

Omics and AI for PROTON

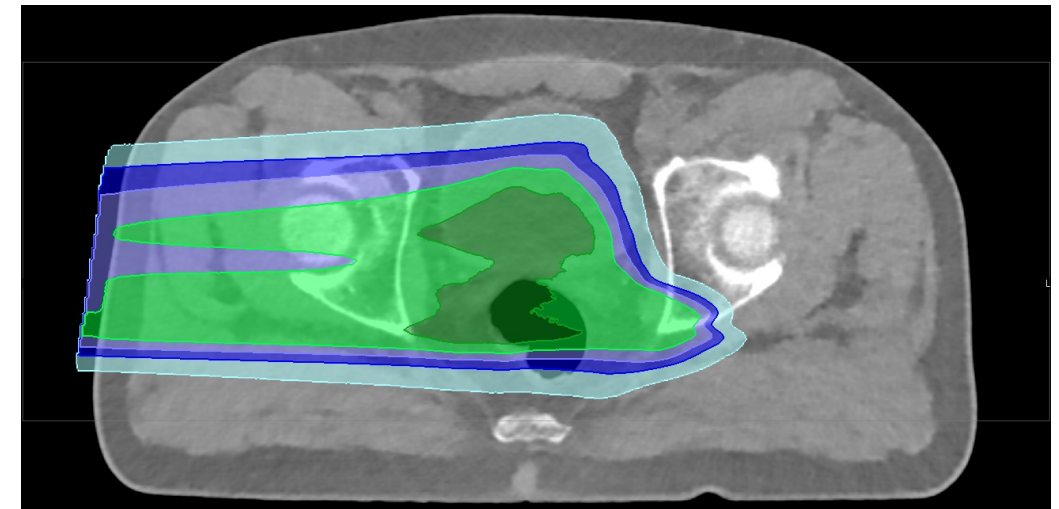
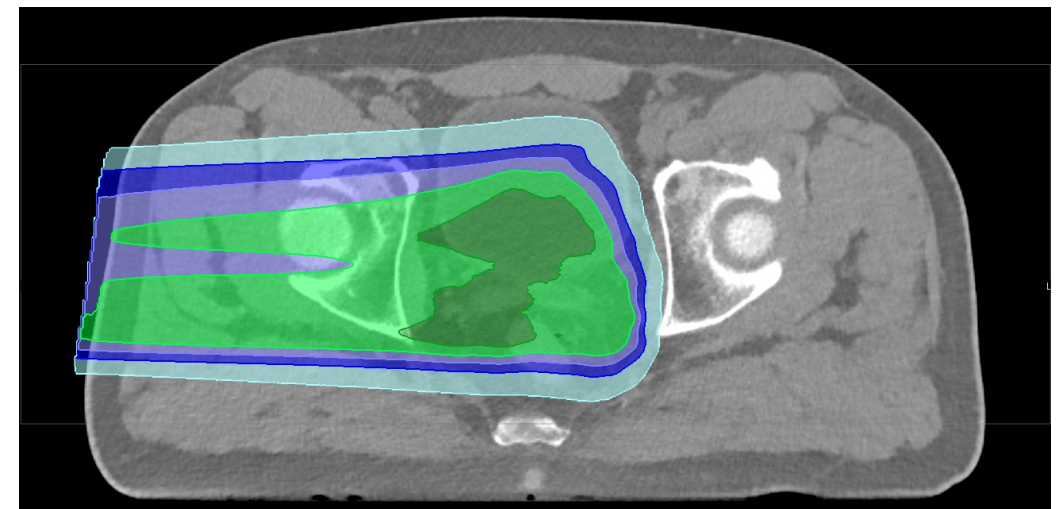
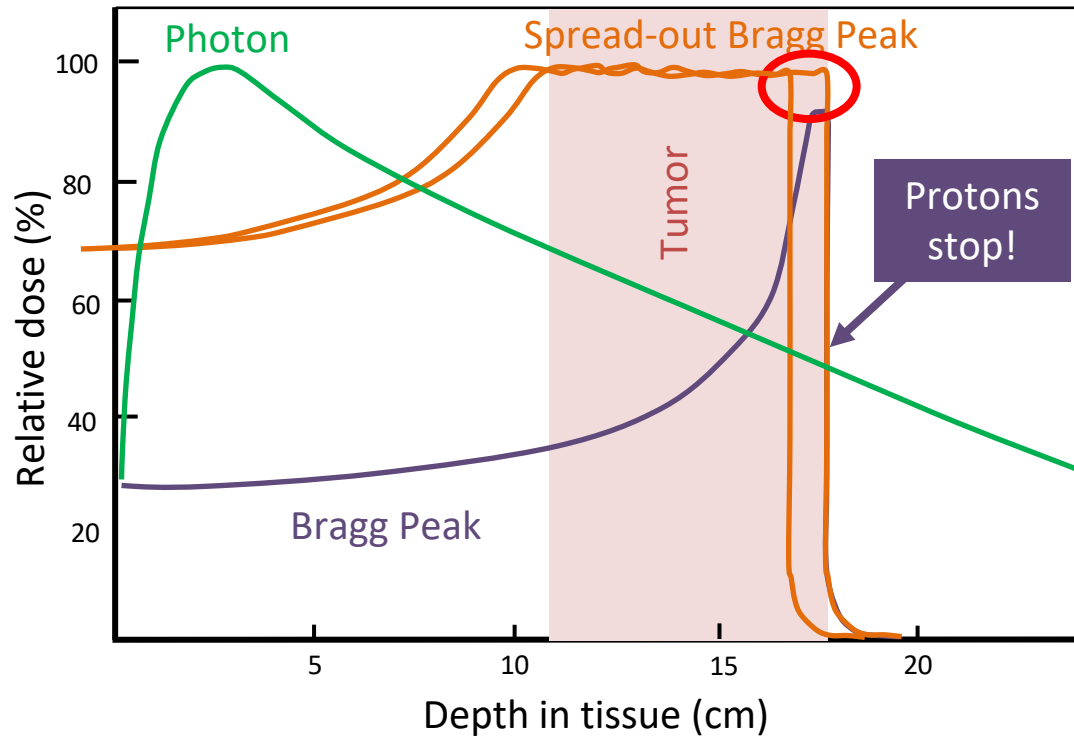
Selection beyond the standard: practice impact and next steps

Dr. Fabian Hennings, 18. October 2022

I. general challenges in PROTONS

I.a anatomical changes

Finite range:

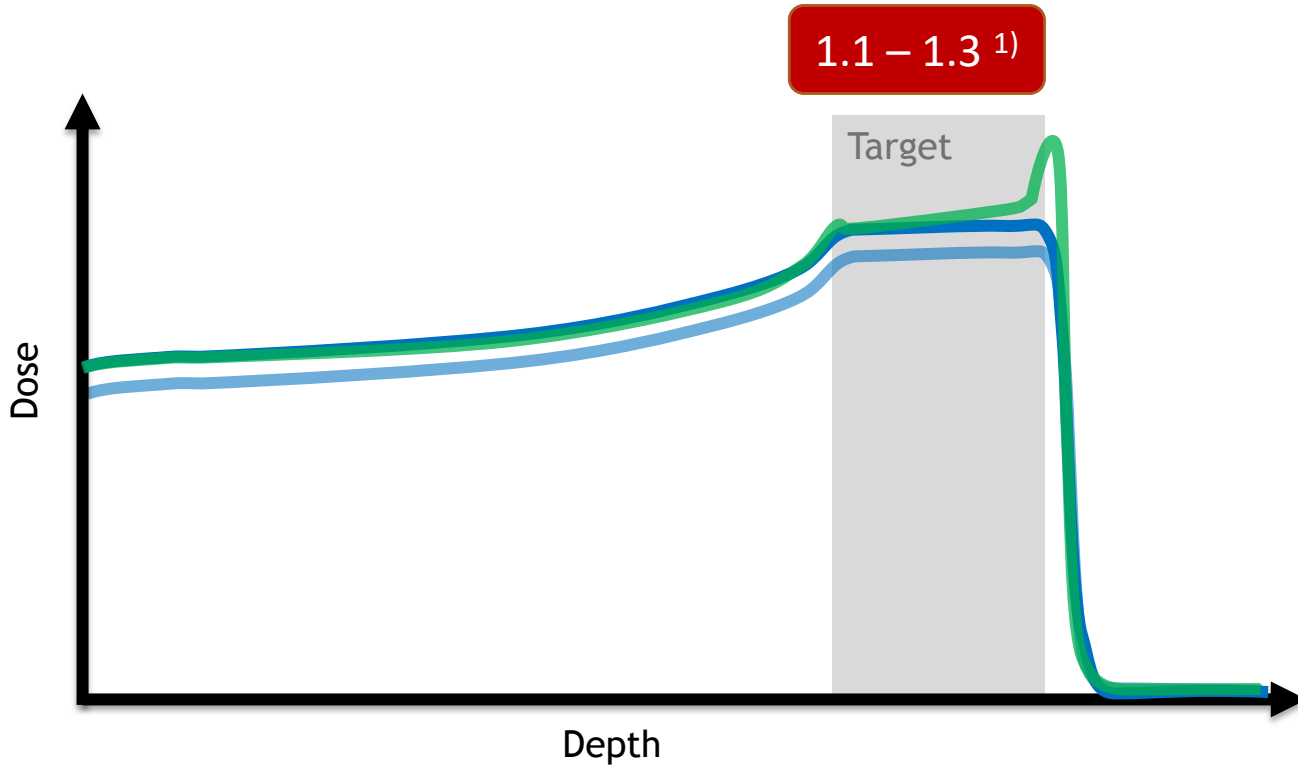


change in anatomy → change in delivery!

Images by: J. Pietsch & Dr. K. Stützer

I.b variable RBE

Relative Biological Effectiveness (RBE):



→ Clinical Standard: RBE-photons + 10%

→ variable RBE: $\Delta RBE \sim x * 10\%$
(in the plateau region)

→ RBE \sim physical dose, LET, tissue

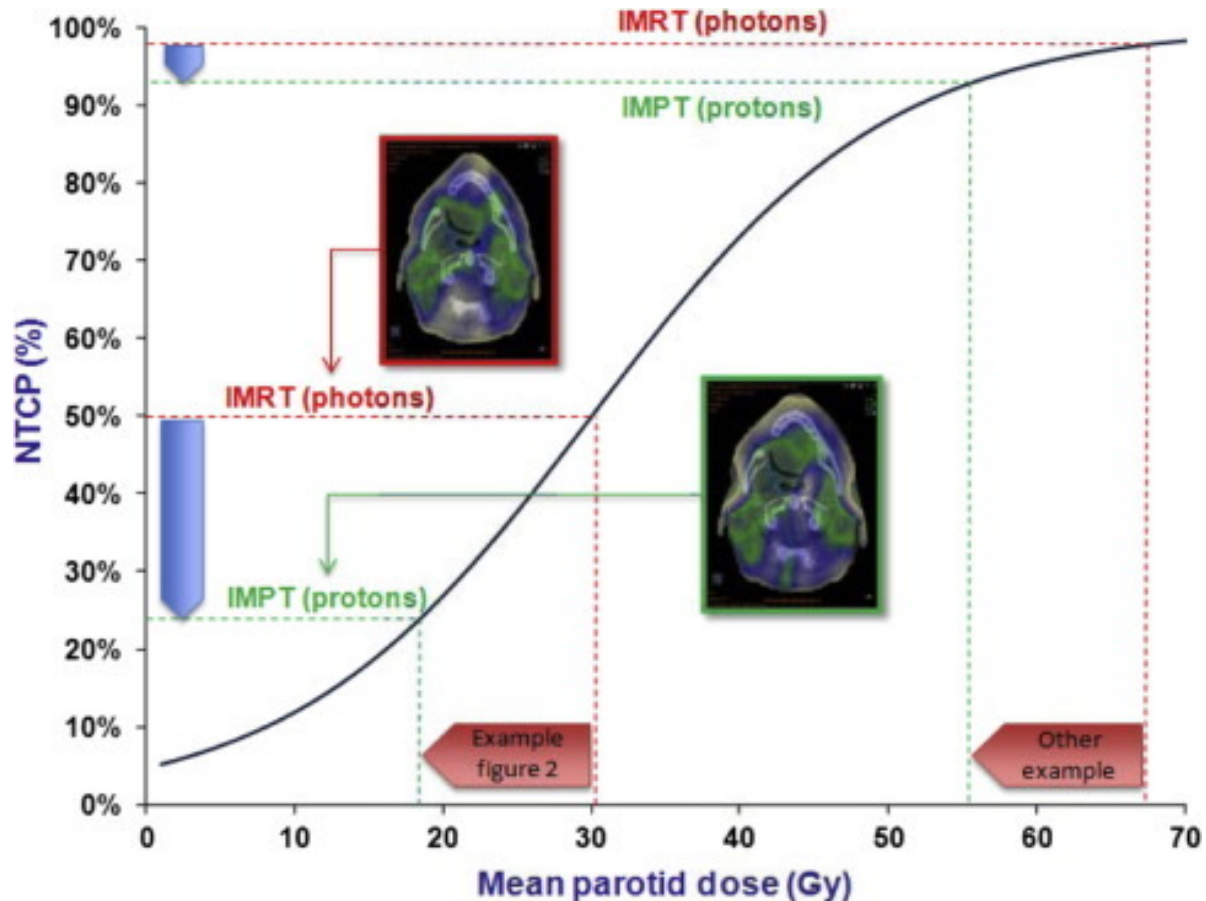
Animation by: M. Palkowitsch

¹⁾ Relative biological effectiveness in proton beam therapy – Current knowledge and future challenges, Lühr, 2018

II. Clinical benefit

How to contribute to the wellbeing of patients?

Finding the fitting treatment for the individual patient!



Model based treatment selection:

- Organs at risk ~ Clinical endpoints
- Estimate clinical benefit
- Δ NTCP \rightarrow treatment selection

Langendijk, 2013, Selection of patients for radiotherapy with protons aiming at reduction of side effects: The model-based approach

II.a global scale

Finding the fitting treatment for the individual patient!

- simulate variable RBE dependencies
- dose for OaR → NTCP models
(Dosiomics/Radiomics?)
- evaluate on level of sideeffects!
- → Decision Support System (AI)

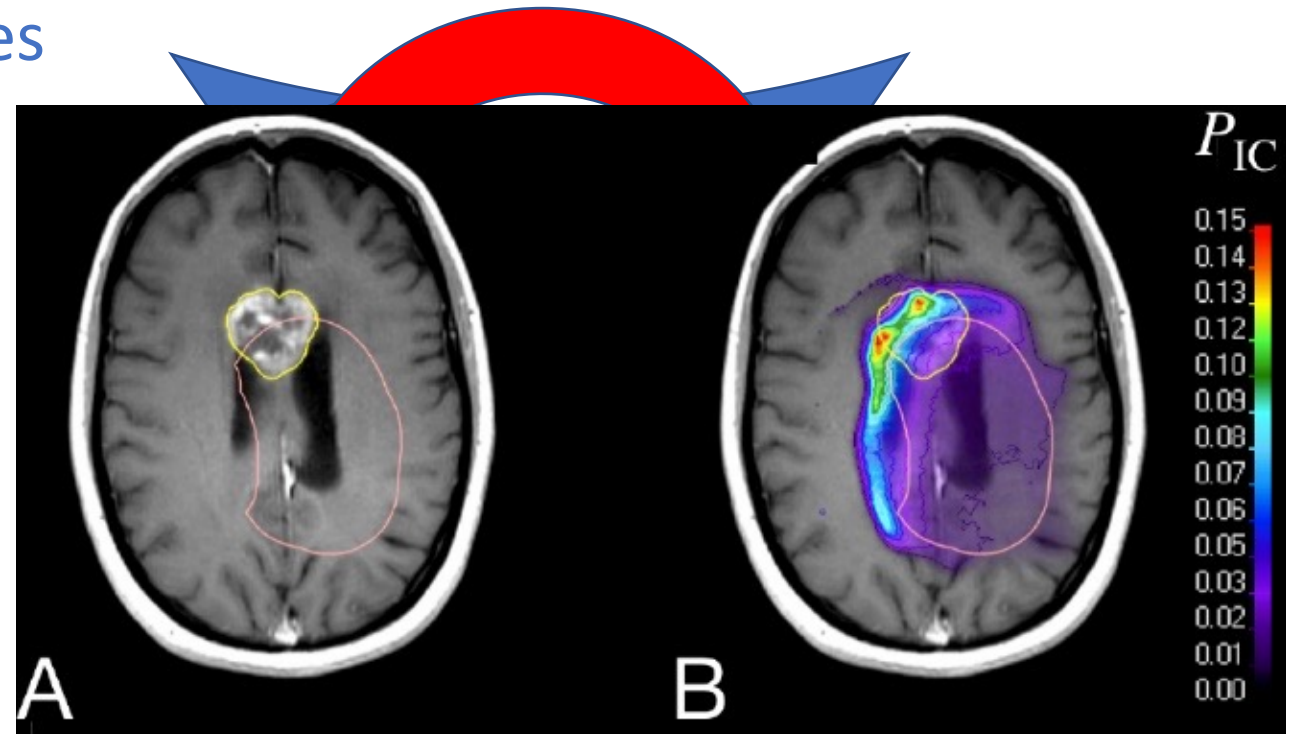
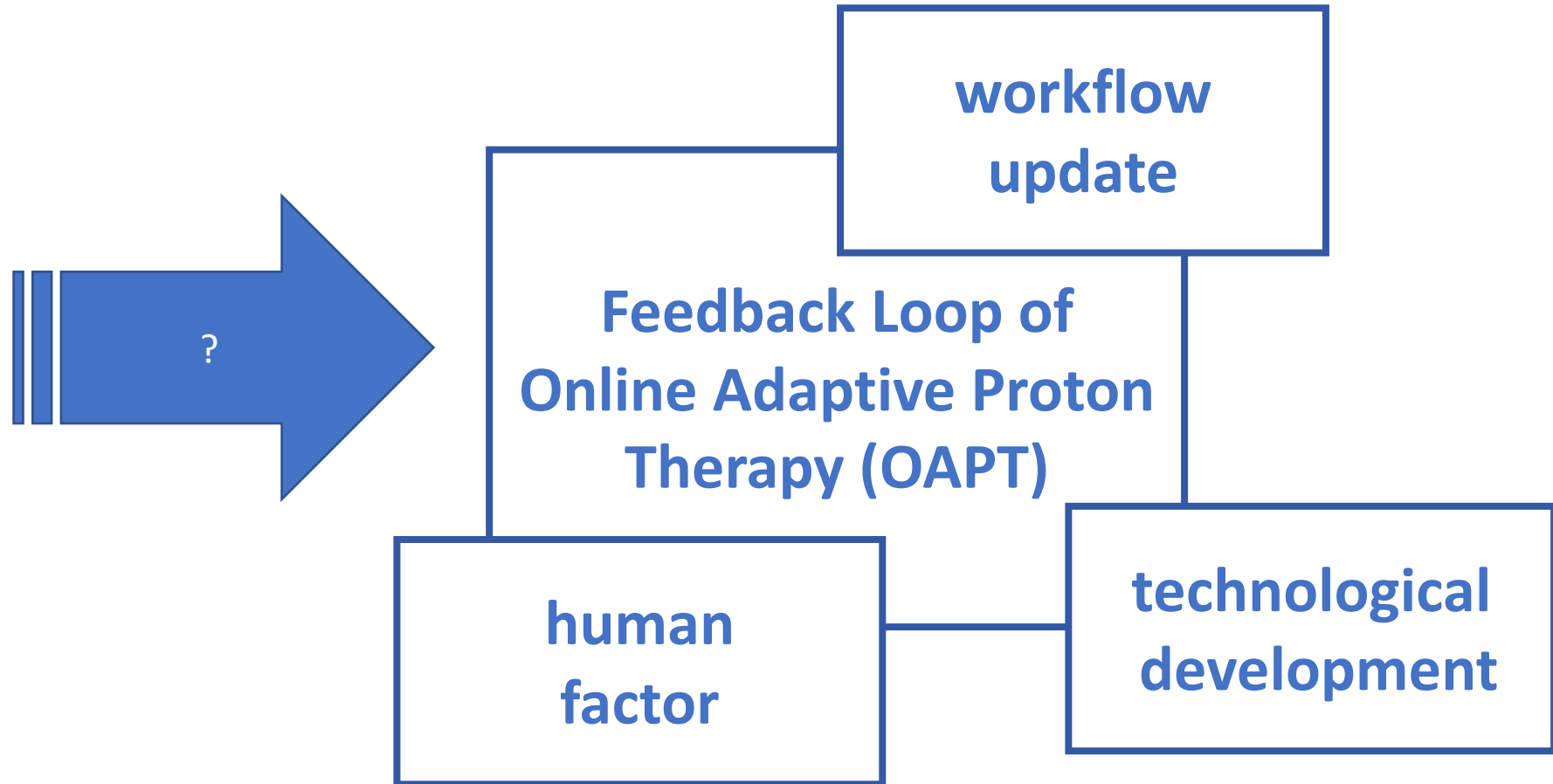
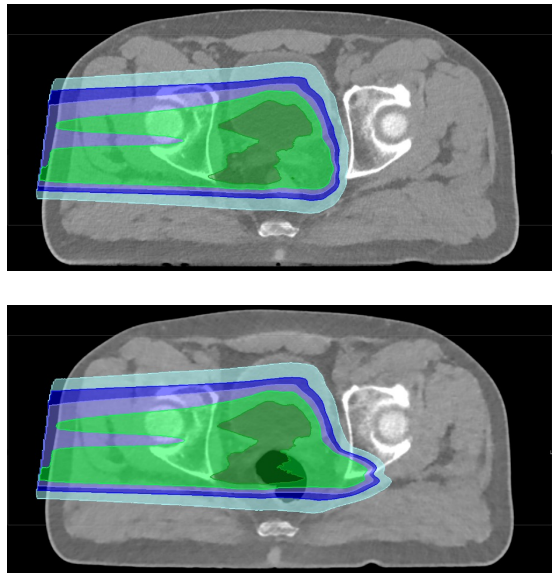


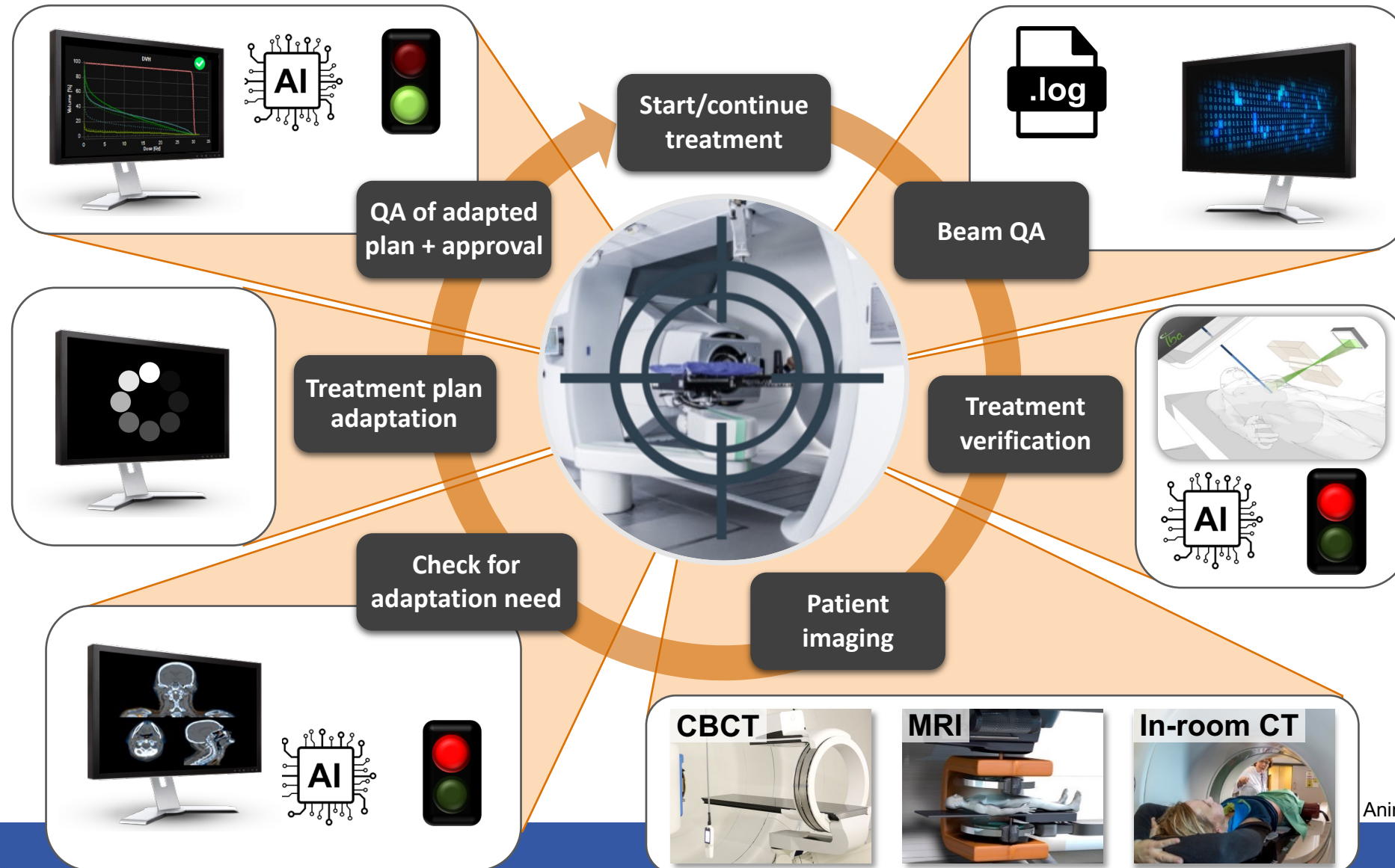
Image: A Monte Carlo based radiation response modelling framework to assess variability of clinical RBE in proton therapy, Eulitz, 2019

Adapting the plan due to the actual anatomy



III. practical impacts of OAPT

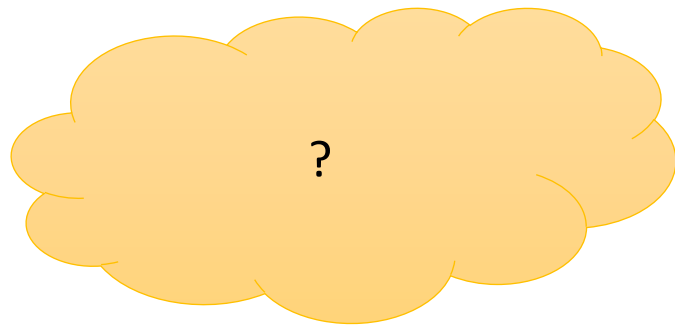
III.a OAPT workflow



Animation: J. Berthold & J. Pietsch

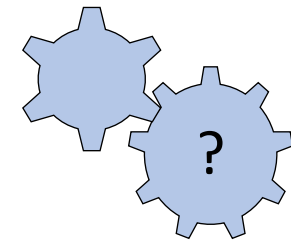
III.b aspects of AI development

interaction

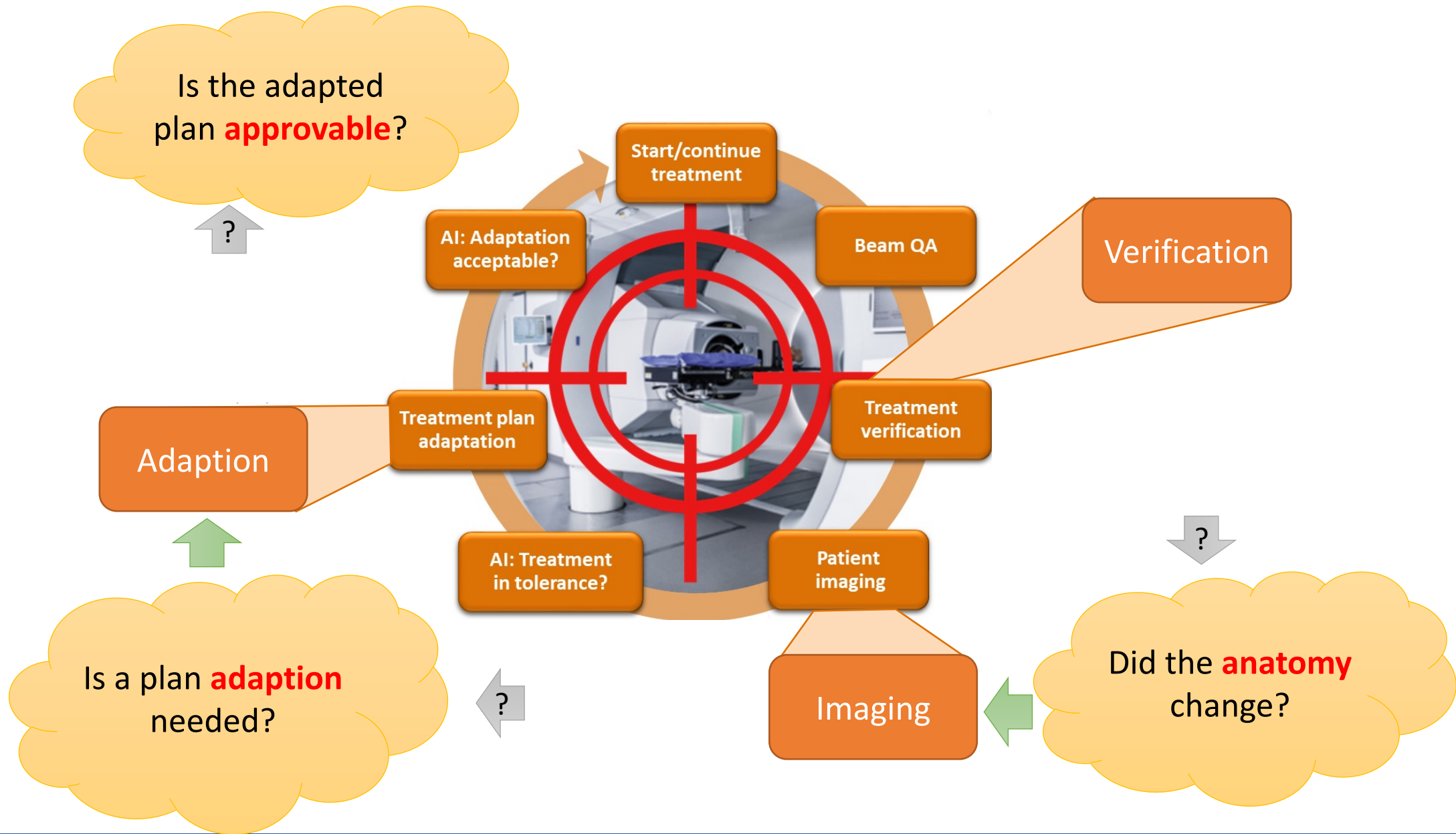


- Condensing data (5 facts at a time)
- Presenting information
- transparency
- Supporting decisions

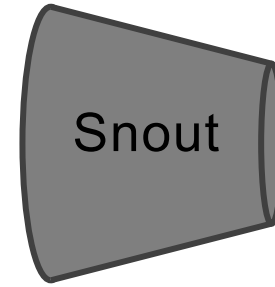
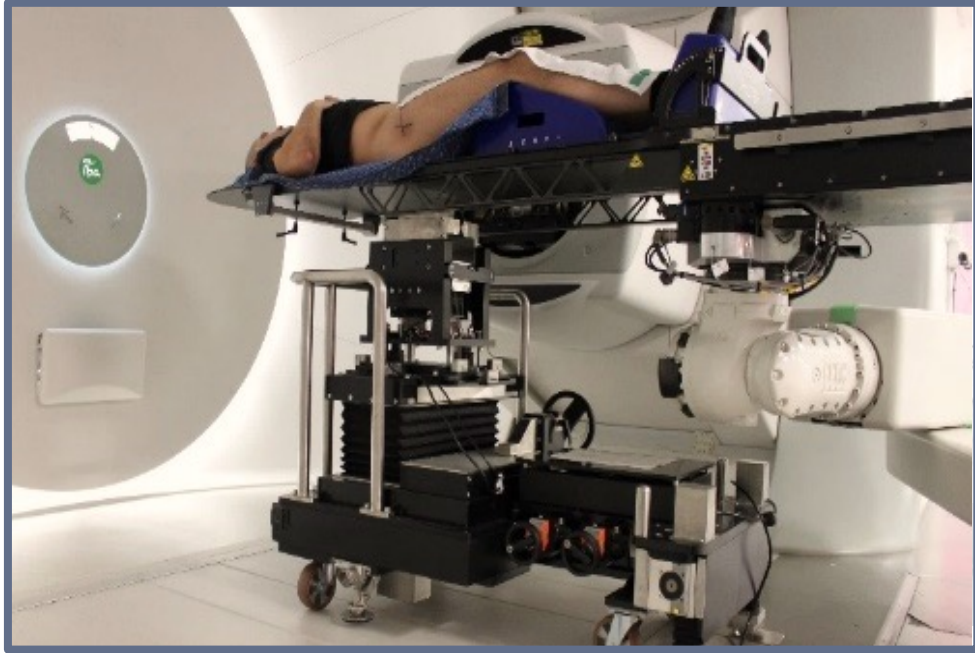
technological



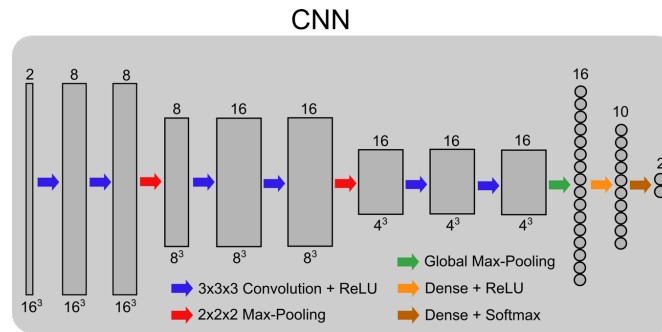
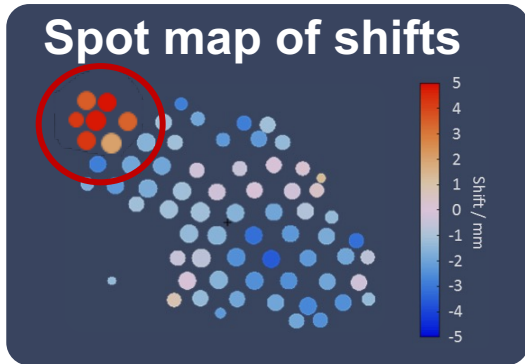
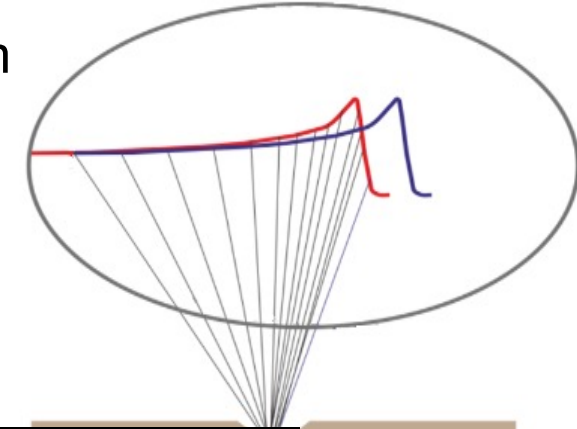
- automation
- acceleration
- structured/ consistent
- tasks oriented



III.c In-vivo verification: PGI



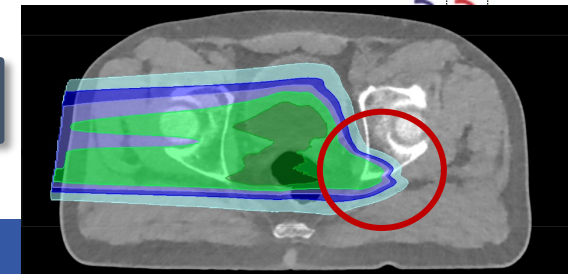
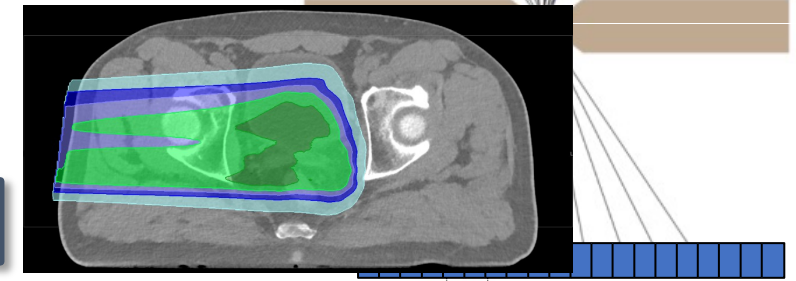
Proton beam



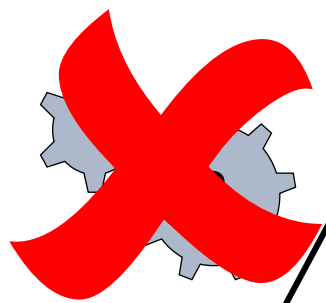
Images: J. Pietsch

no change

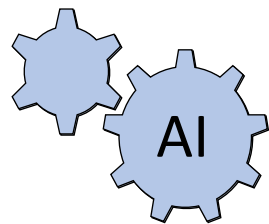
change



change shift



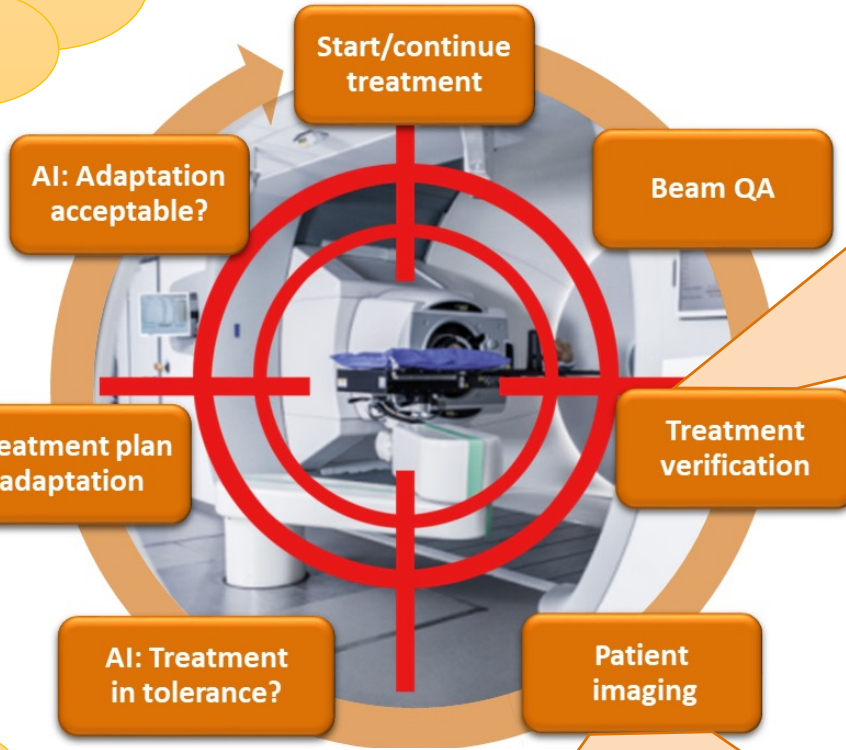
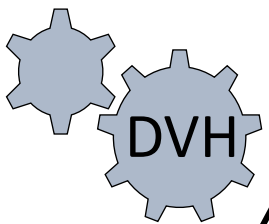
Is the adapted plan **approvable**?



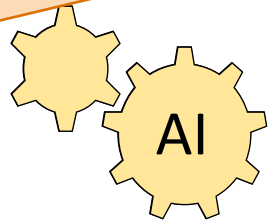
Adaption



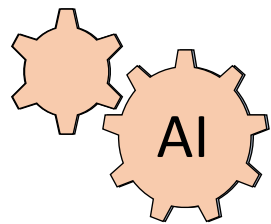
Is a plan **adaption** needed?



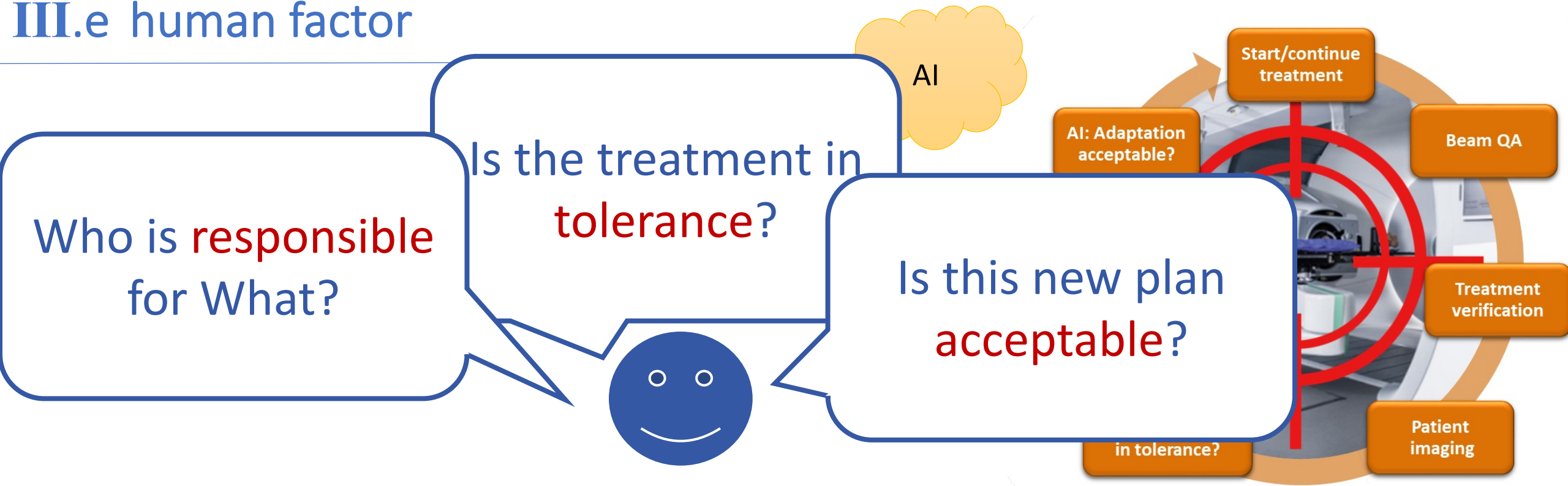
Verification



Did the **anatomy** change?



III.e human factor



establish **trust**



prevent **blind faith**

AI = Tool

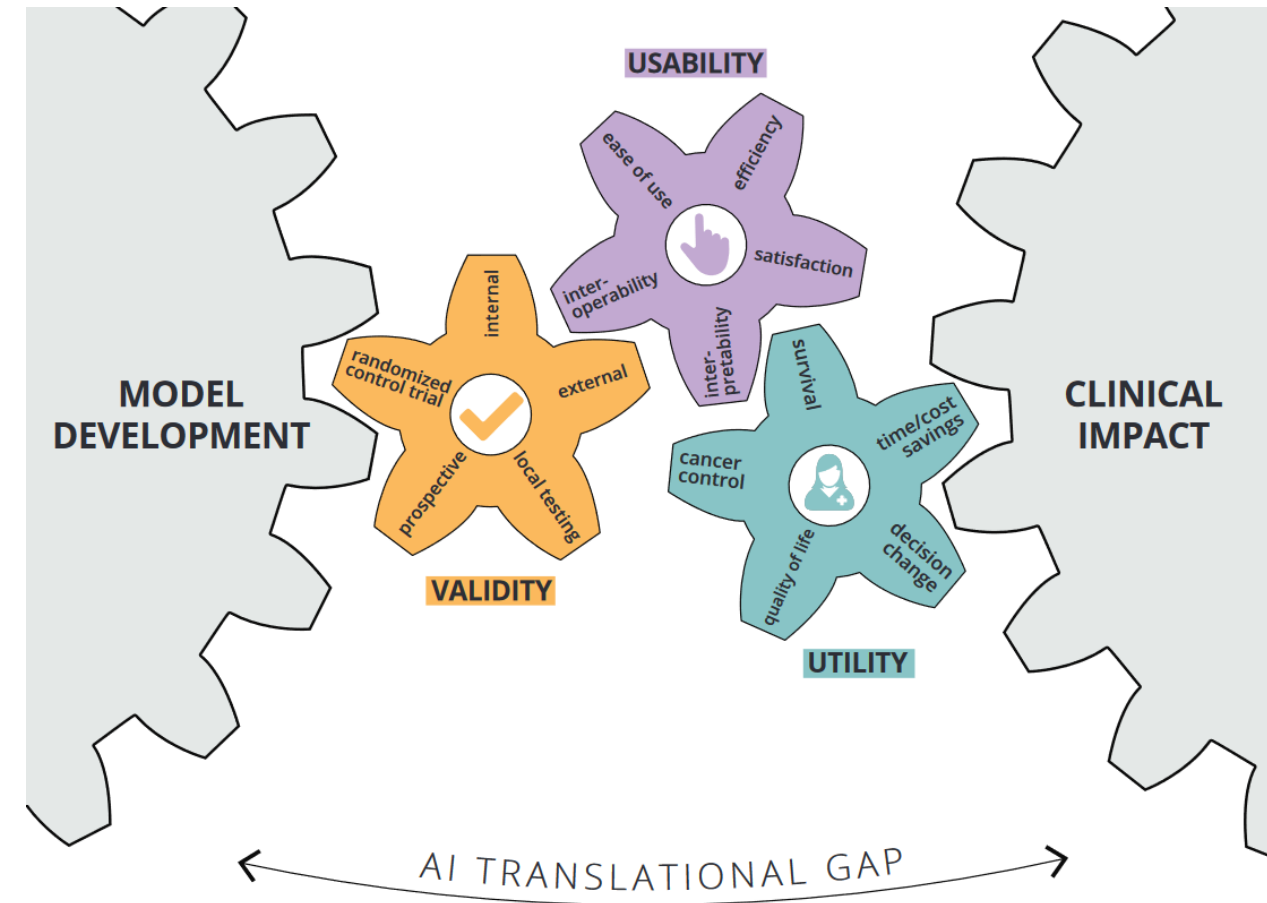
transparent

understood

participated

IV. next..?

IV next steps



Validity:

External testing

Utility:

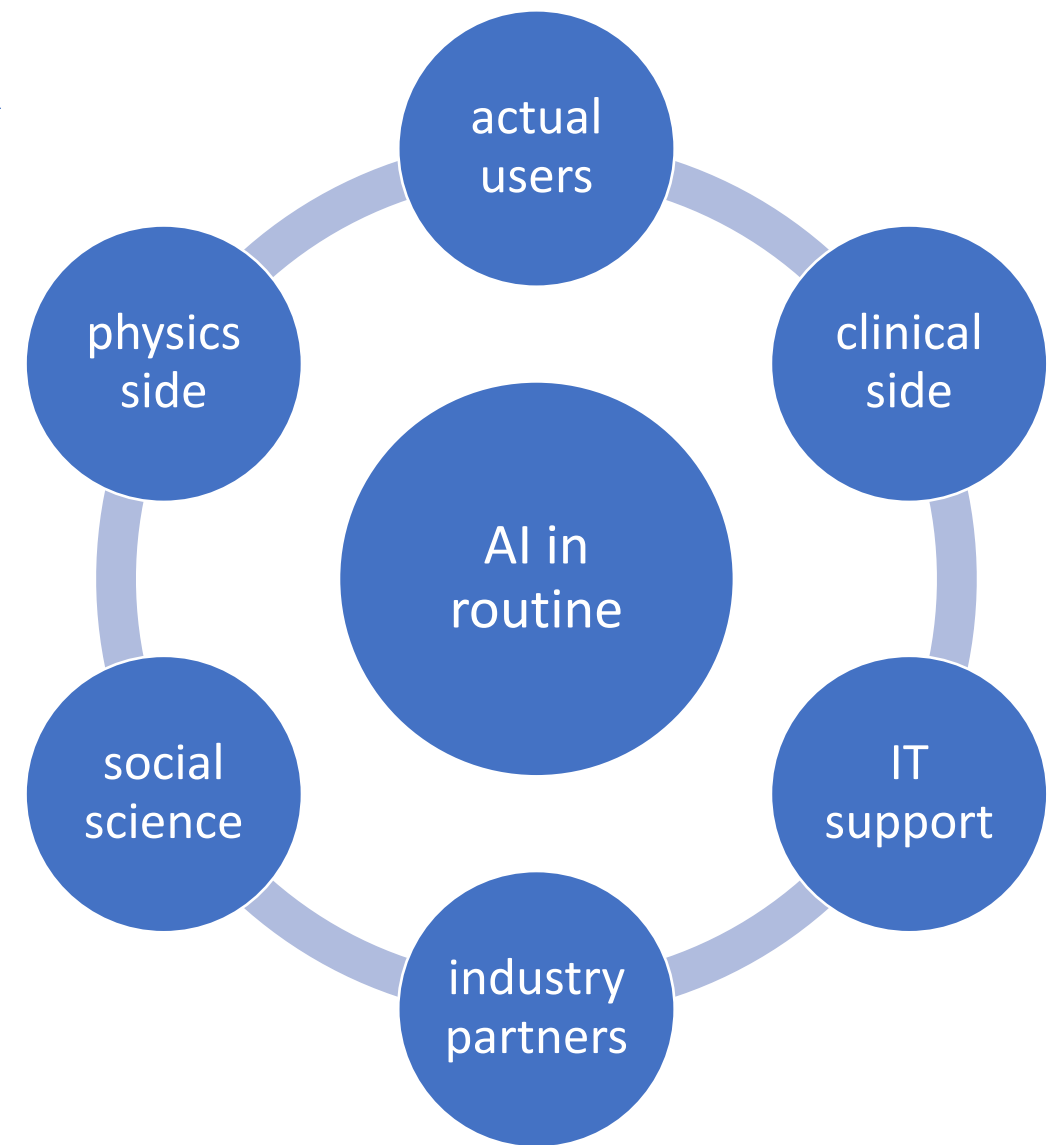
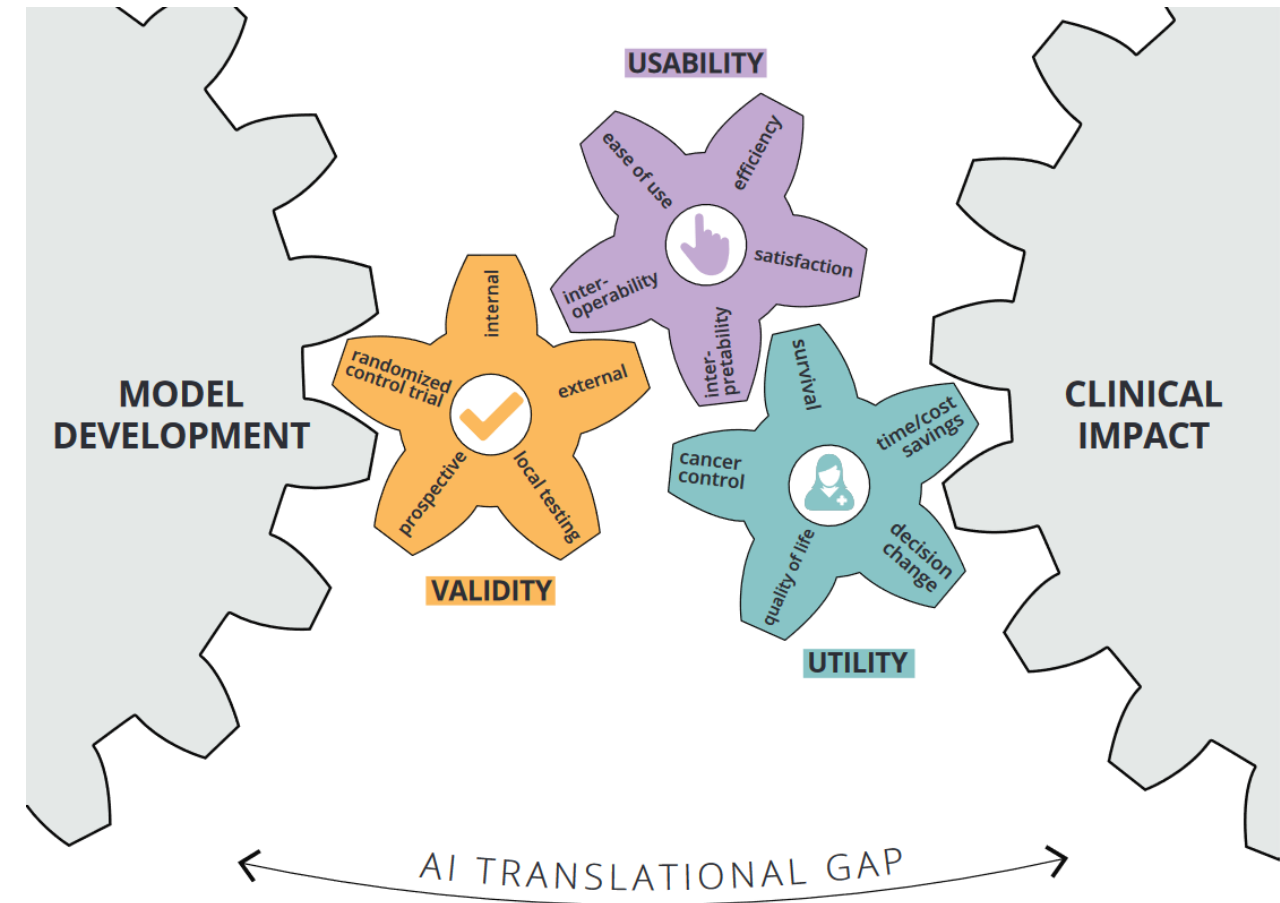
RCT?!

Usability:

actual useful?

Benjamin H. Kann, Artificial intelligence for clinical oncology, 2021

IV next steps



Benjamin H. Kann, Artificial intelligence for clinical oncology, 2021

AI is a tool

Let`s shape and design
what we hope for!

V Thank you!

Prof. Dr. Steffen Löck
Martina Palkowitsch
Alex Zwanenburg-Bezemer
Sebastian Starke
Asier Rabasco Meneghetti
Prof. Dr. Christian Richter
Kristin Stützer
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Lukas Wolter

