

# Decision making in radiotheranostics

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University of Wisconsin  
SCHOOL OF MEDICINE  
AND PUBLIC HEALTH

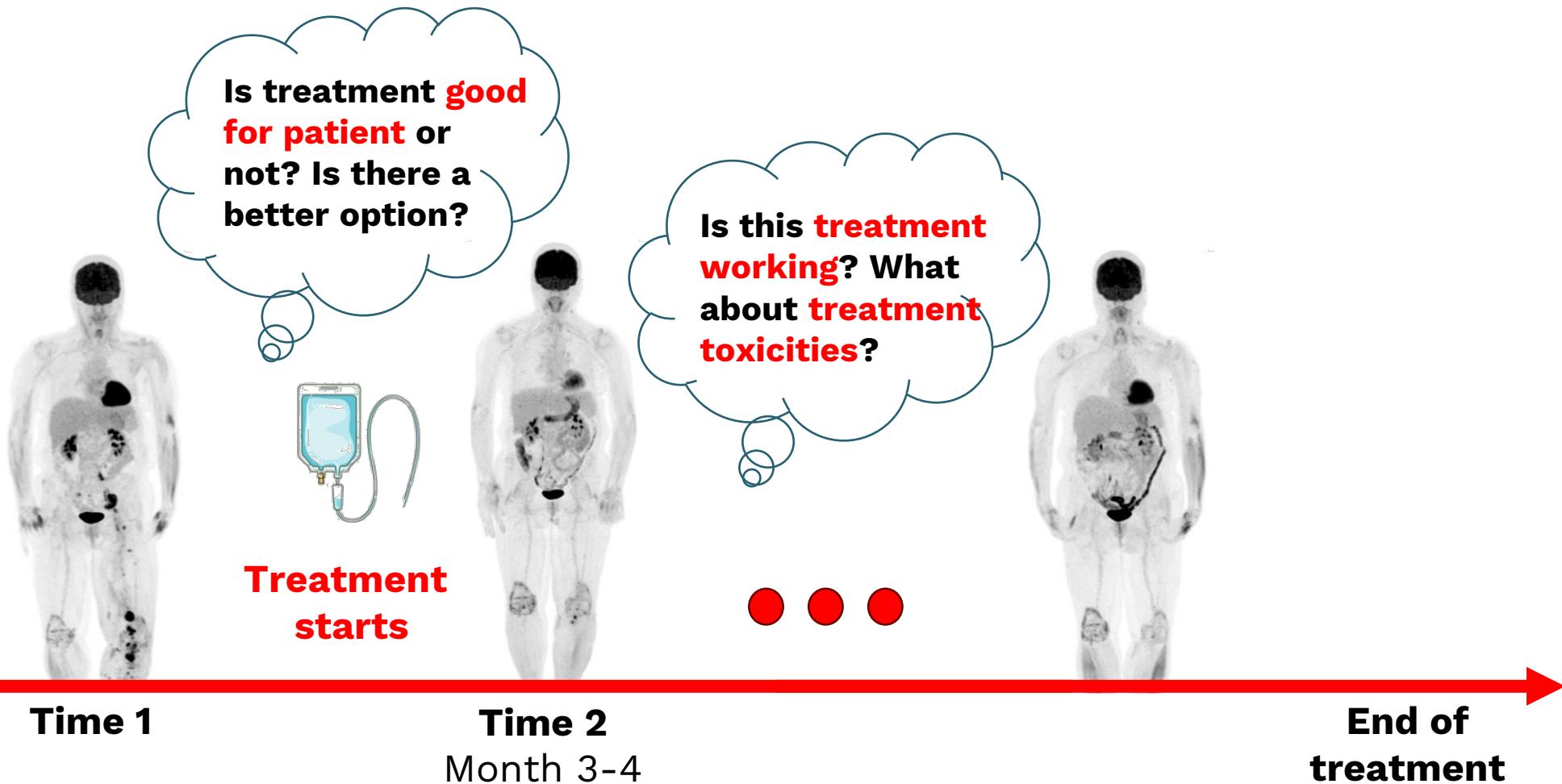


# Disclosure

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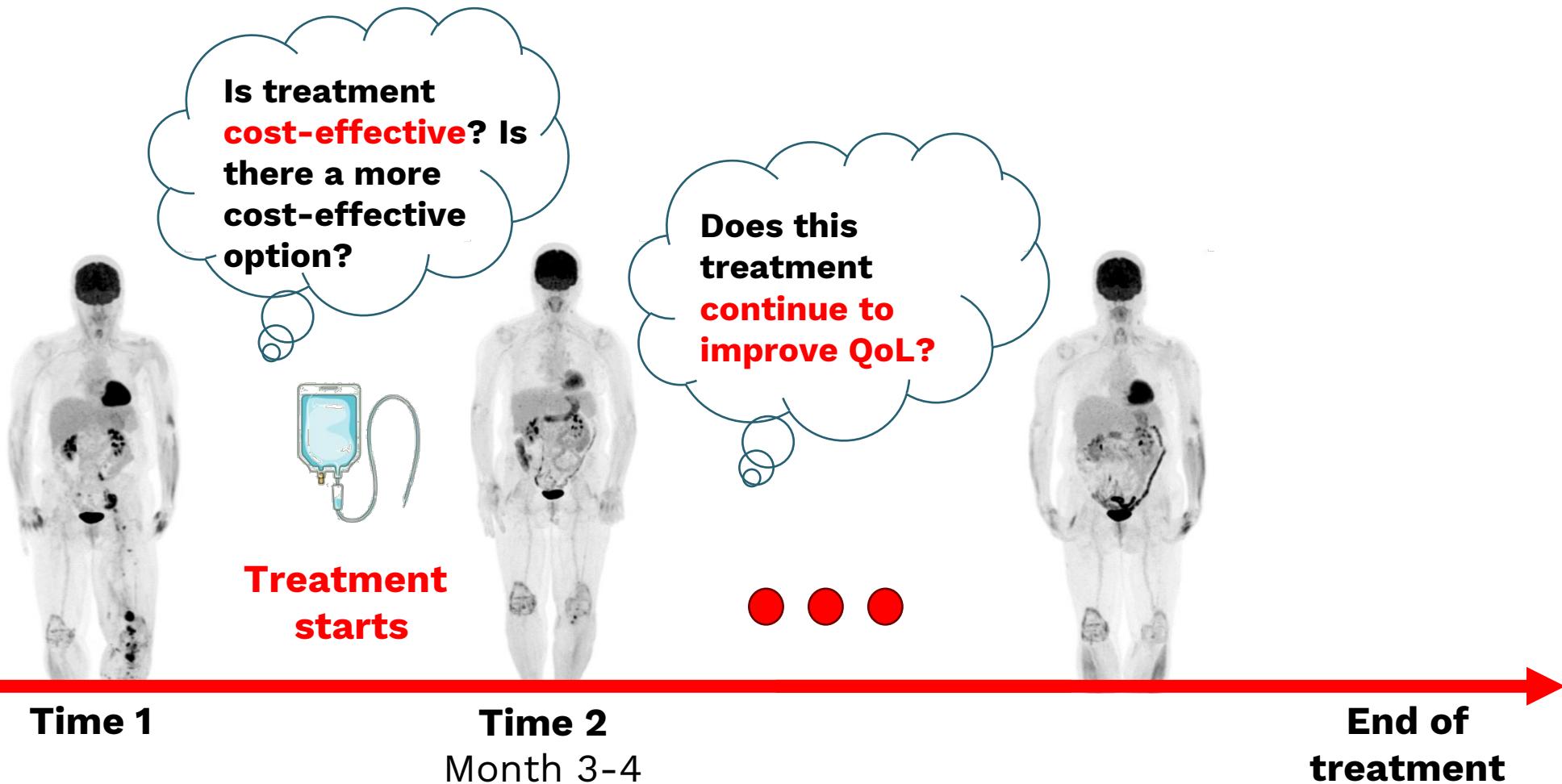
- Founder and CSO of AIQ Solutions

# Patient journey

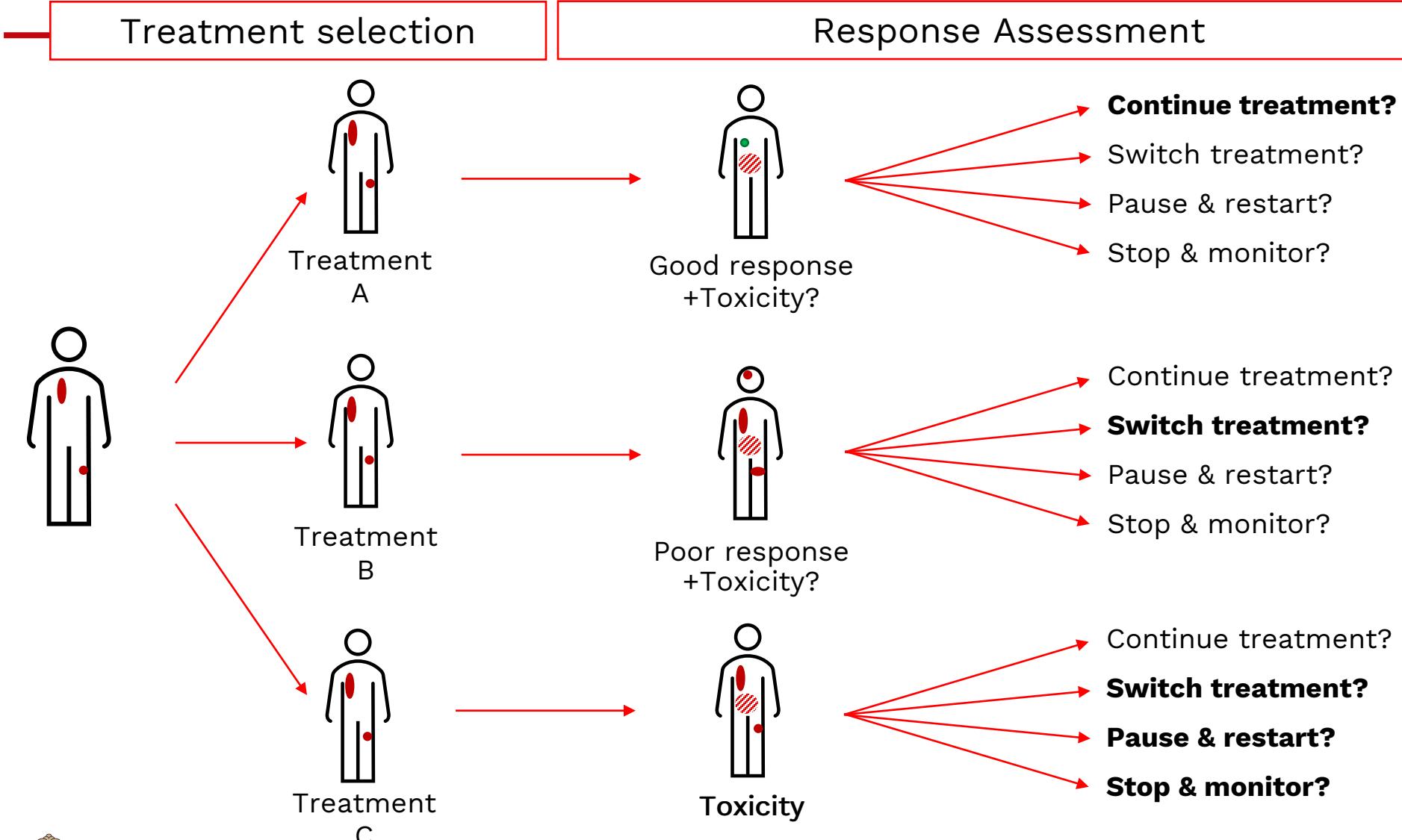


# HTA perspective

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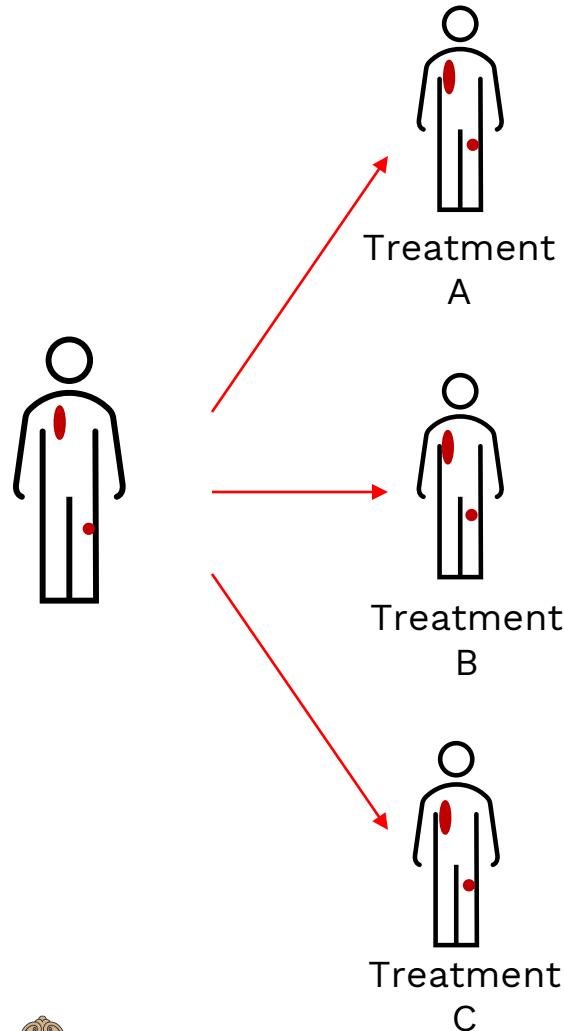


# Adapting treatment schedules

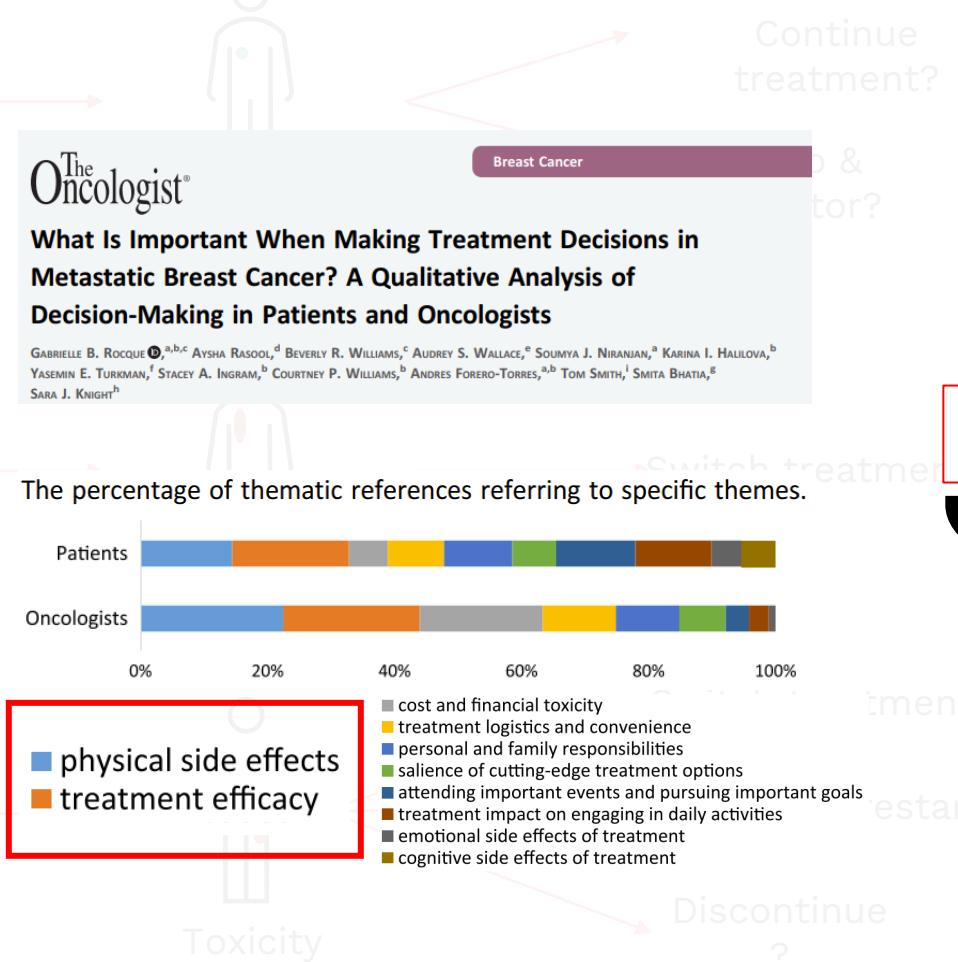


# Balancing risks and benefit

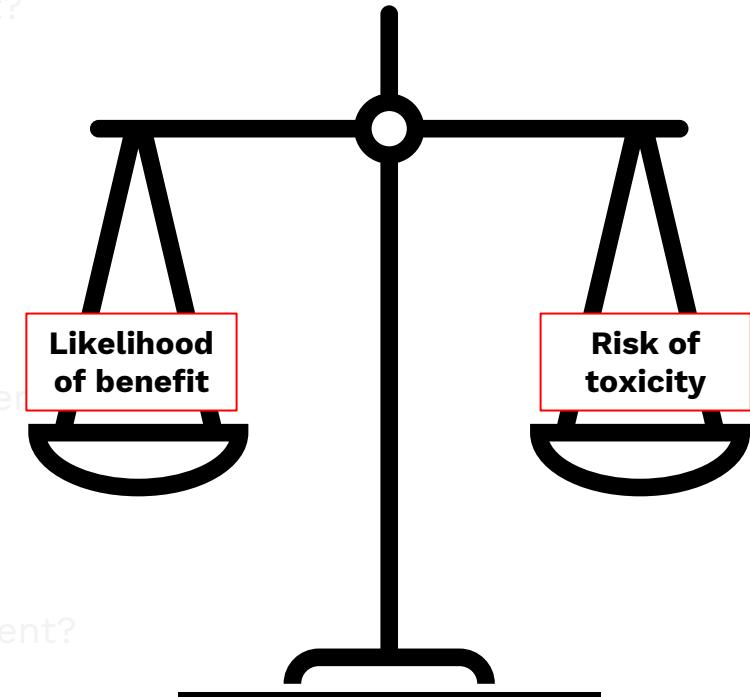
## Treatment selection



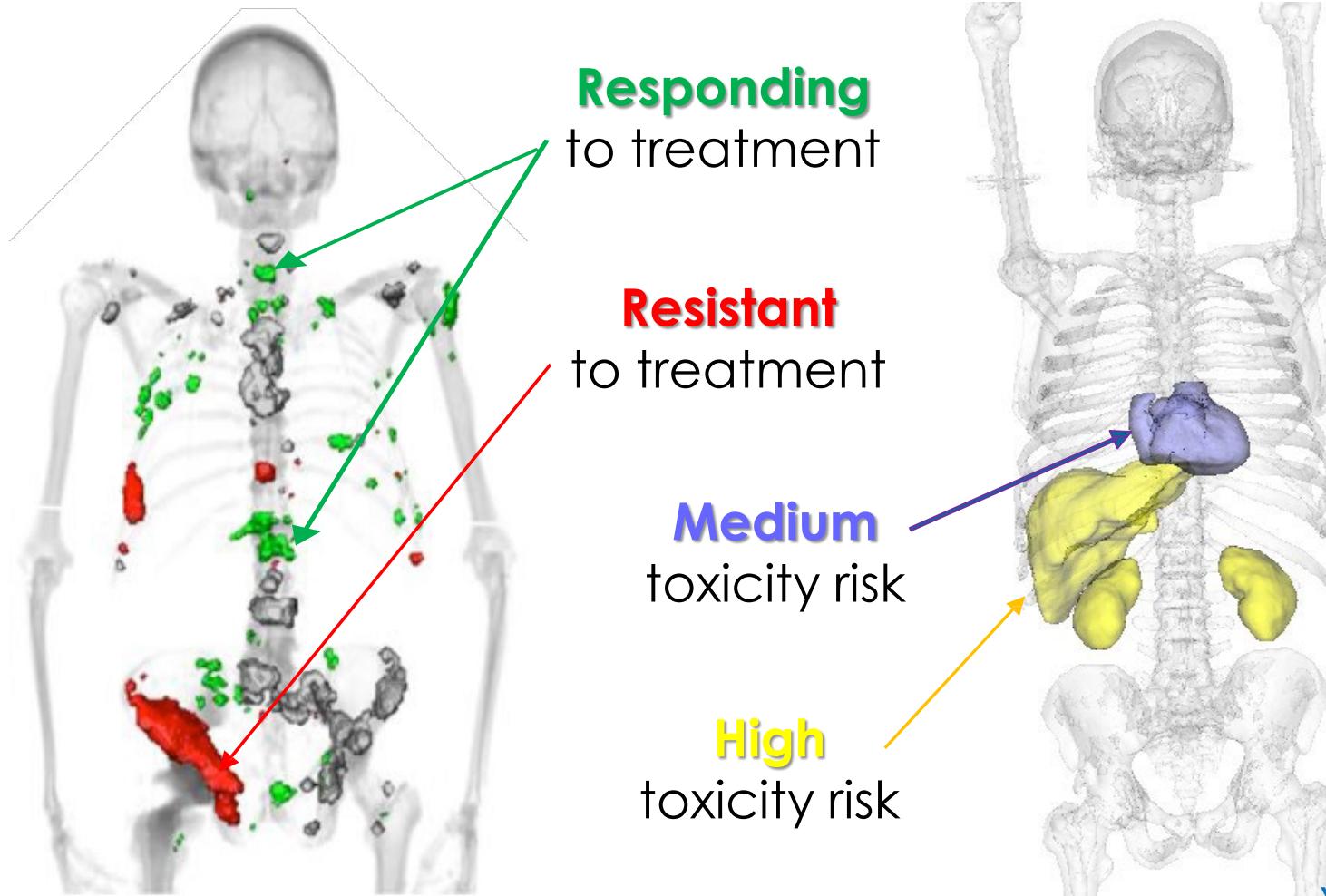
## Response Assessment

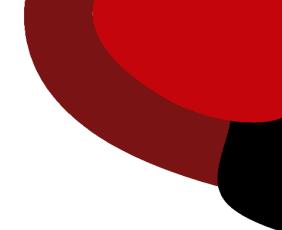


Rocque et al, 2019, Oncologist, 24:1313-1321.



# Assessment of risks and benefit: AI-based Quantitative Imaging Biomarkers

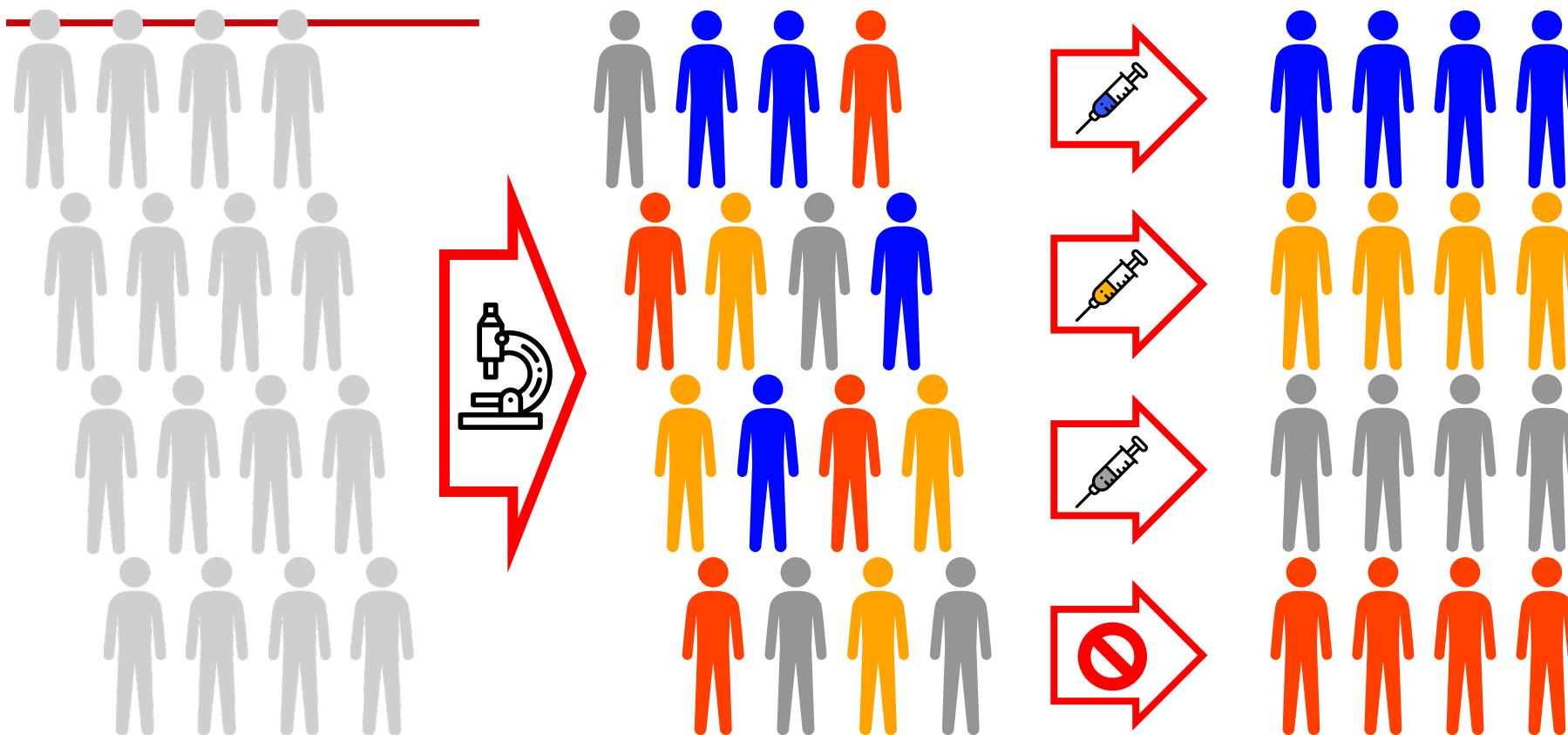




# PRECISION MEDICINE

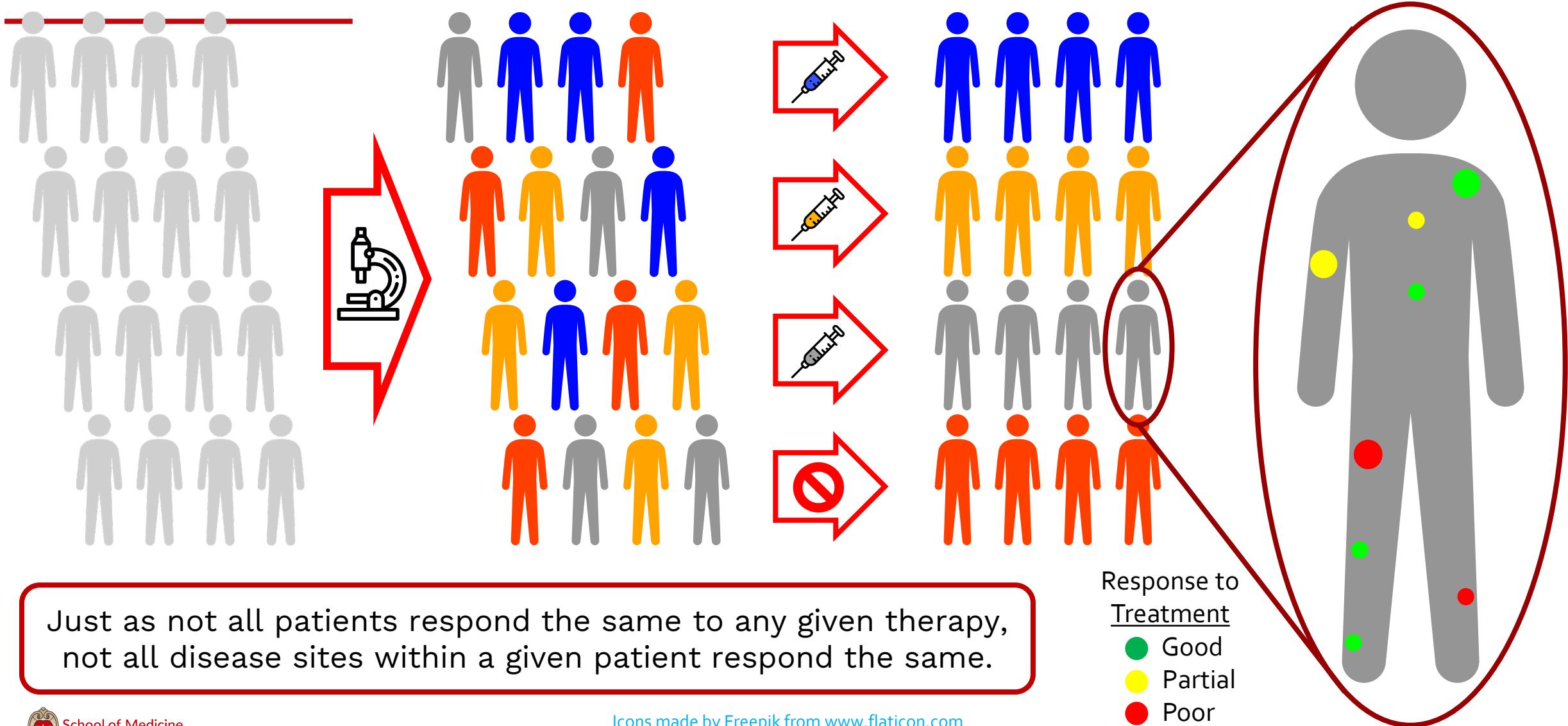
- The problem of response heterogeneity
- The problem of treatment resistance

# Precision medicine aims for this...



Not all patients respond the same to any given therapy,  
therefore different treatments need to be chosen

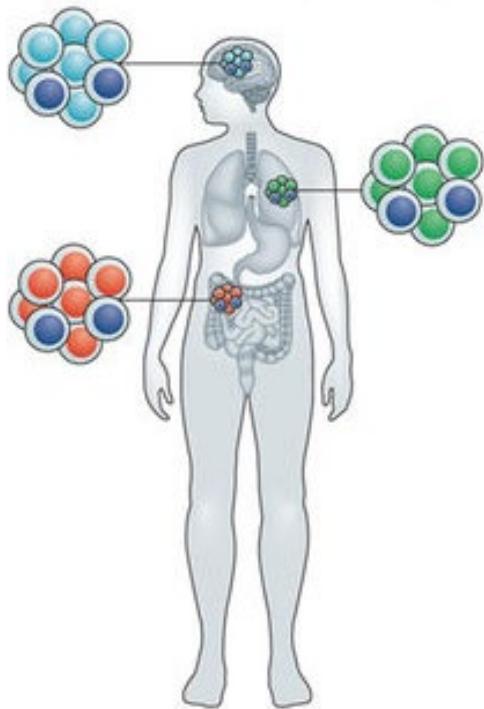
# ...but there is a big problem!



# Why heterogeneity?

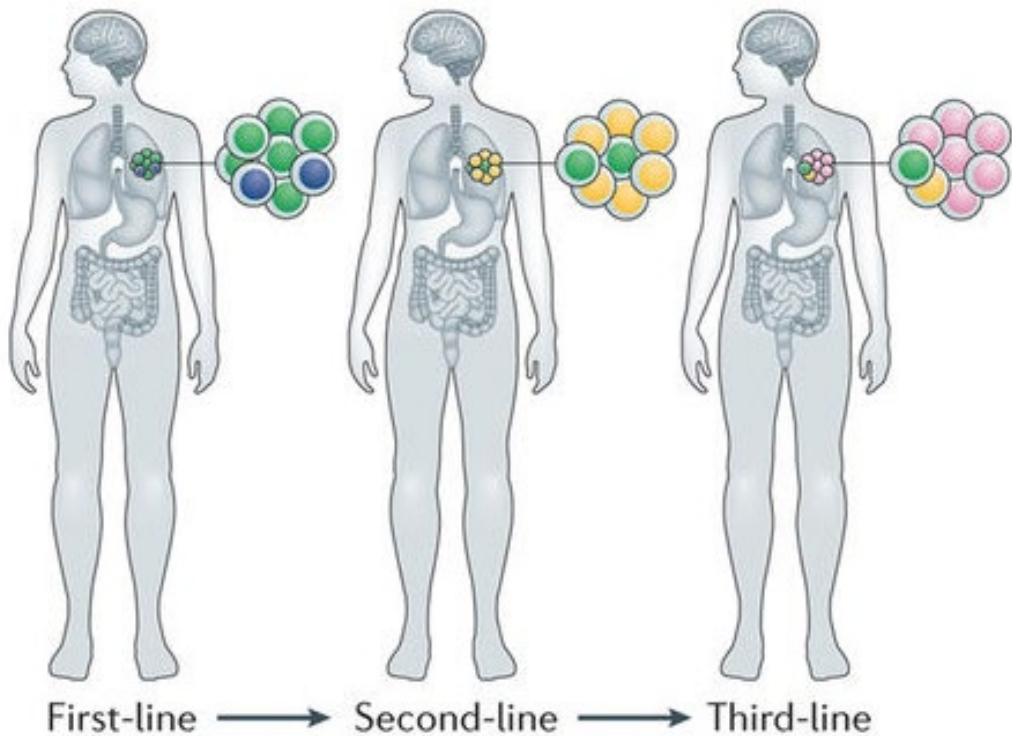
## Spatial Heterogeneity

Different disease sites have different responses to therapy at a given point in time

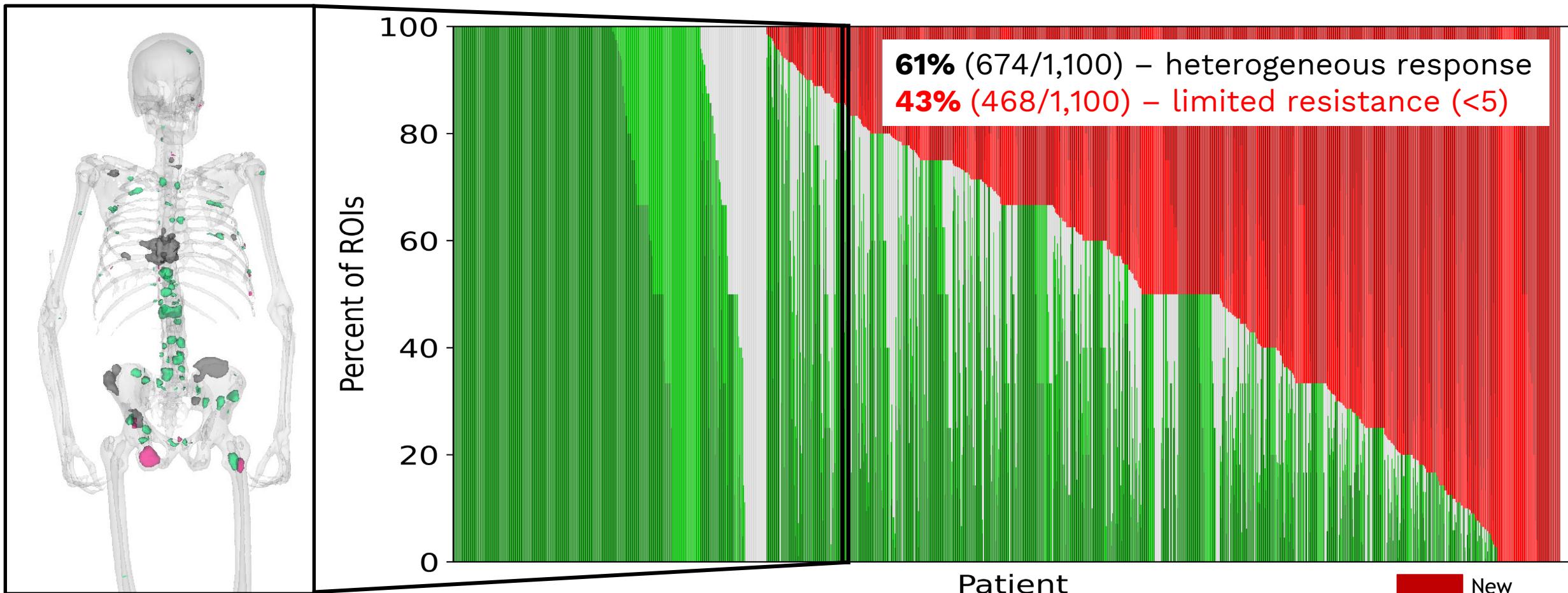


## Temporal Heterogeneity

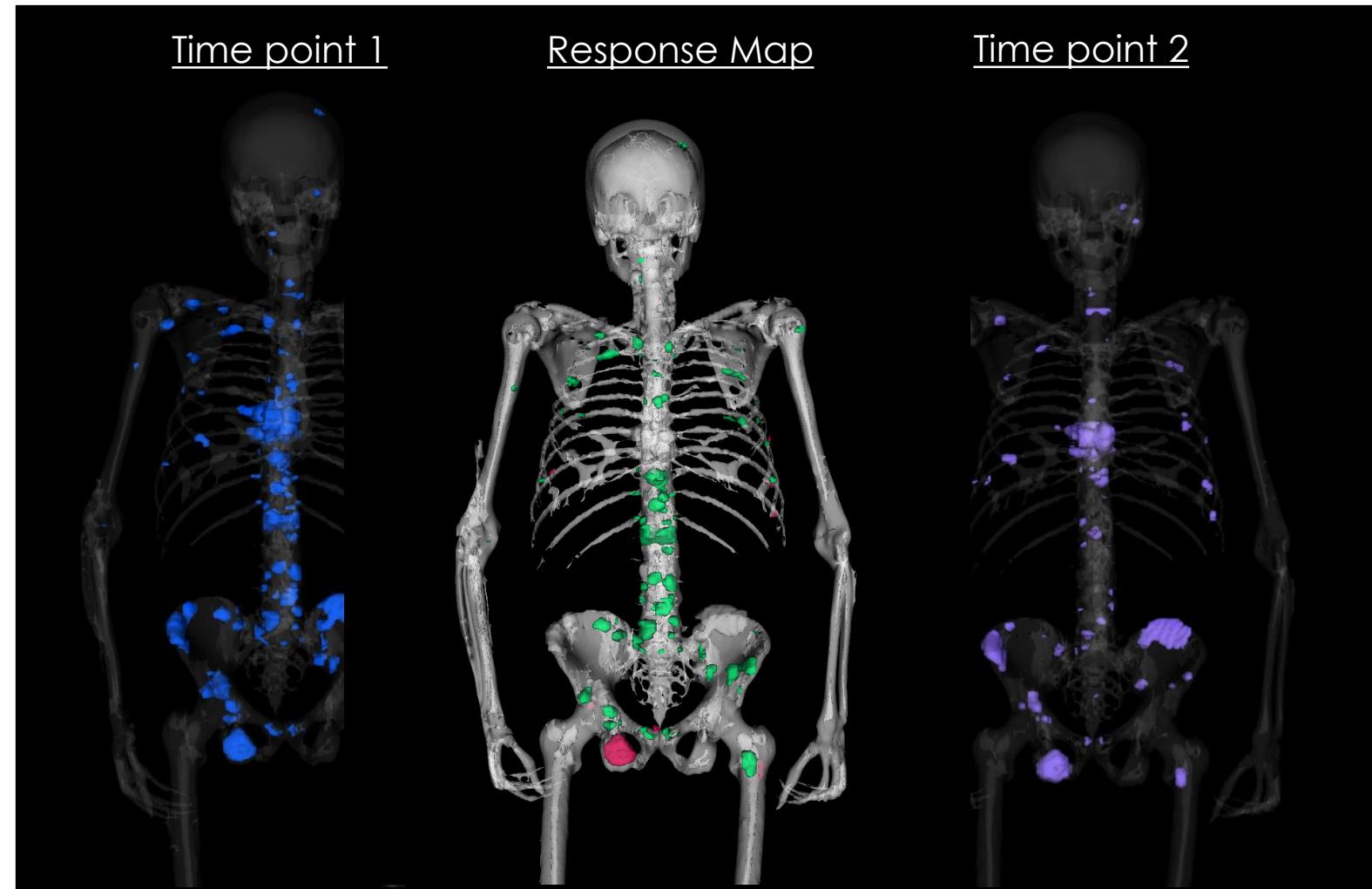
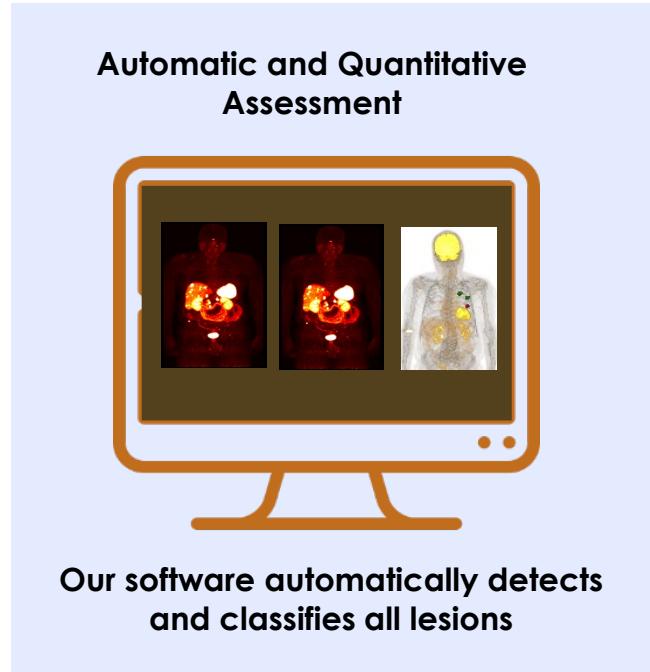
The same disease site may respond differently at different points in time



# Treatment response heterogeneity



# Treatment response assessment – AI-based approach



Responding

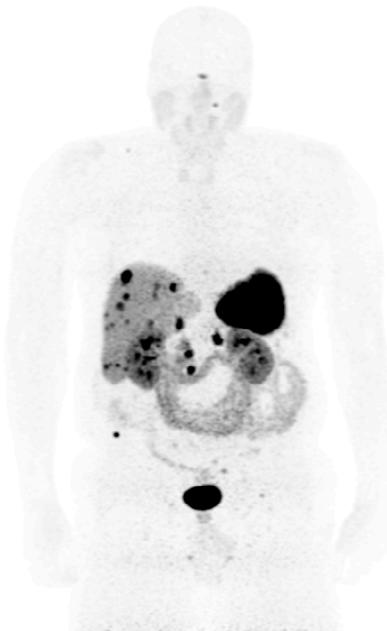


Progressing

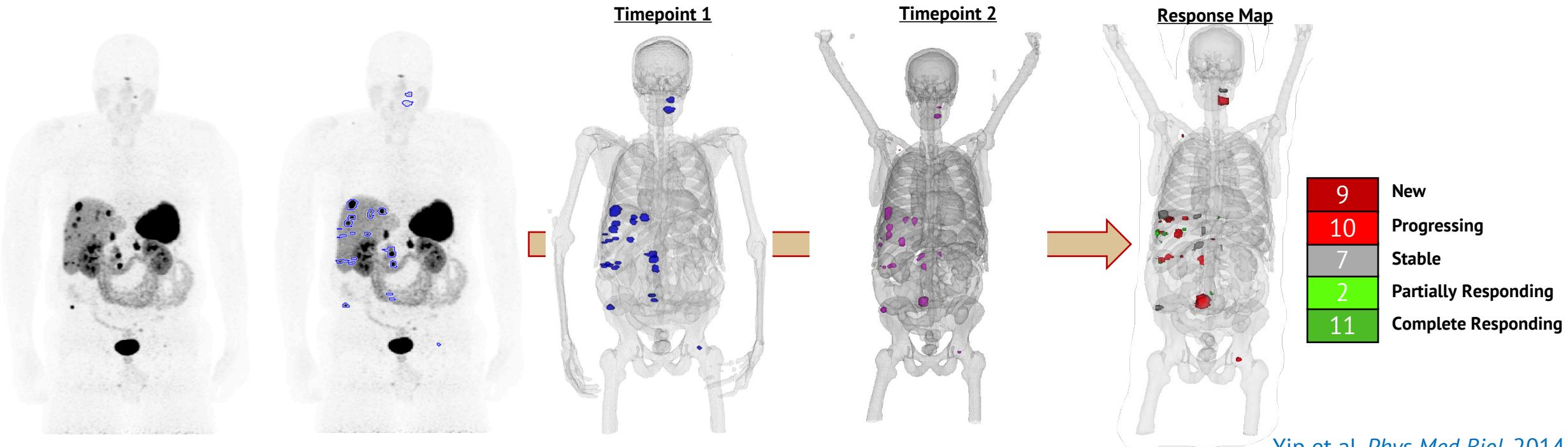
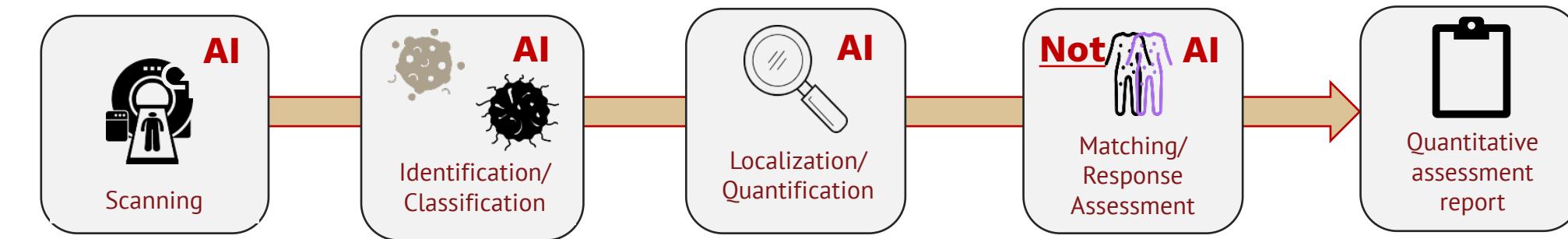


Stable

# Treatment response assessment – AI-supported workflow



# Treatment response assessment – AI-supported workflow

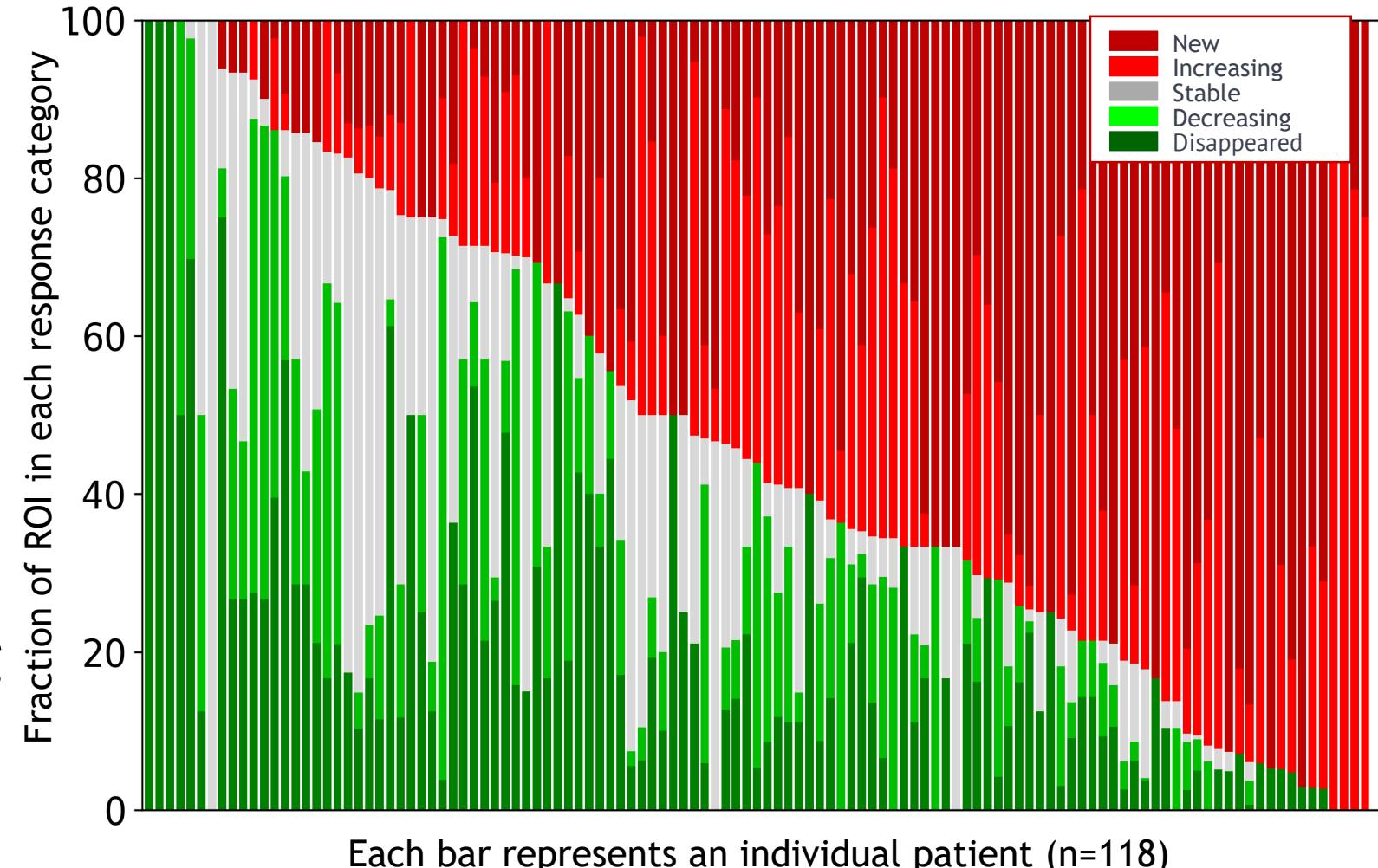


Yip et al. *Phys Med Biol.* 2014  
Santoro-Fernandes et al. *Phys Med Biol.* 2021  
US Patent 9,603,567

# Treatment response heterogeneity

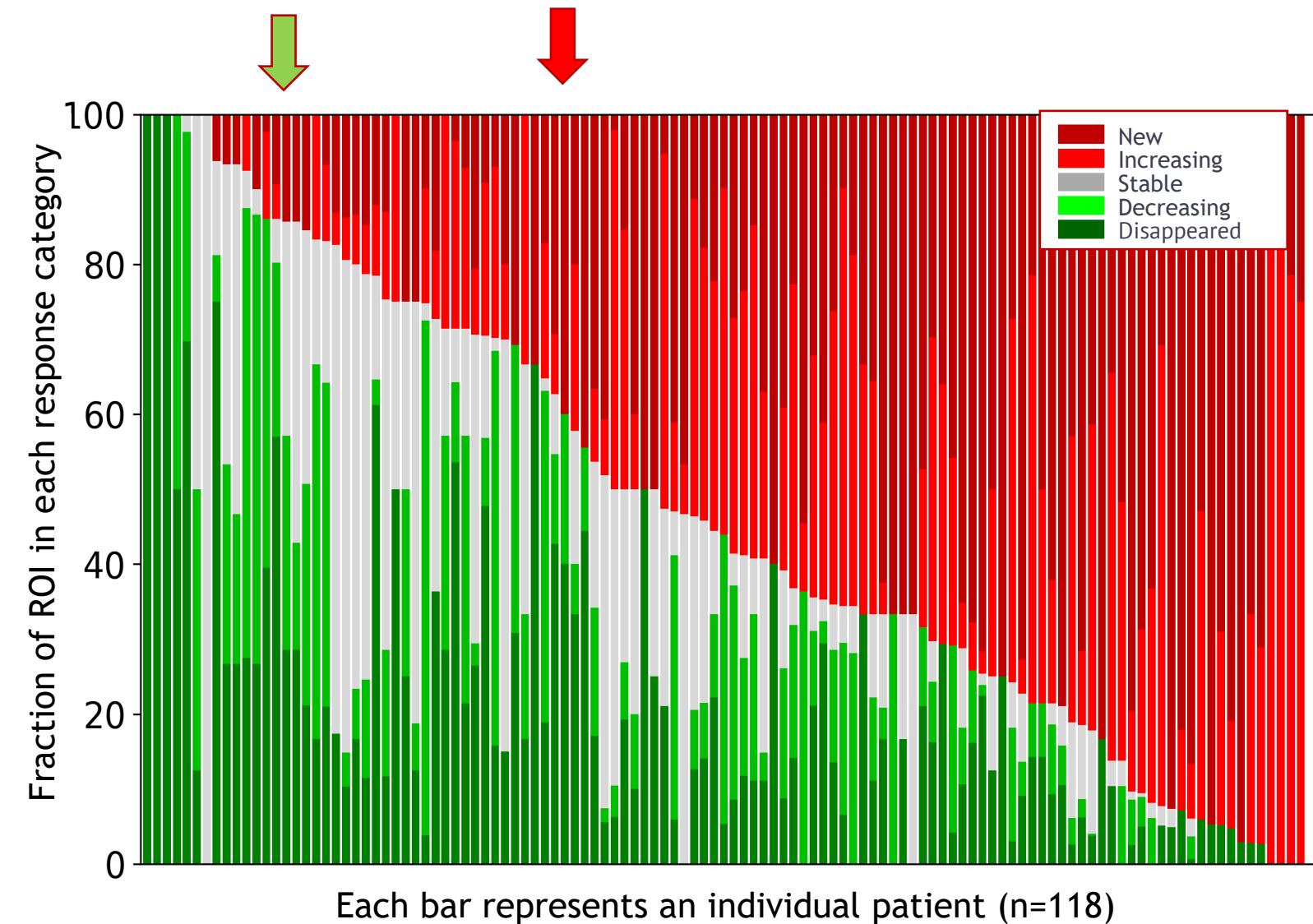
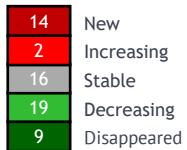
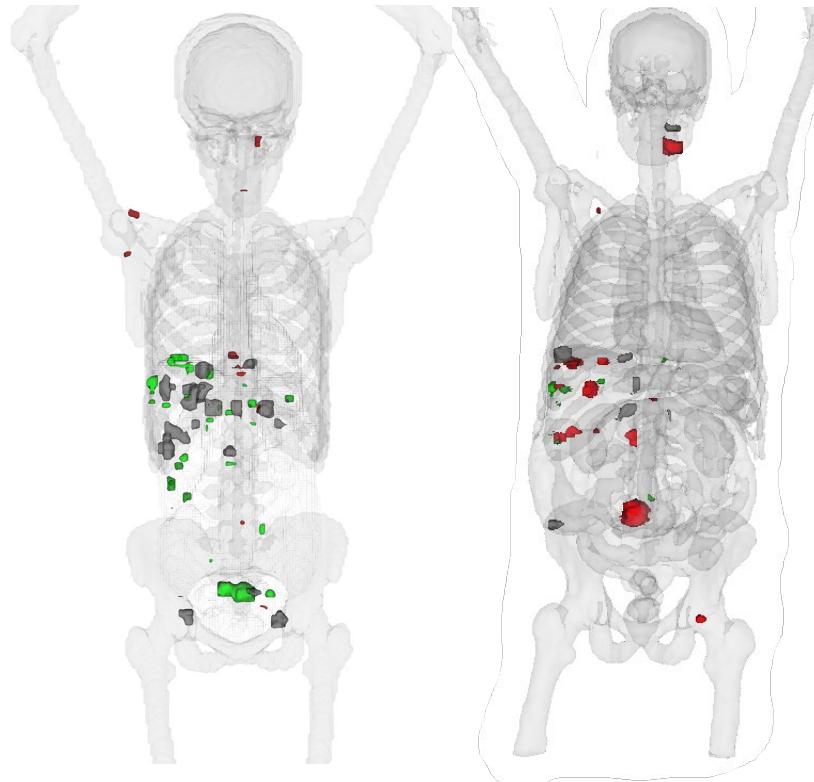
## Spatial heterogeneity

- Retrospective theranostics study of 118 patients
- Sequential  $^{68}\text{Ga}$ -DOTATATE PET/CT imaging during  $^{177}\text{Lu}$ -DOTATATE therapy
- Imaging per standard of care
- **91% (107/118)** of patients simultaneously had increasing and decreasing lesions



# Treatment response heterogeneity

## Spatial heterogeneity



# Treatment response heterogeneity

## Temporal heterogeneity

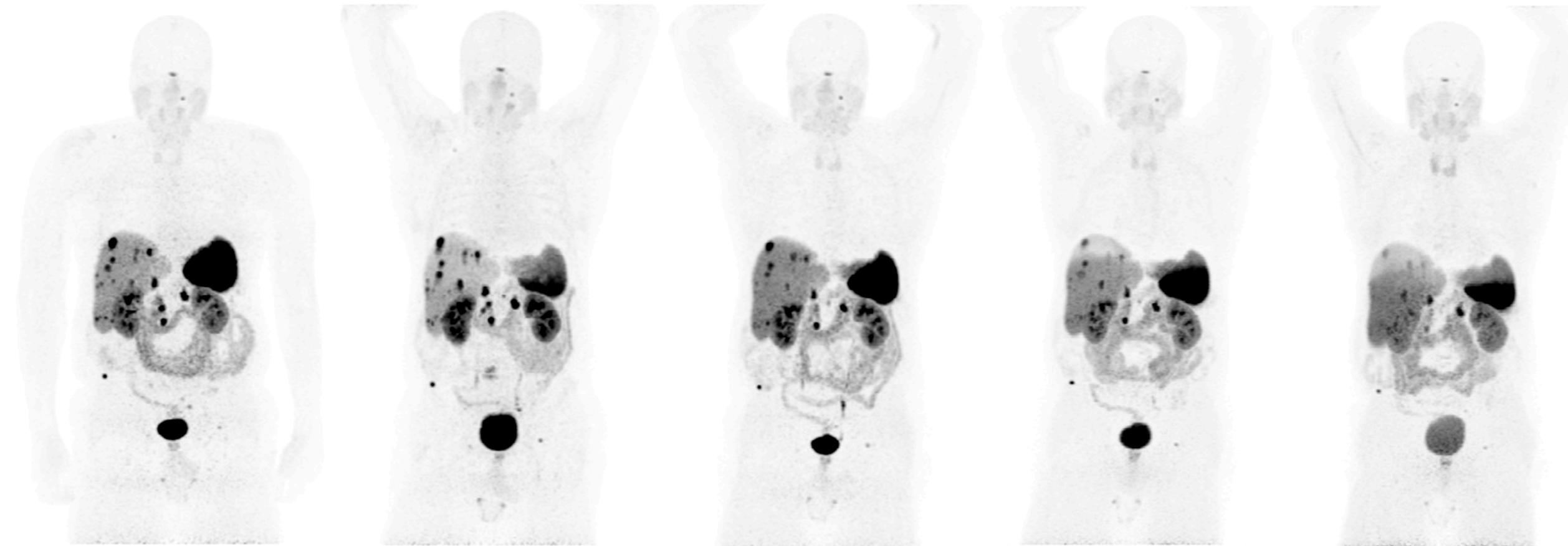
Scan1

Scan2

Scan3

Scan4

Scan5

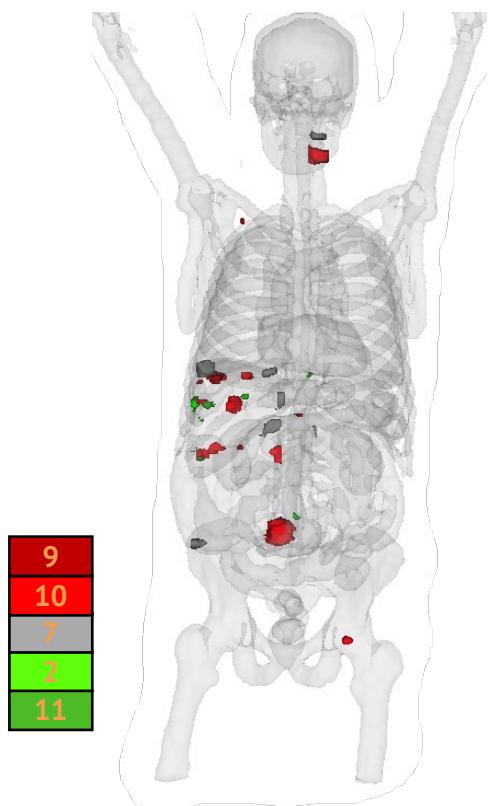


Sequential <sup>68</sup>Ga-DOTATATE PET/CT imaging during Lutathera therapy

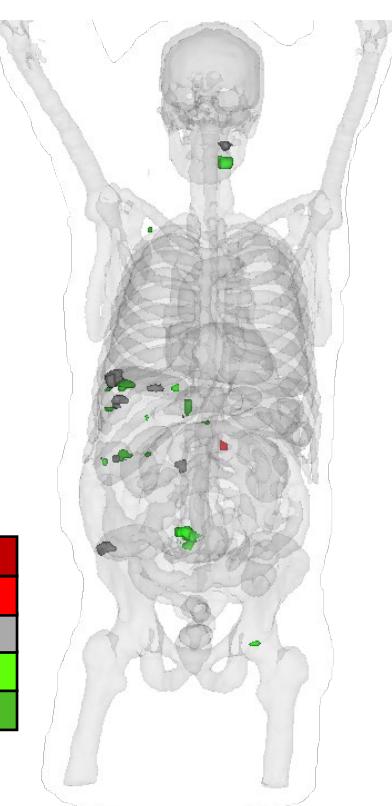
# Treatment response heterogeneity

## Temporal heterogeneity

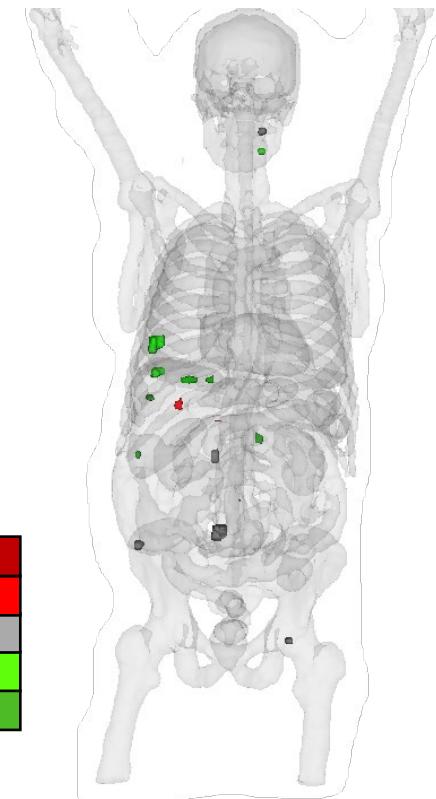
Scan1 to Scan2  
Response



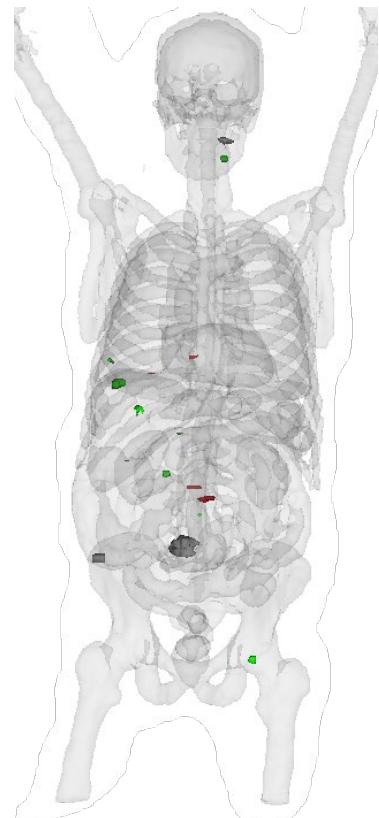
Scan2 to Scan3  
Response



Scan3 to Scan4  
Response

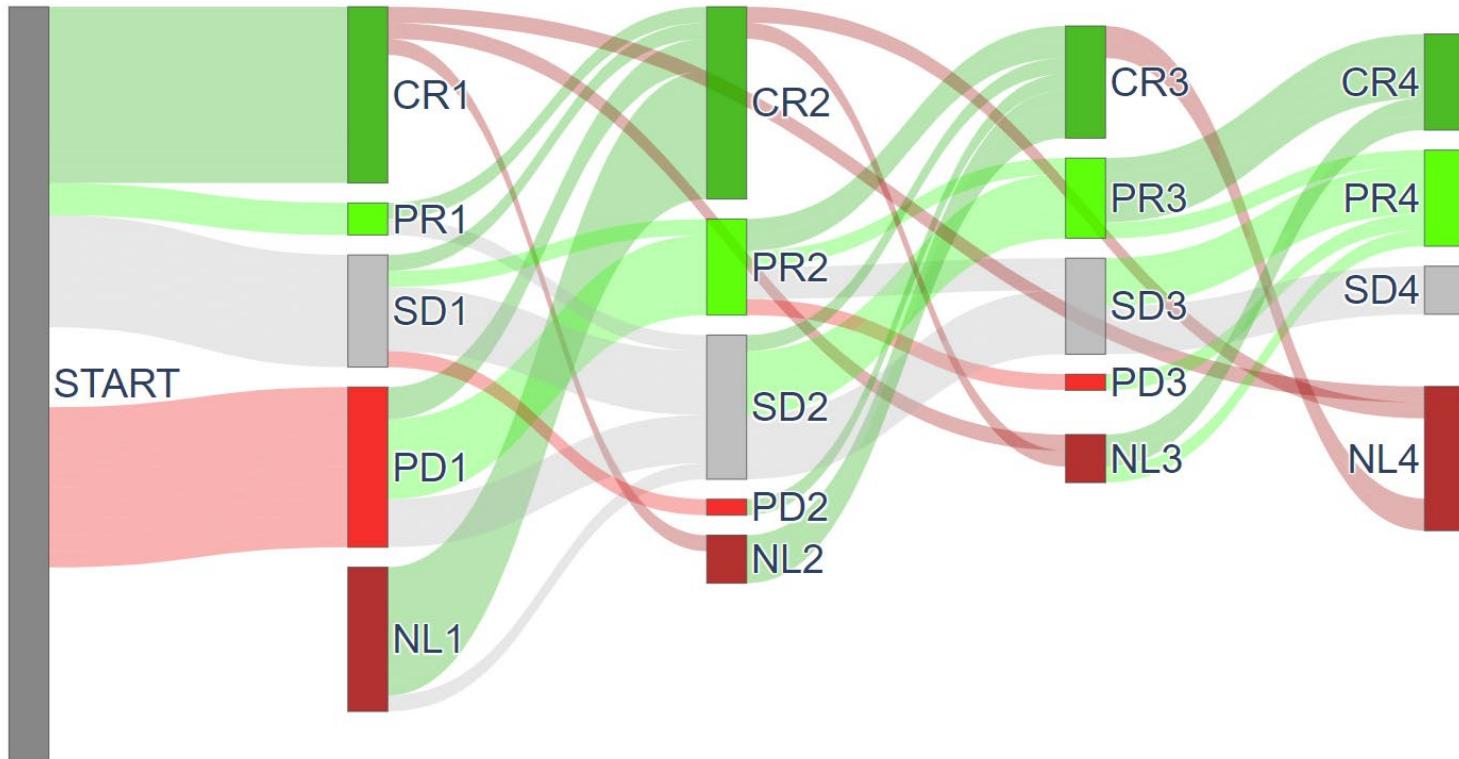


Scan4 to Scan5  
Response



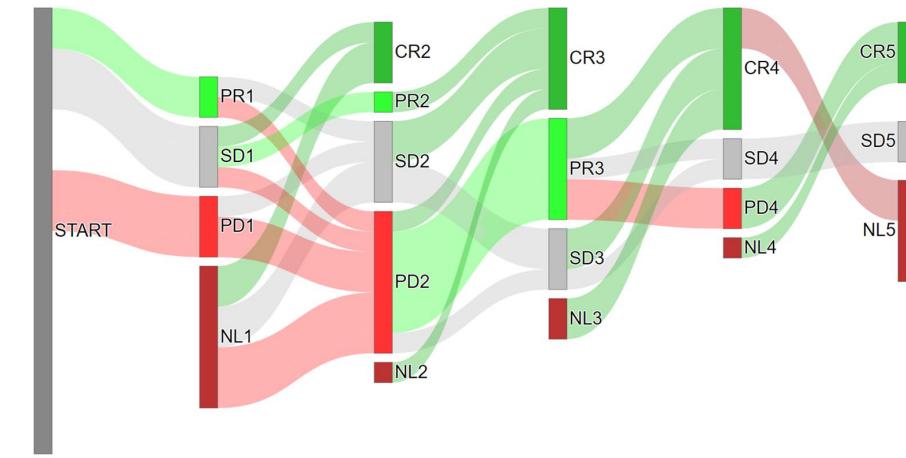
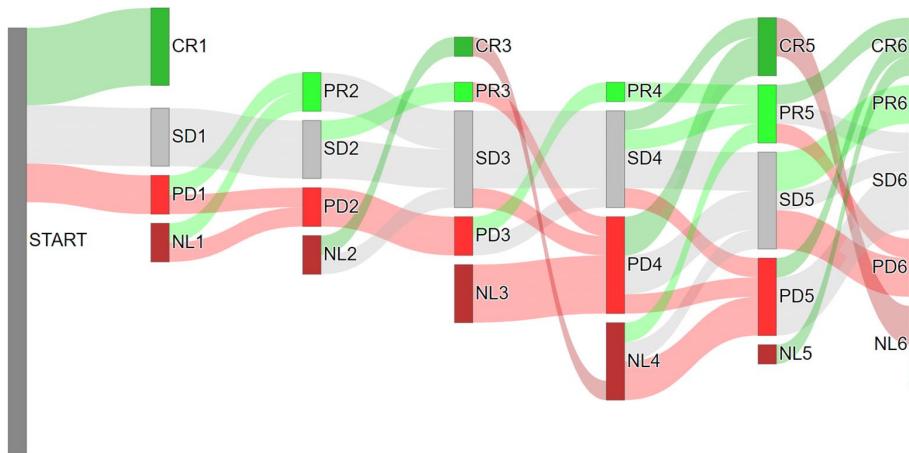
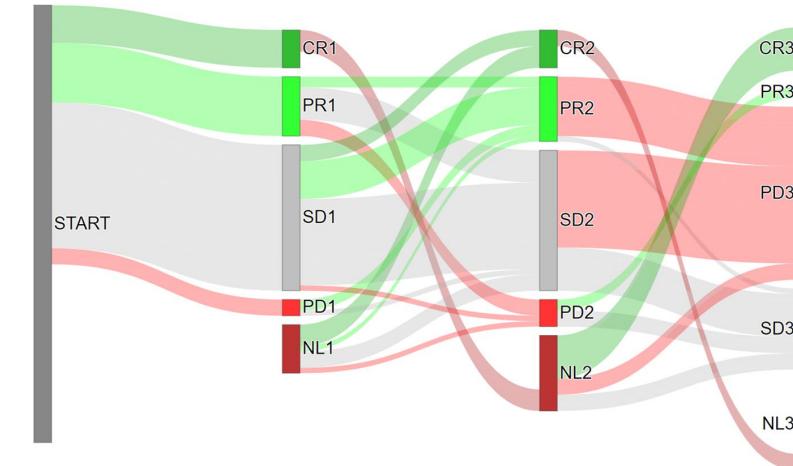
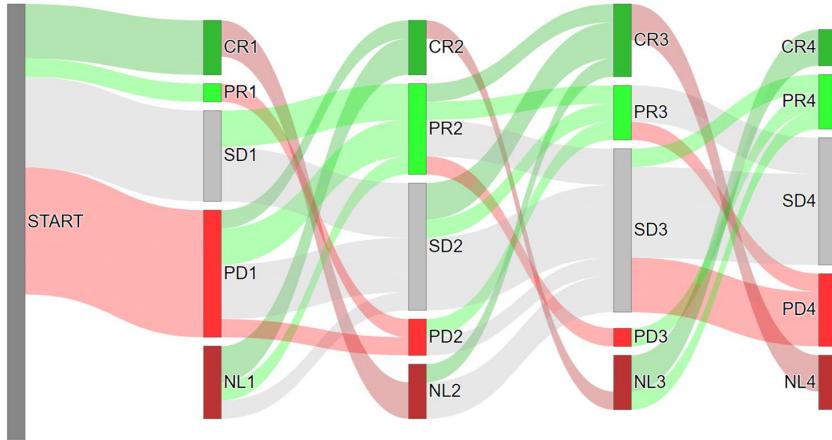
# Treatment response heterogeneity

## Temporal heterogeneity



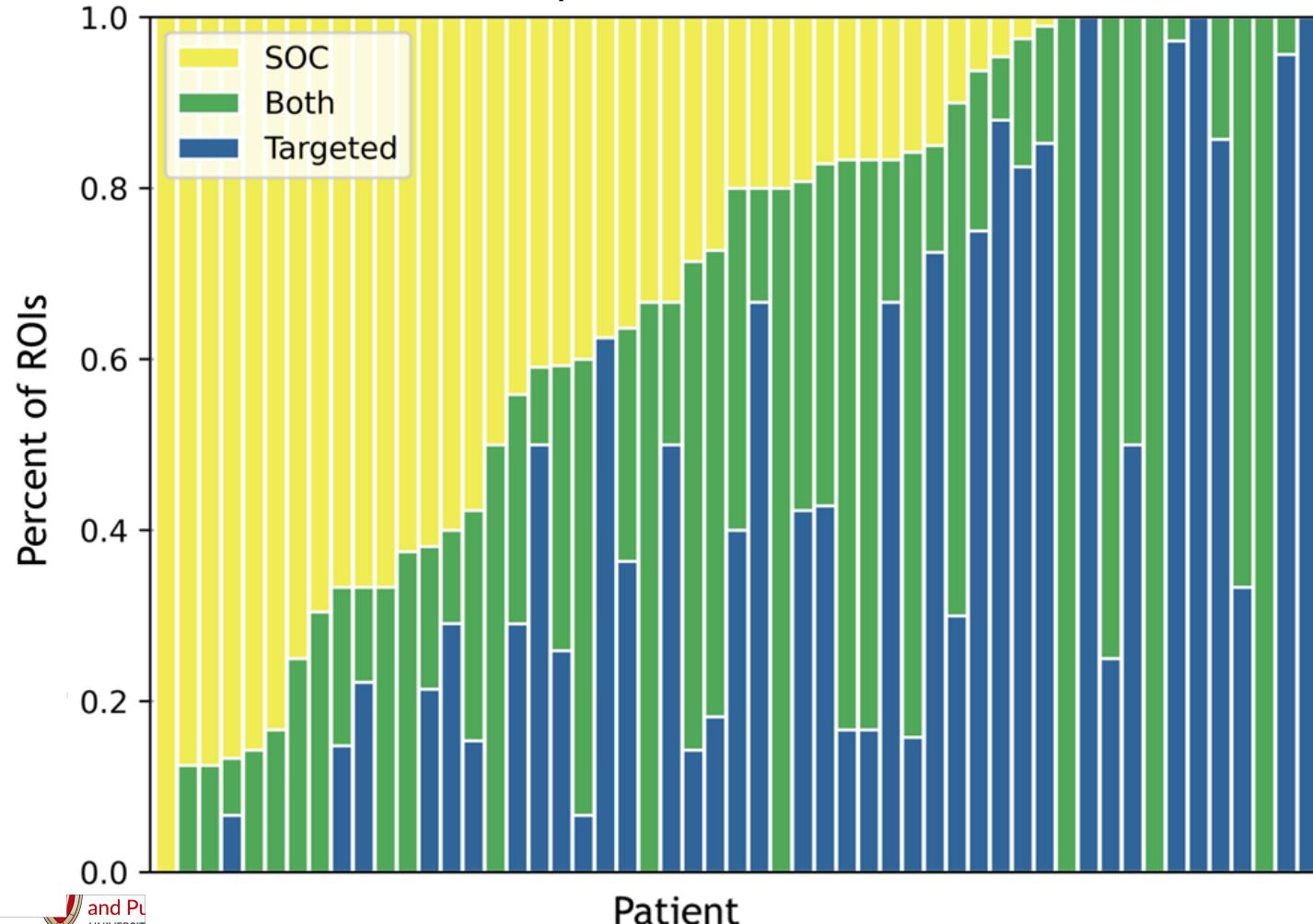
# Treatment response heterogeneity

## Temporal heterogeneity



# Why is this?

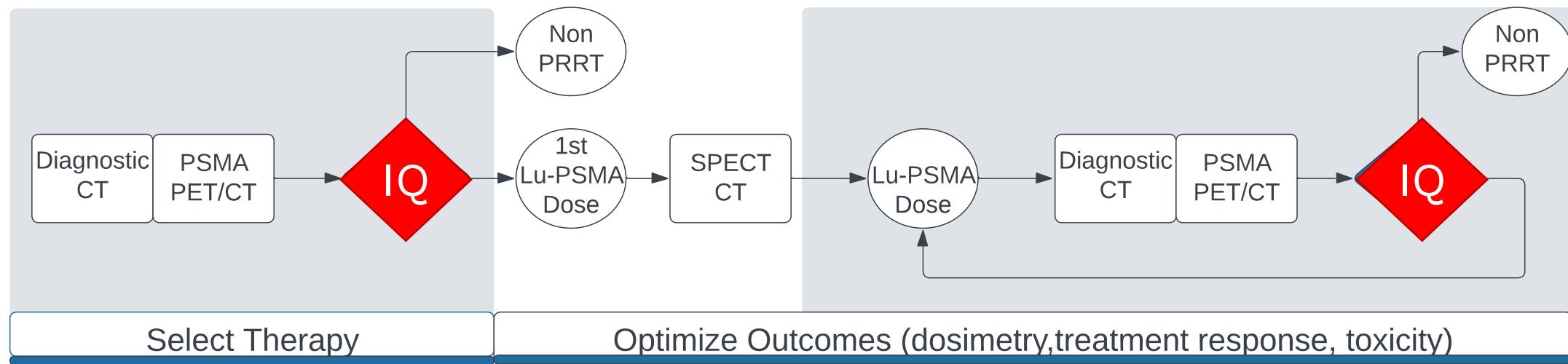
Cu-DOTATATE, Ga-DOTATATE, FES, PSMA, or FAraG with CT or FDG (53 patients)



- Only 23% of patients all lesions identified by the targeted tracer
- 77% of patients have lesions found by standard of care imaging, missed by targeted tracers
- 66% of patients have 5 or fewer lesions missed by the targeted tracer

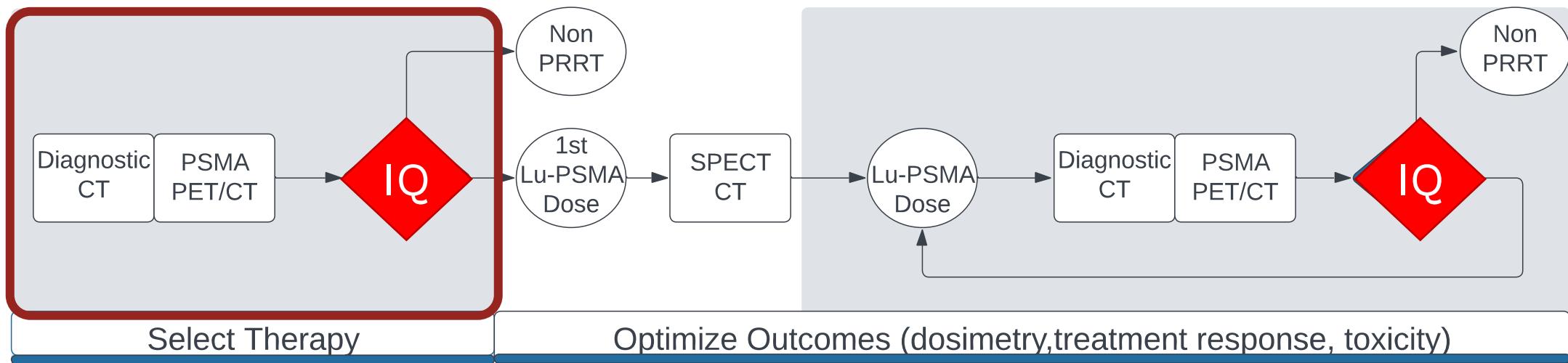
# How can we optimize treatments?

## Theranostics example



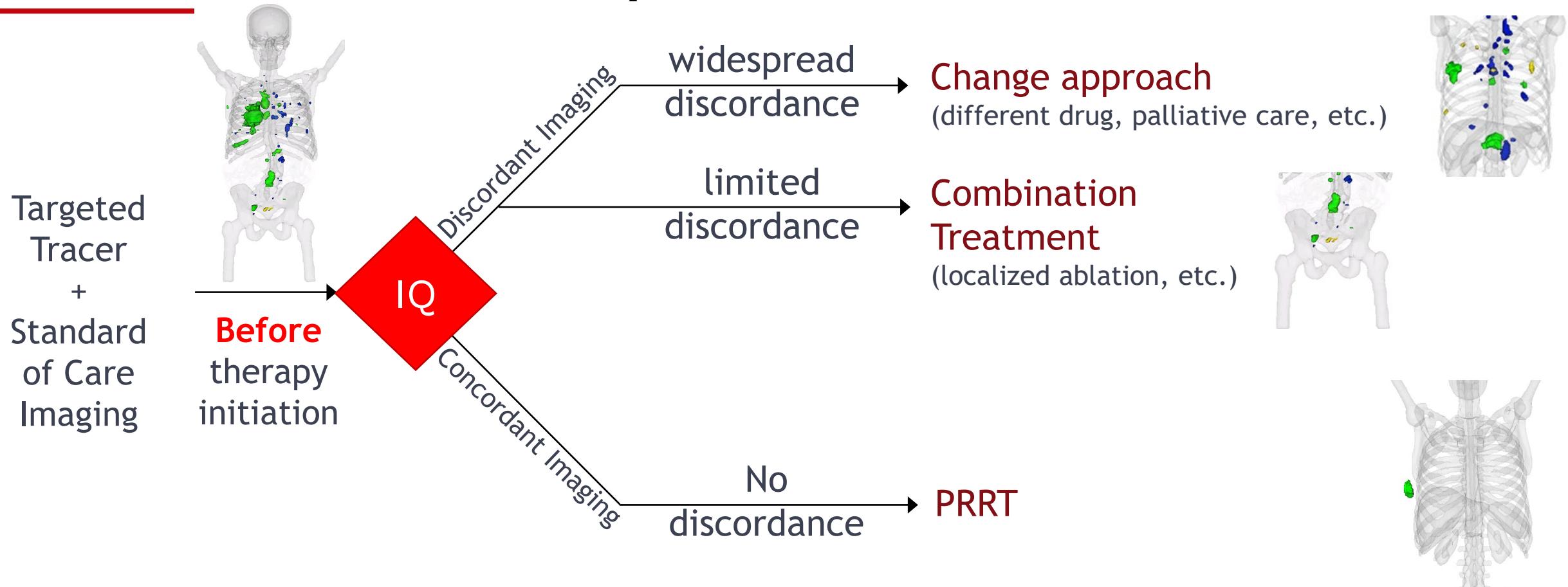
# How can we optimize treatments?

## Theranostics example



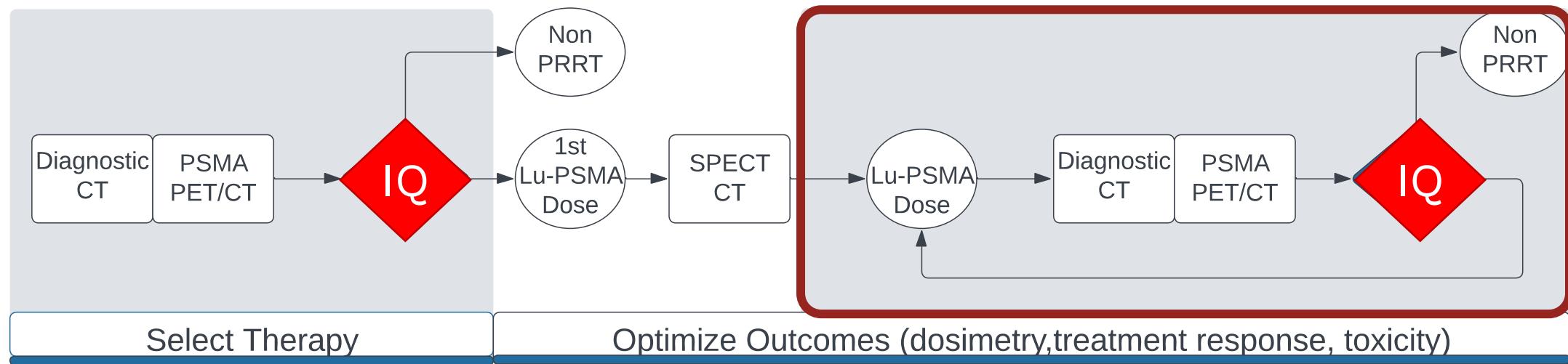
# How can we optimize treatments?

## Theranostics example



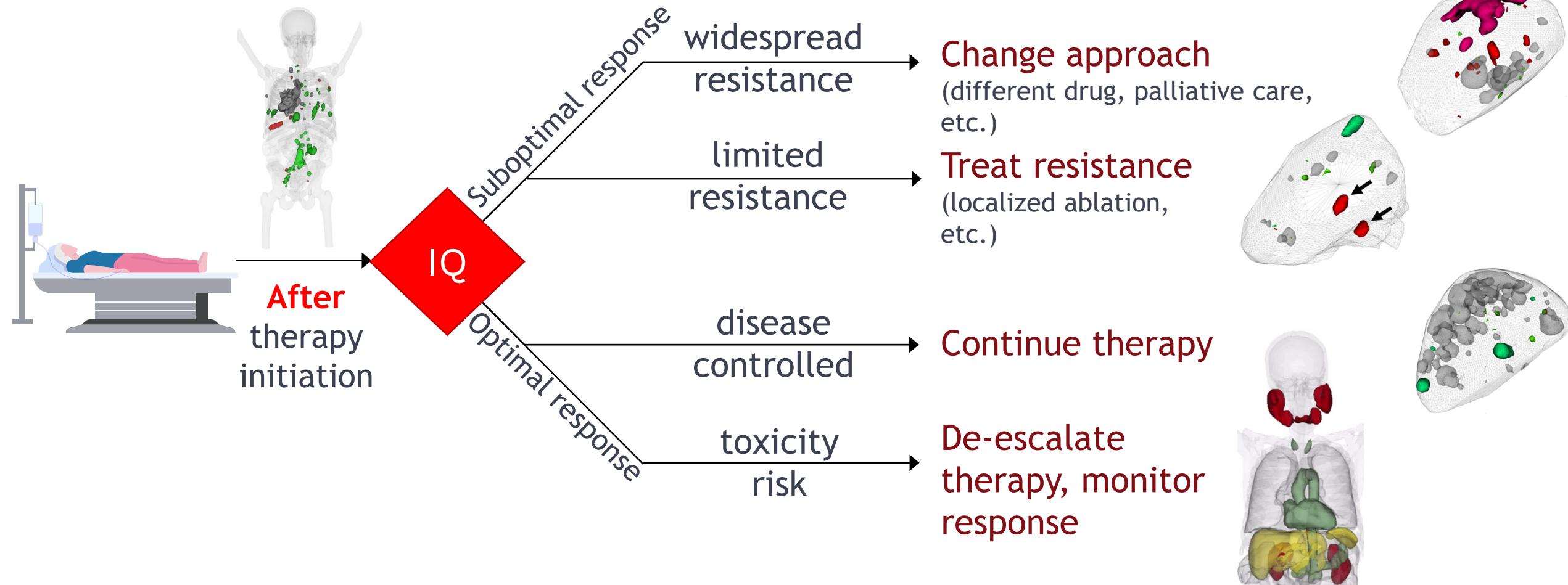
# How can we optimize treatments?

## Theranostics example

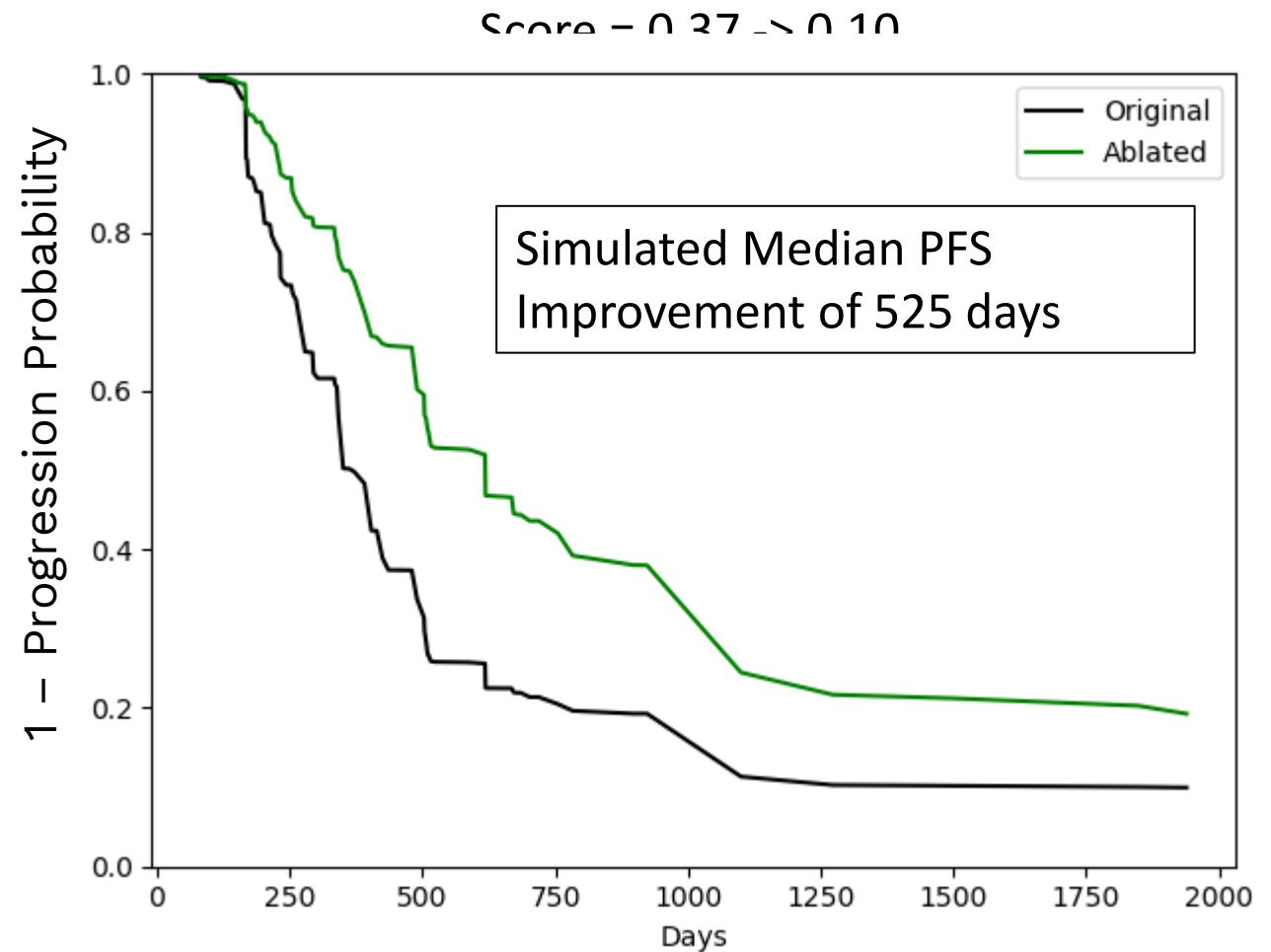
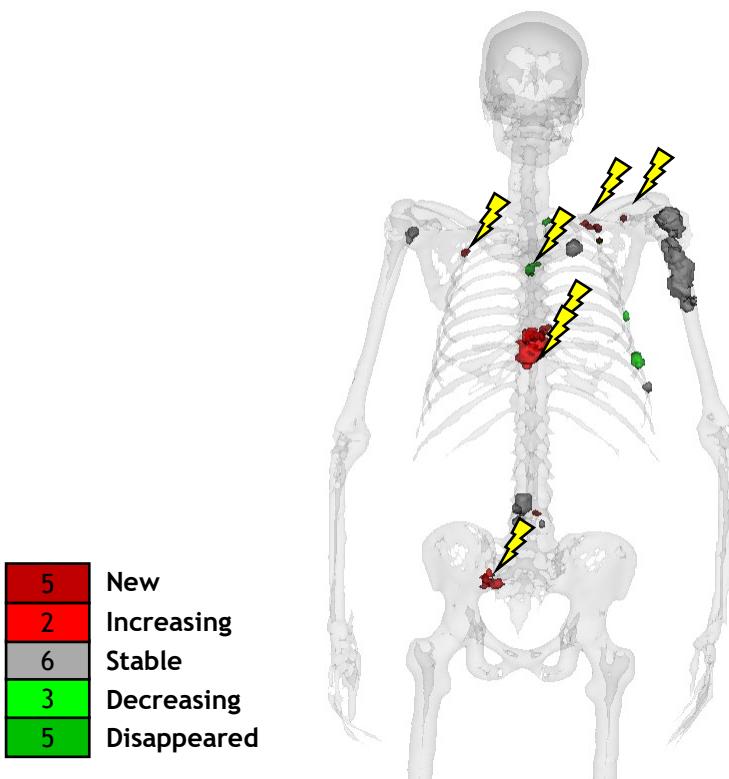


# How can we optimize treatments?

## Theranostics example



# Targeting individual lesions



# Summary

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- **Optimizing cancer treatments is complex:**
  - Balancing risks and benefits of individual patients
  - Accounting for spatial and temporal (response) heterogeneity
- **Decision making in radiotheranostics has two critical points:**
  - Treatment selection - is patient a good candidate (concordance analysis)
  - Treatment optimization - how much/how long to treat (response analysis)
- **Impact on HTA:**
  - Treatment selection – radiotheranostics is not cost effective for all patients!
  - Treatment optimization – more RPT does not always mean improved QoL!

# Thanks to:

## Research groups:



University of Wisconsin, WI, USA



University of Ljubljana, Slovenia

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# Thank you for your attention