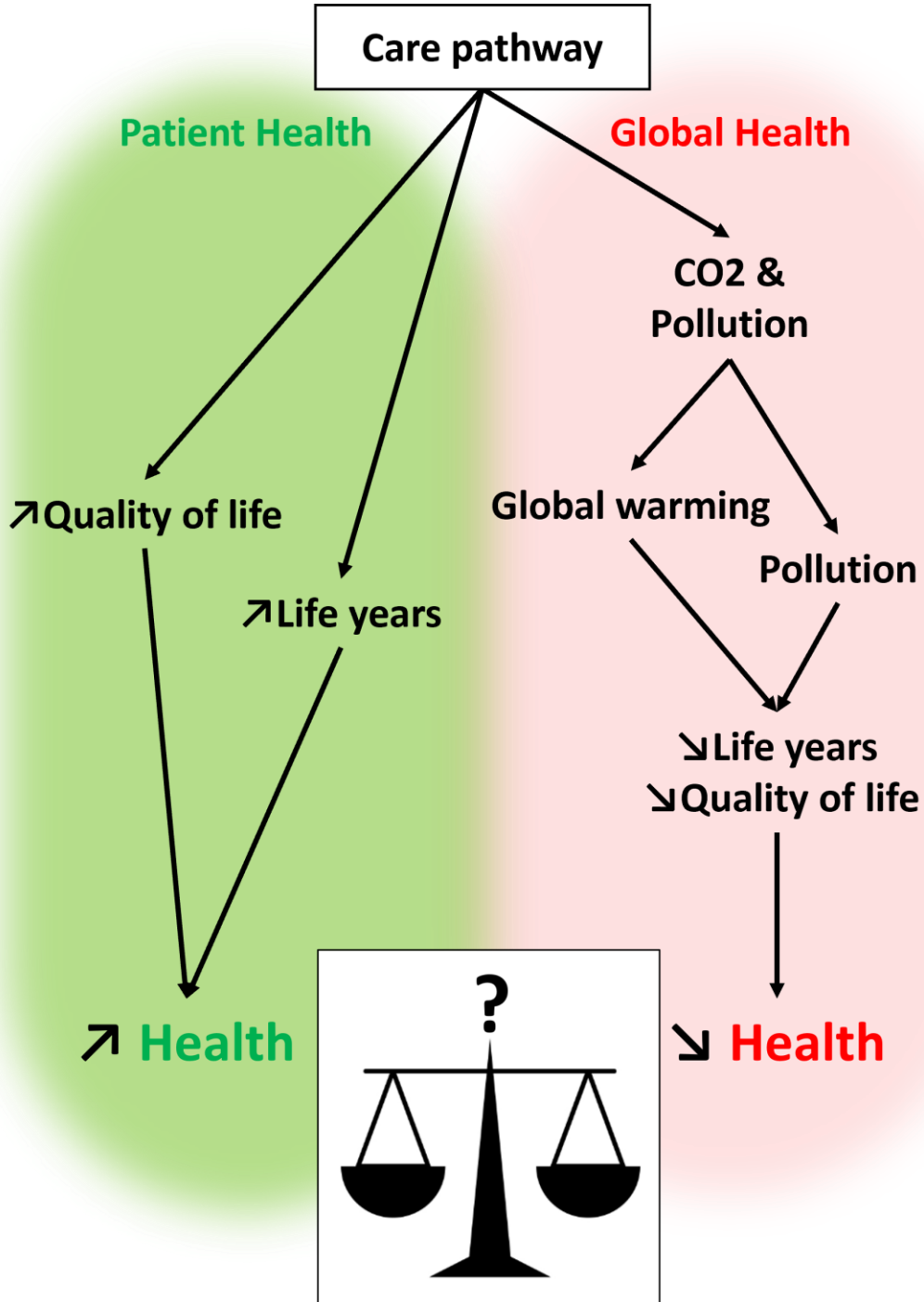
- Healthcare has a large health impact on the future
- CO2eq is our main problem
- It is feasible to estimate the carbon footprint of specific care pathways

A proof of concept in radiotherapy



Piffoux et al, Cancer Radiother, 2023
Ali et al, CTRO, 2024
Dupraz et al, CTRO, 2024

How to integrating the carbon footprint in health technology assessment ?


Care pathway
Patient Health
Global Health
CO2 &
Pollution
↗Quality of life
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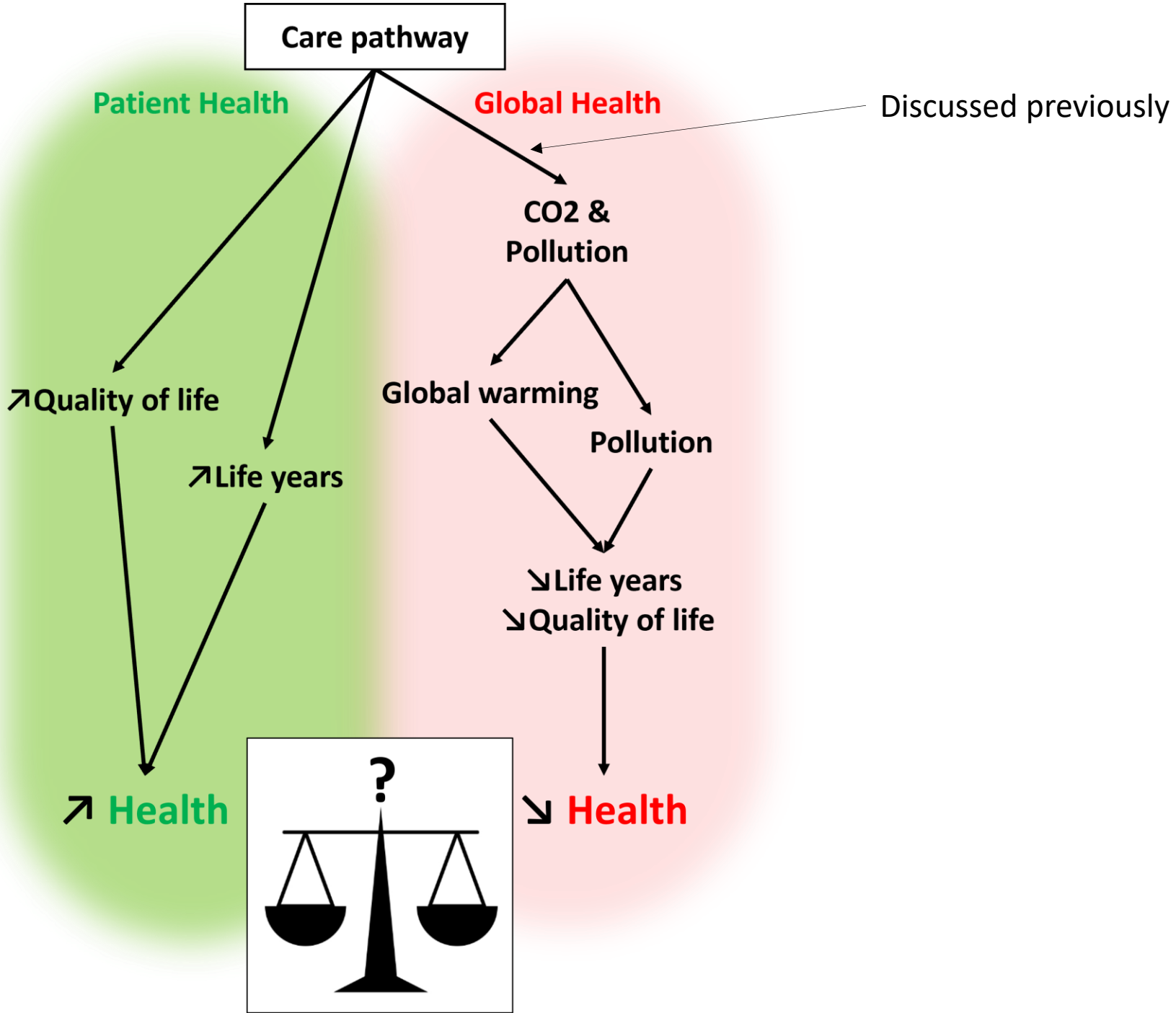
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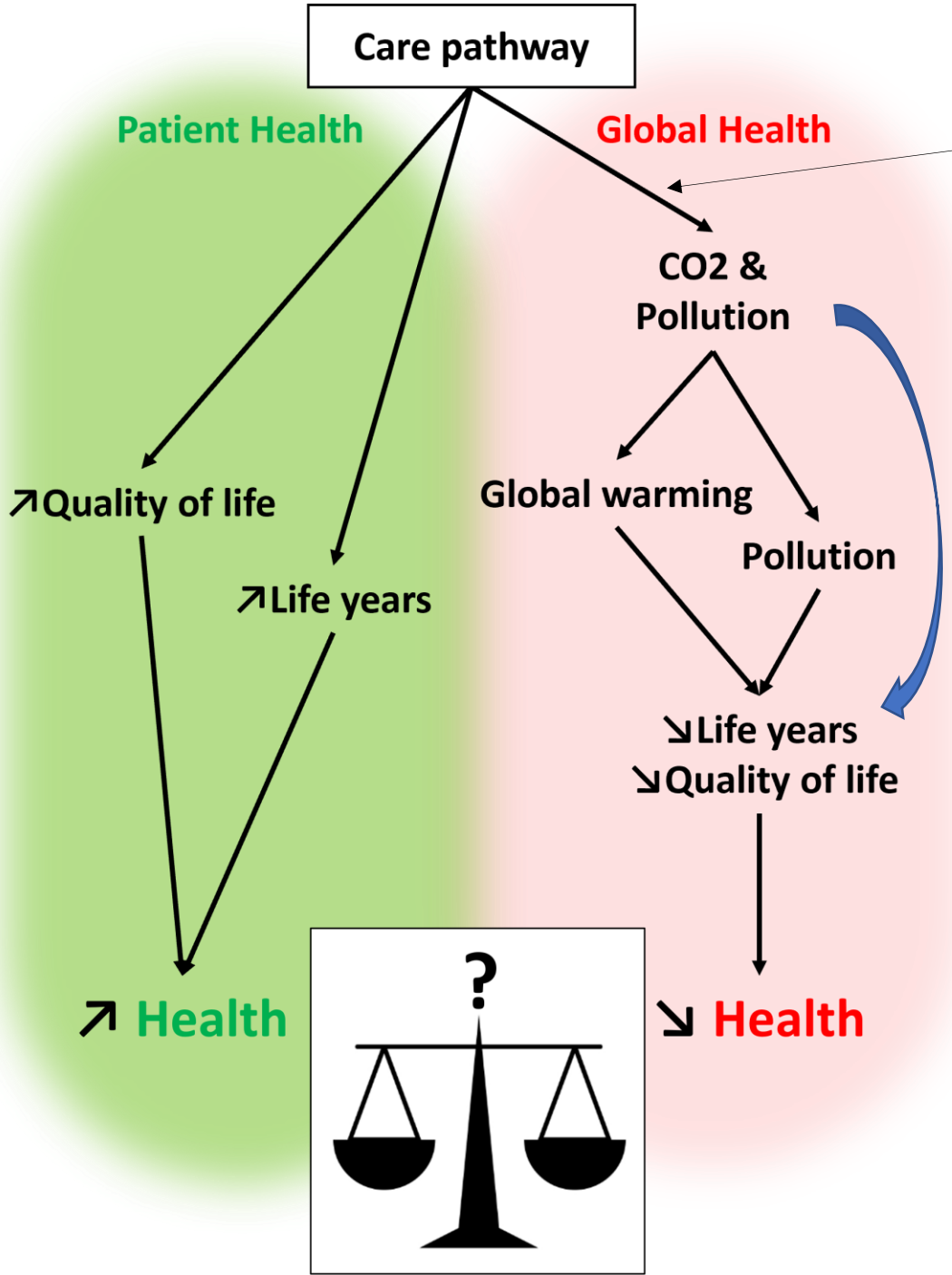
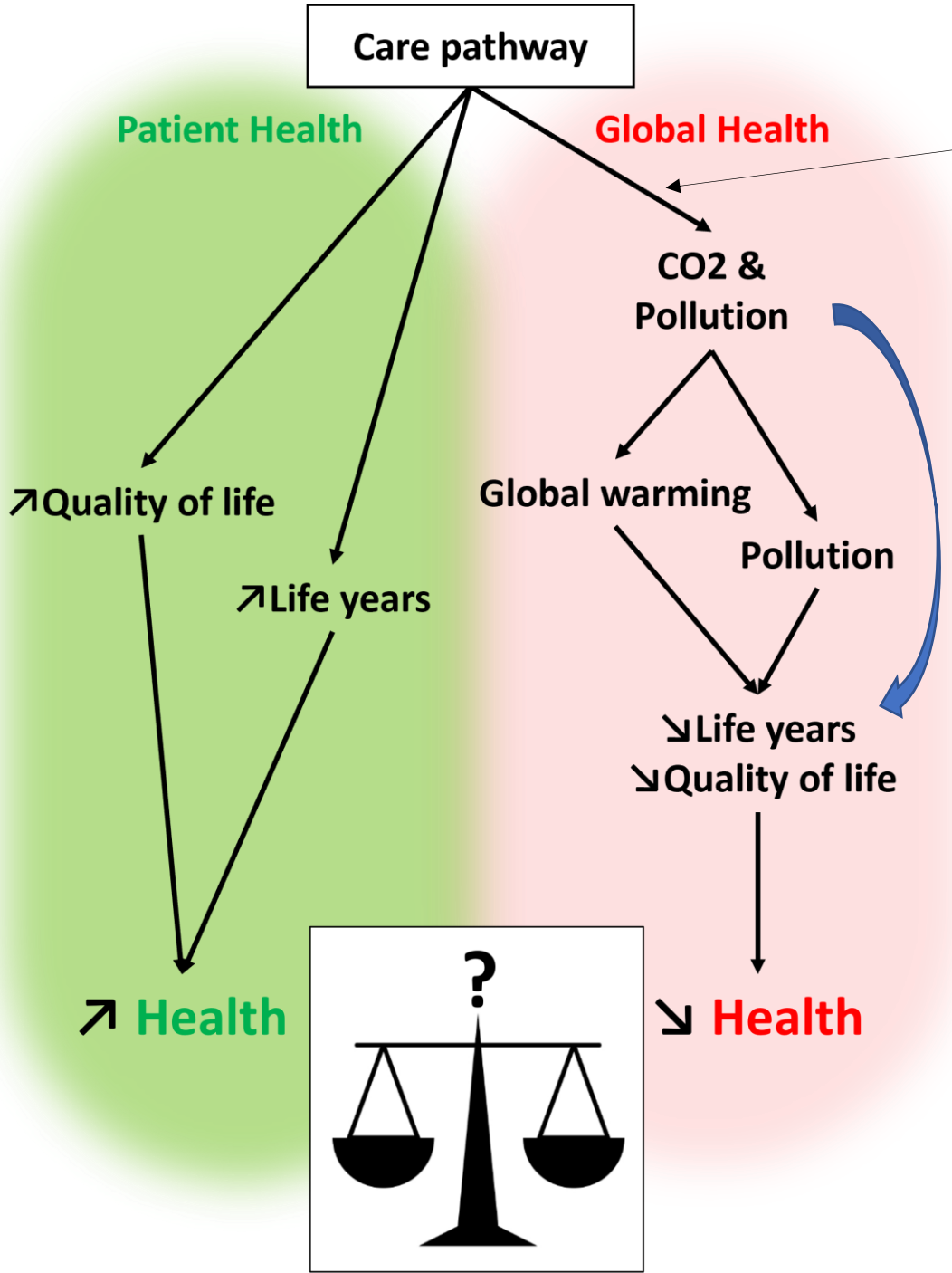


Discussed previously

The tricky part !

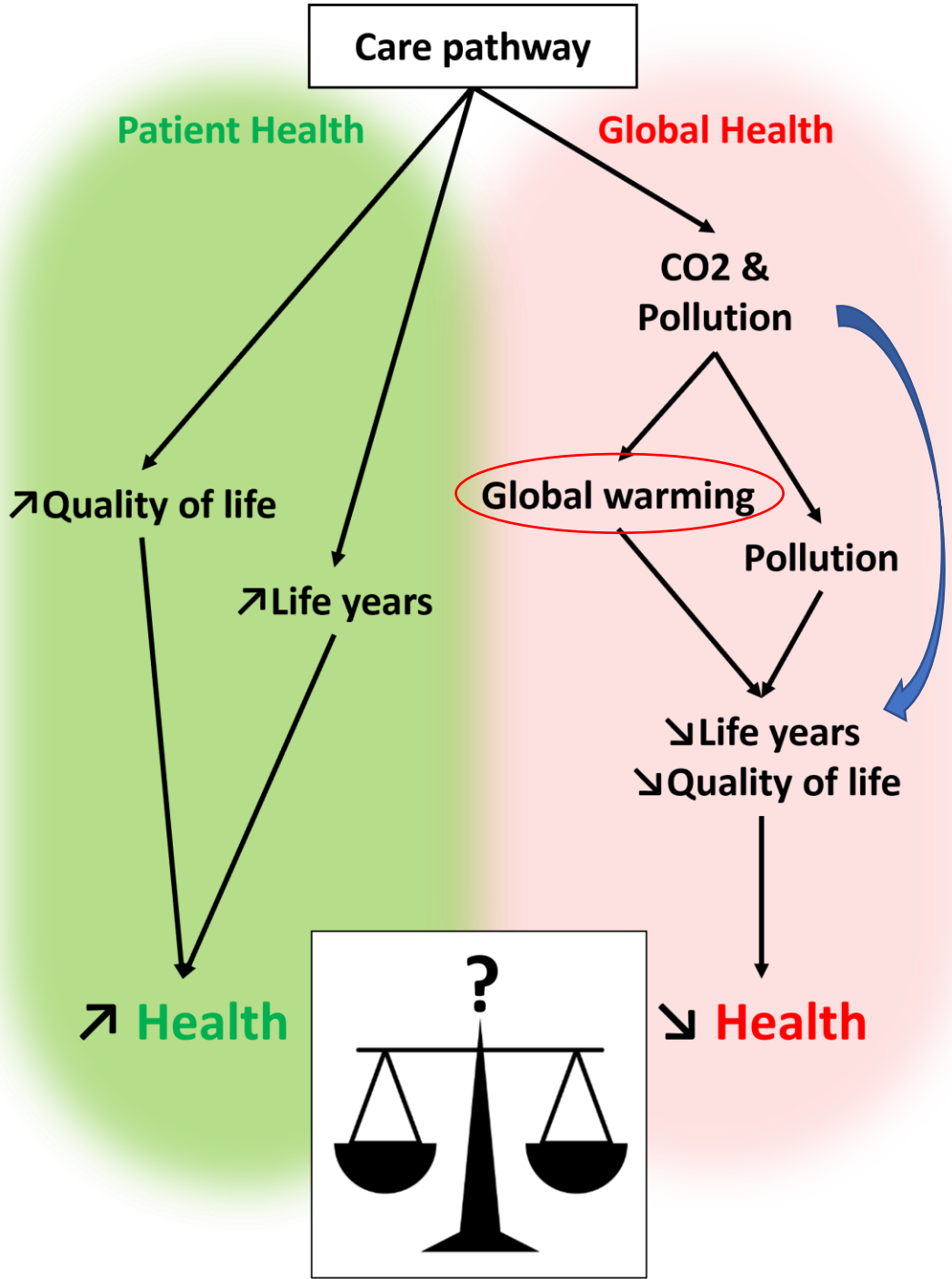
Huijbregts et al, ReCiPe model, 2008 and 2016



Discussed previously

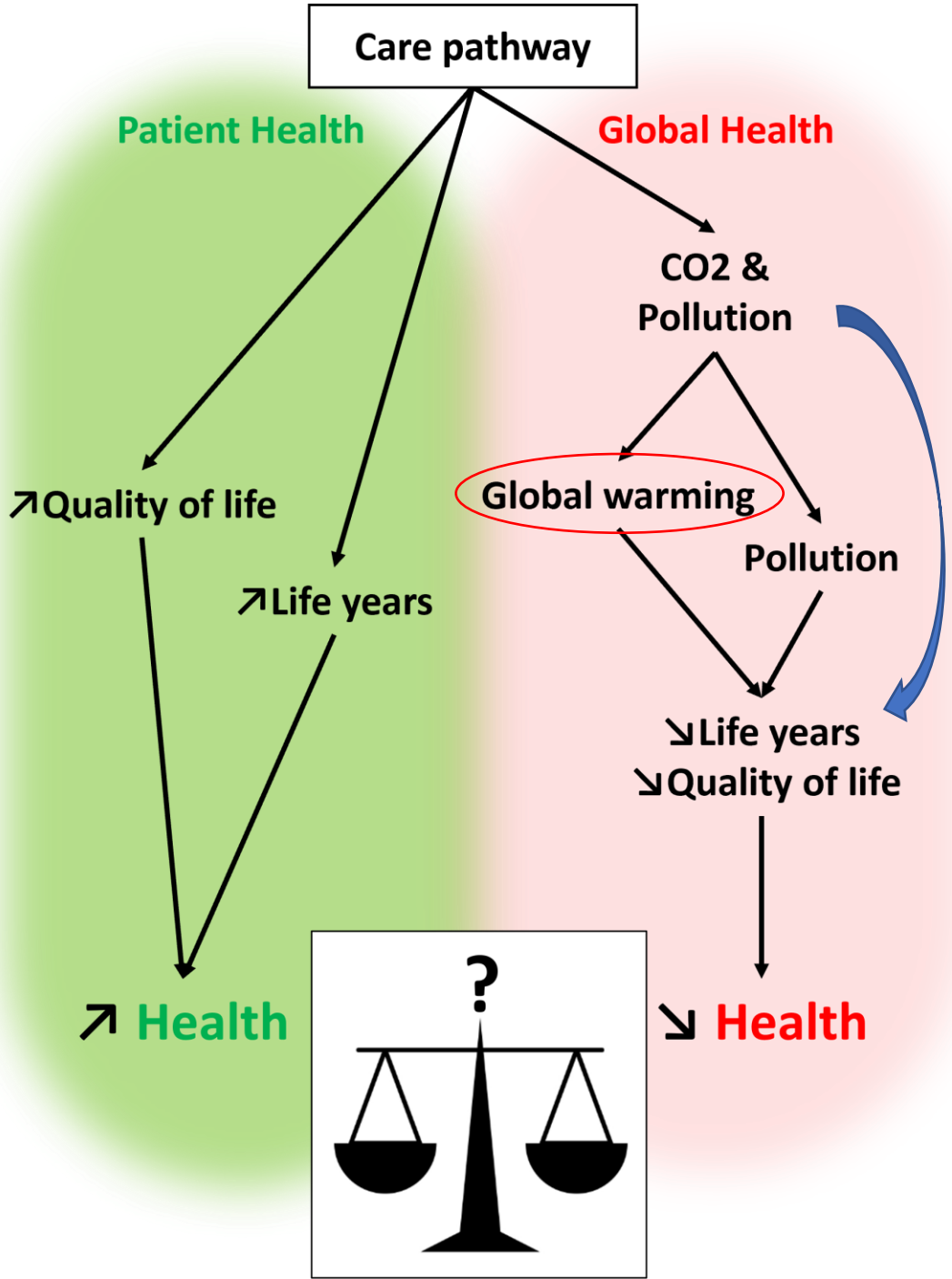
Other teams already proposed models (e.g. ReCiPe model)

Huijbregts et al, ReCiPe model, 2008 and 2016



1 year in good health (1 QALY/DALY)
lost in the future

Huijbregts et al, ReCiPe model, 2008 and 2016



1 year in good health (1 QALY/DALY) lost in the future

= 80 tCO2eq

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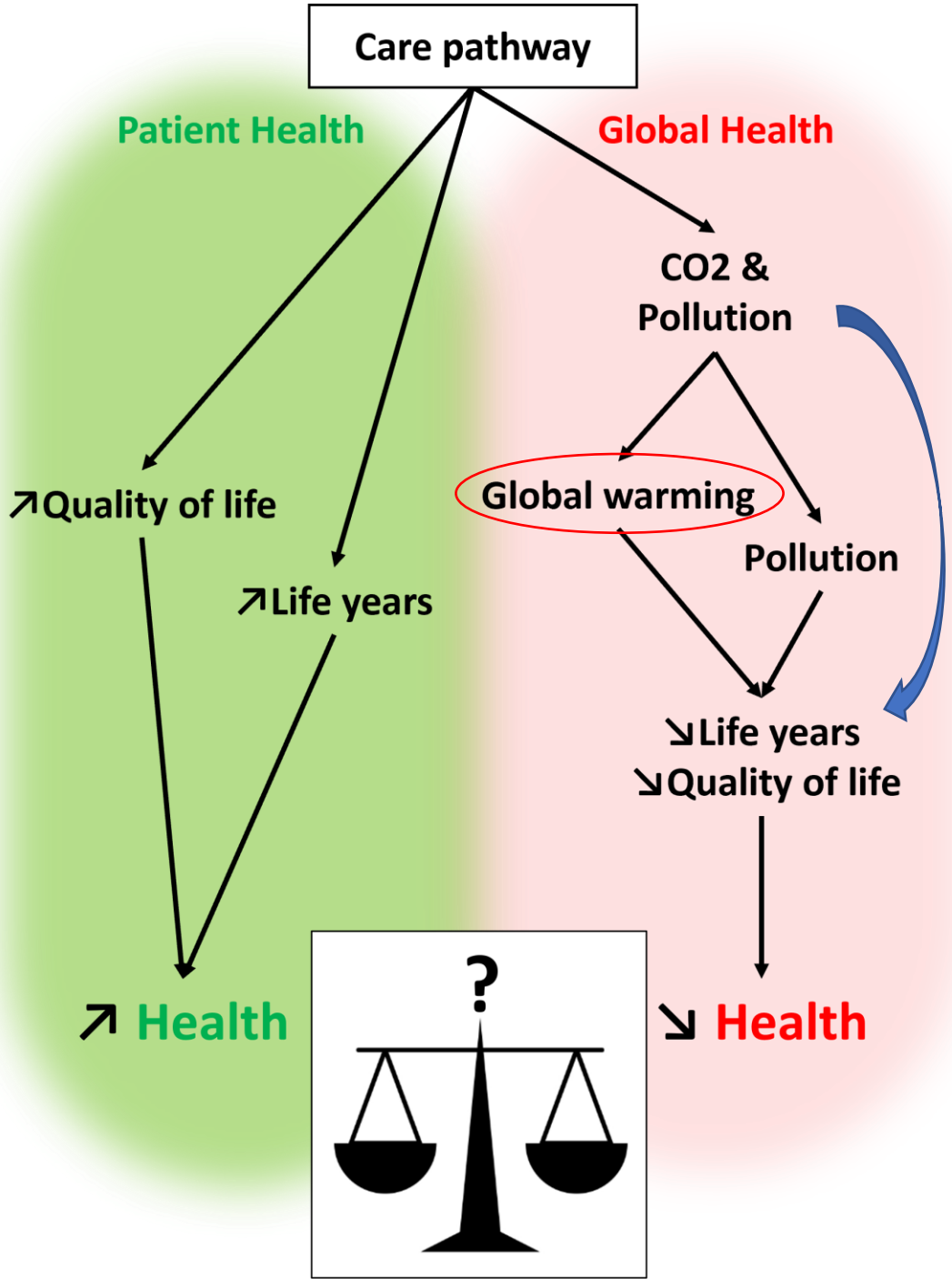

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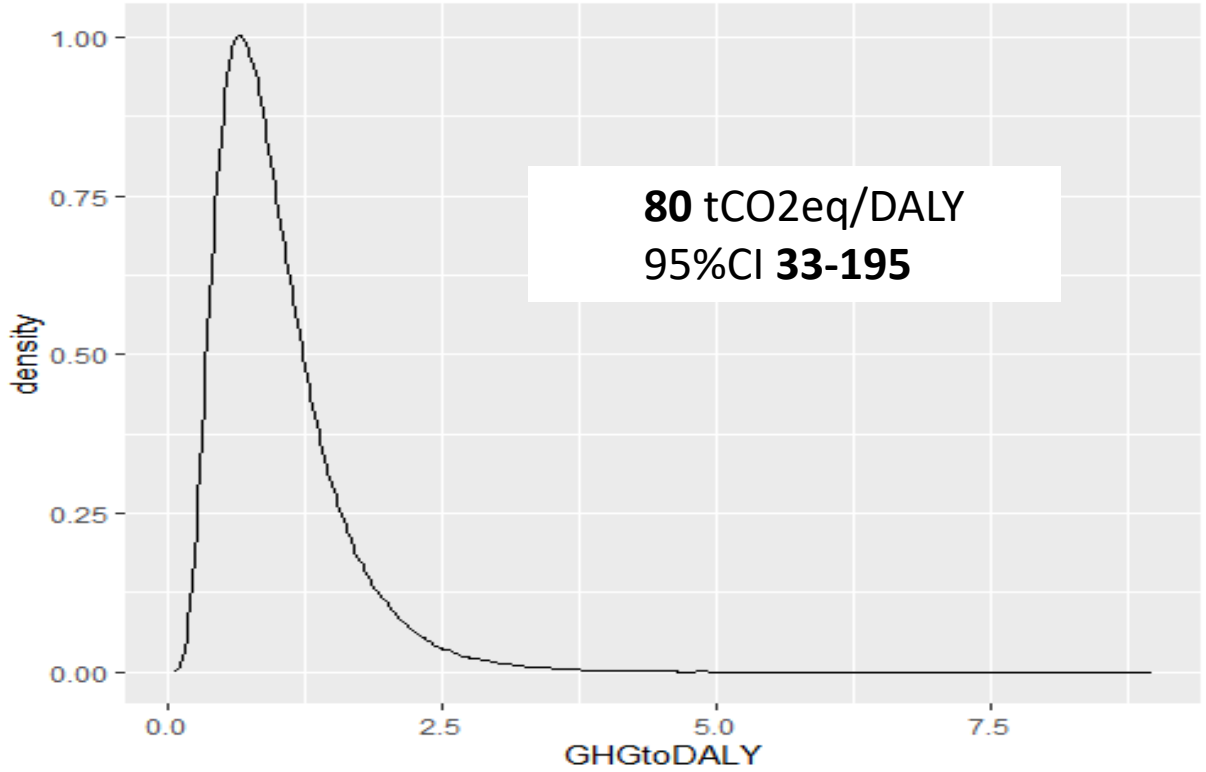
if

Our life *value* = Our grand (grand) children life *value*

Huijbregts et al, ReCiPe model, 2008 and 2016

Take home messages (2)

- We may compare health gains and health losses associated to a care pathway
  - Large confidence interval



M. Piffoux et al, unpublished

Applications in oncology

- 6-months adjuvant trastuzumab versus 12-months (or 9 weeks ?)
  - An option in ESMO recommandations

> • HER2-directed therapy (with initial concurrent ChT) should be given for 12 months, covering both the neoadjuvant and/or adjuvant phases of treatment. Administration can be combined, if indicated, with RT and ET. In selected low-risk situations, 6 months of anti-HER2 therapy may be non-inferior

Applications in oncology

- 6 months adjuvant trastuzumab versus 12 months (or 9 weeks ?)
  - An option in ESMO recommandations
- Demonstrated as non-inferior
- Saves :
  - ≈ 10 000 €
  - ≈ 7 outpatient visits
  - **≈ 3-5 tCO2eq/patient**
  - **≈ 14-23 days in good health saved in the future**

Take home messages (3)

- We can integrate carbon footprint in health technology assessment
  - (There are others methods to do so)

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- Other things that I cannot discuss in details because of time :
  - In some care pathways : losses > gains
  - Some care pathways diminish emissions (vaccines)
  - In most care pathways losses = 10-80% gains

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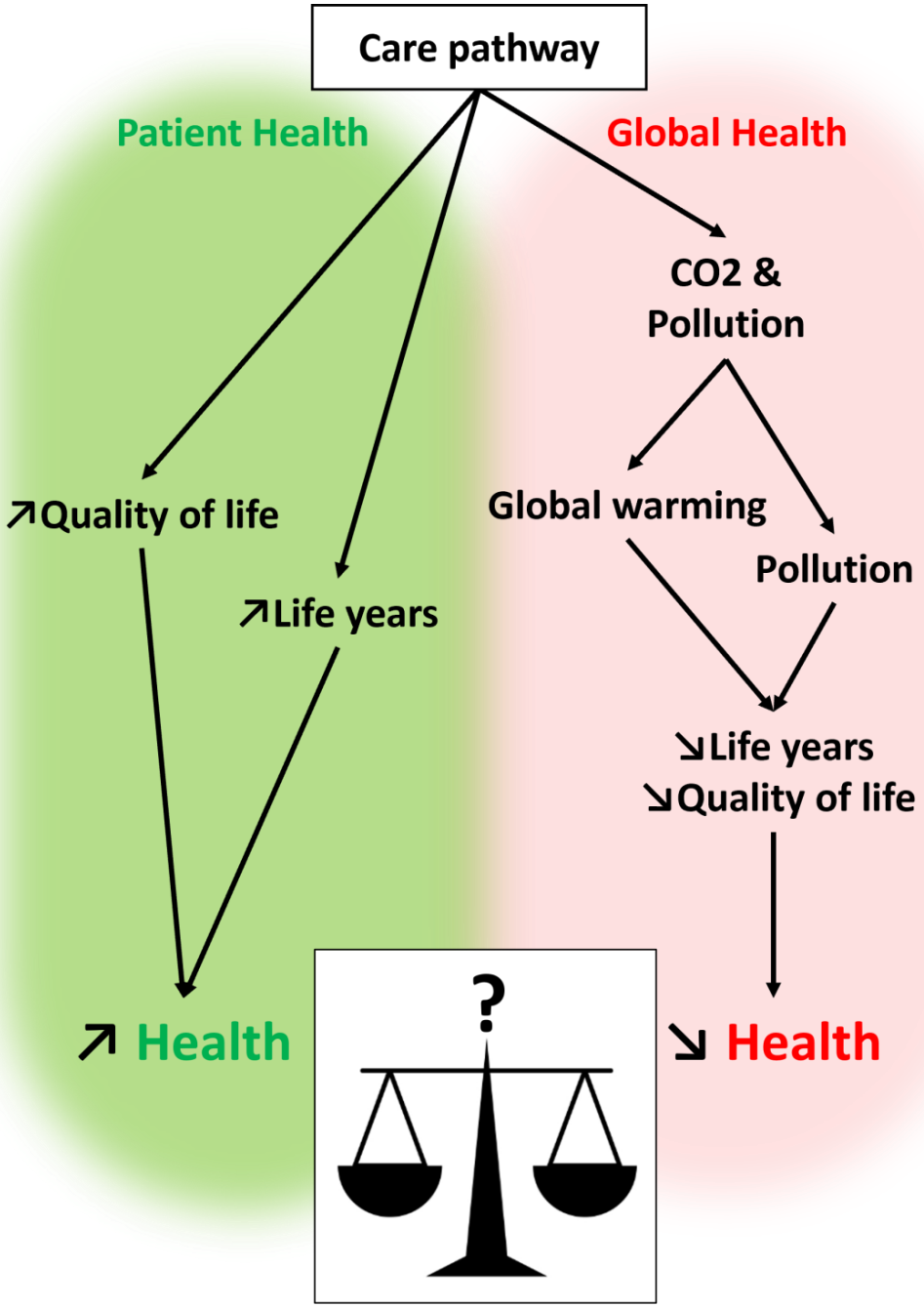
- Few numbers of interest :
  - Top 10% Europe = 25 tCO2eq/year = **3.7 months lost/year**
  - Top 10% US = 54 tCO2eq/year = **8.1 months lost/year**
  - A typical radiation therapy oncologist : **100-300 tCO2eq/year**
  - A typical medical oncologist : **100-1,000 tCO2eq/year**

Thank you for listening ! Questions ?

- Special thanks to **Dr Coline Ducrot**
- Currently working on CO2 in medico economic analysis & continuing the drug database (open for collaborations !)
- Network in France/belgium/other with **Dr Matthieu Delaye**



Contact : max.piffoux@cri-paris.org

What is your carbon footprint ? Carbonfootprint.com