



From Spins to Pictures to Digital Organs

The PHRT Deep Data Collection Initiative

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Prelude

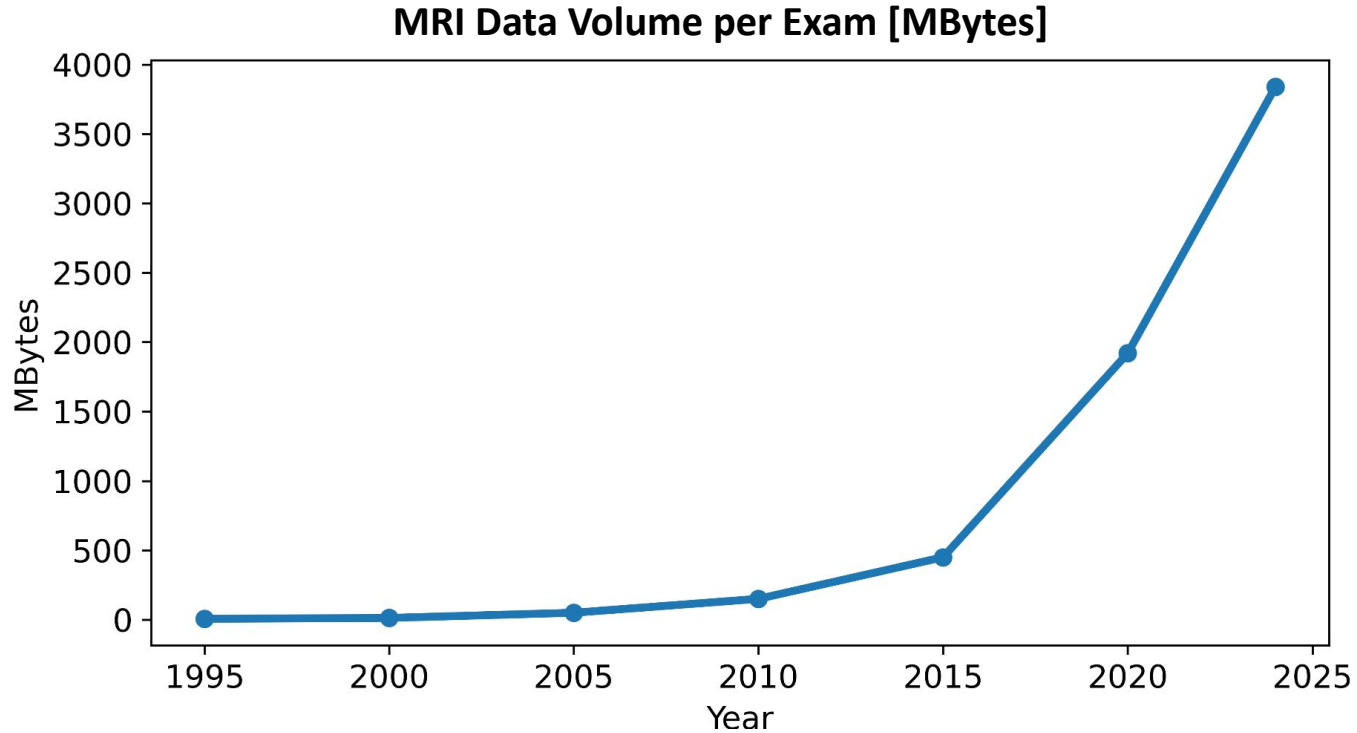
“I think that if you work as a radiologist ... you’re already over the edge of the cliff, but you haven’t yet looked down ... It’s just completely obvious that in five years deep learning is going to do better than radiologists. It might be ten years.”

— *Geoffrey Hinton, Nov 2016*



Geoffrey Hinton, Nobel prize, Oct 2024

What's past is prologue

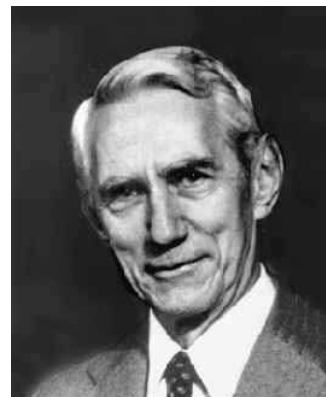


Is more imaging data more information?

- **Informational content** of data depends on how “surprising” it is

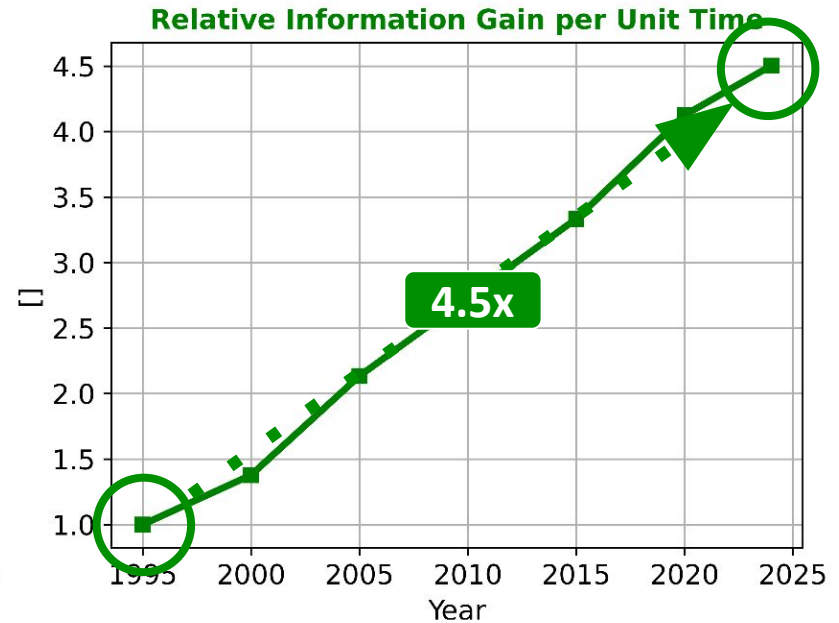
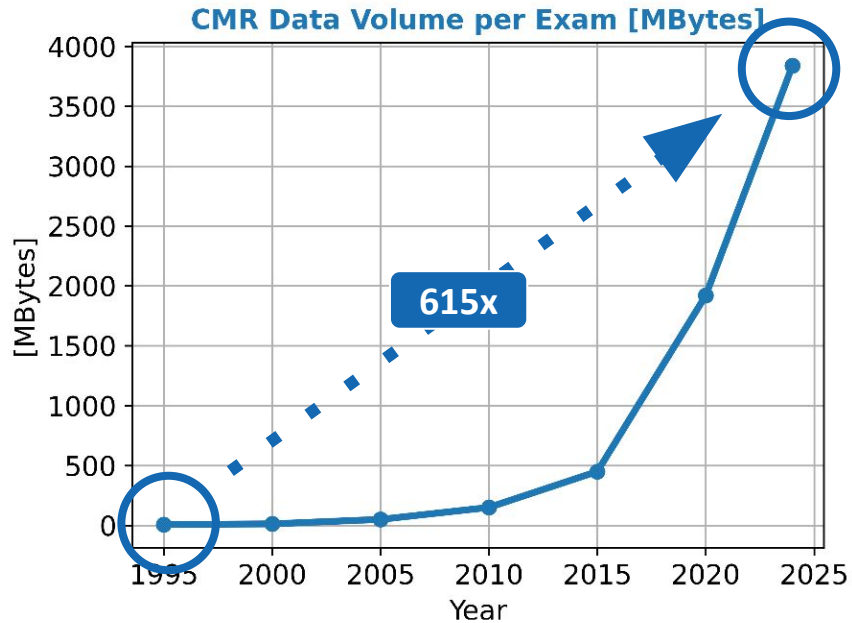
$$\text{Entropy: } \mathbf{H(X)} = - \sum_{\mathbf{x} \in \mathbf{X}} \mathbf{p(x)} \log_2 \mathbf{p(x)}$$

- Approximate **information gain** per exam:
 - Denoise data using suitable projection
 - Calculate entropy
 - Estimate information gain as **bits/pixel**

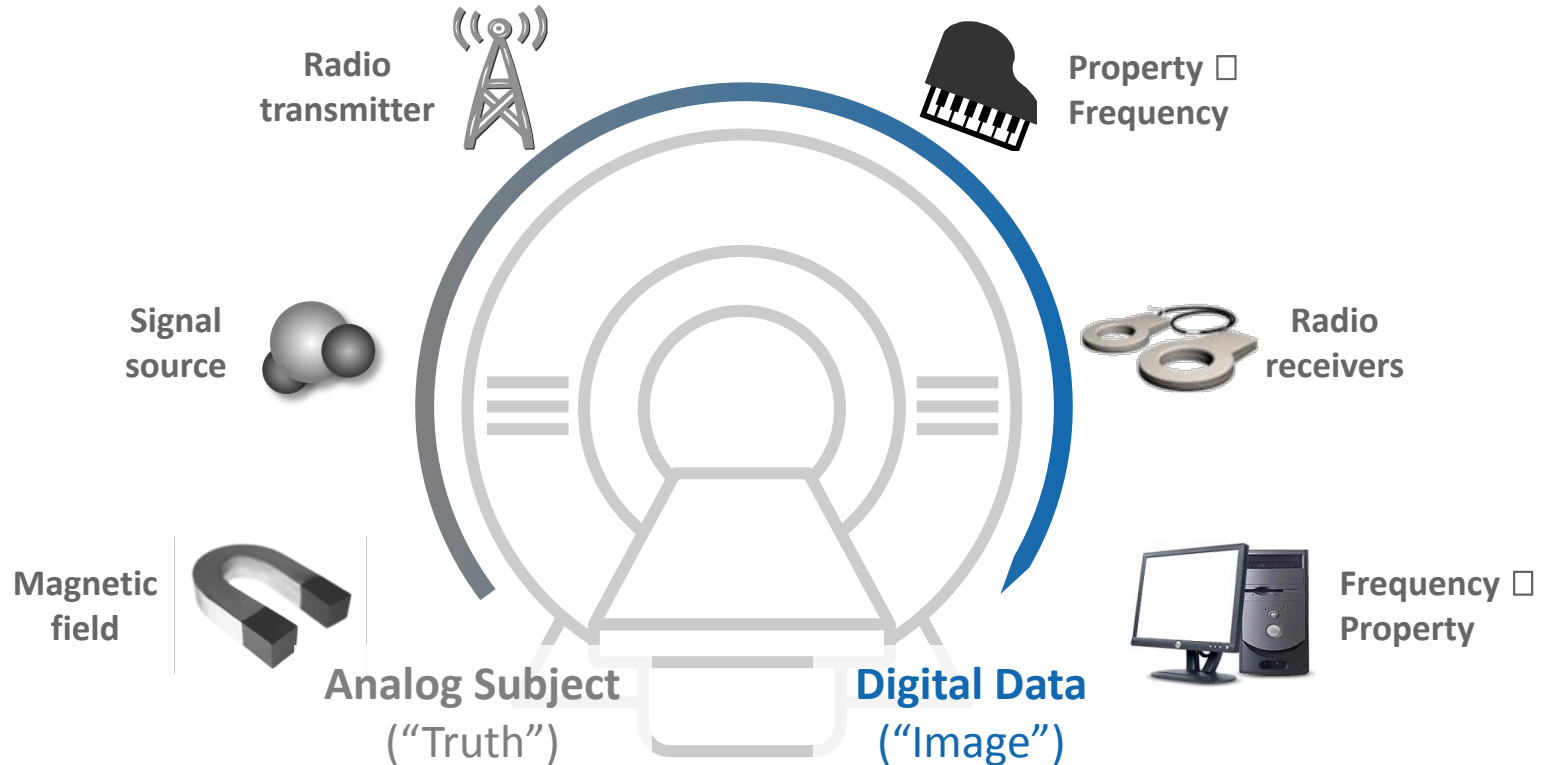


— Claude Shannon, 1948

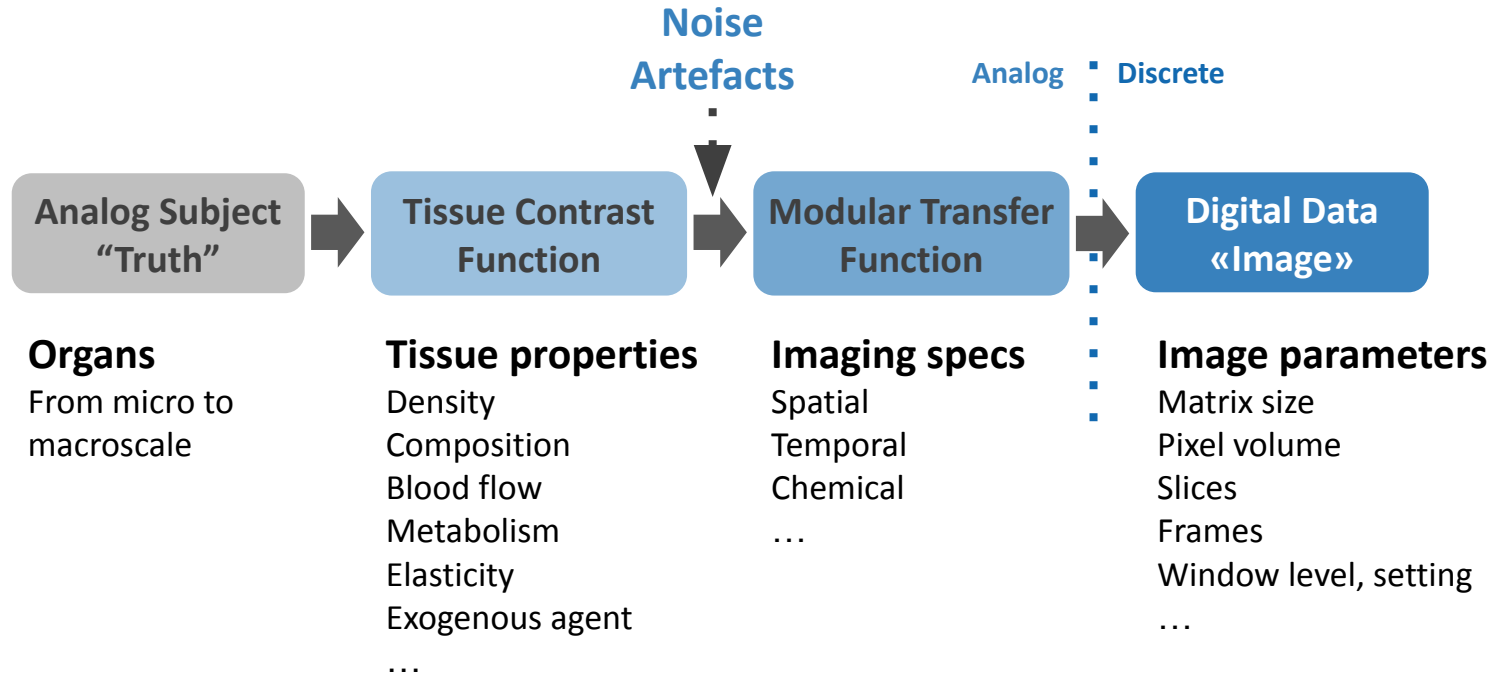
Data volume vs information gain



Data production

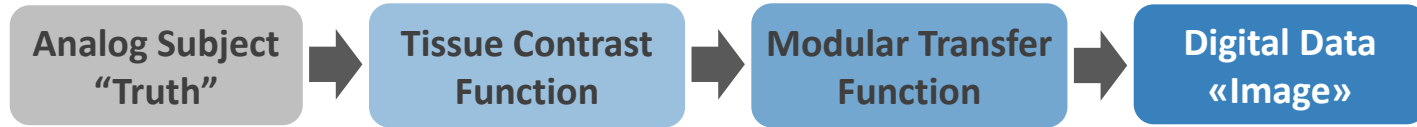


Data production



Information encoding

Information encoding

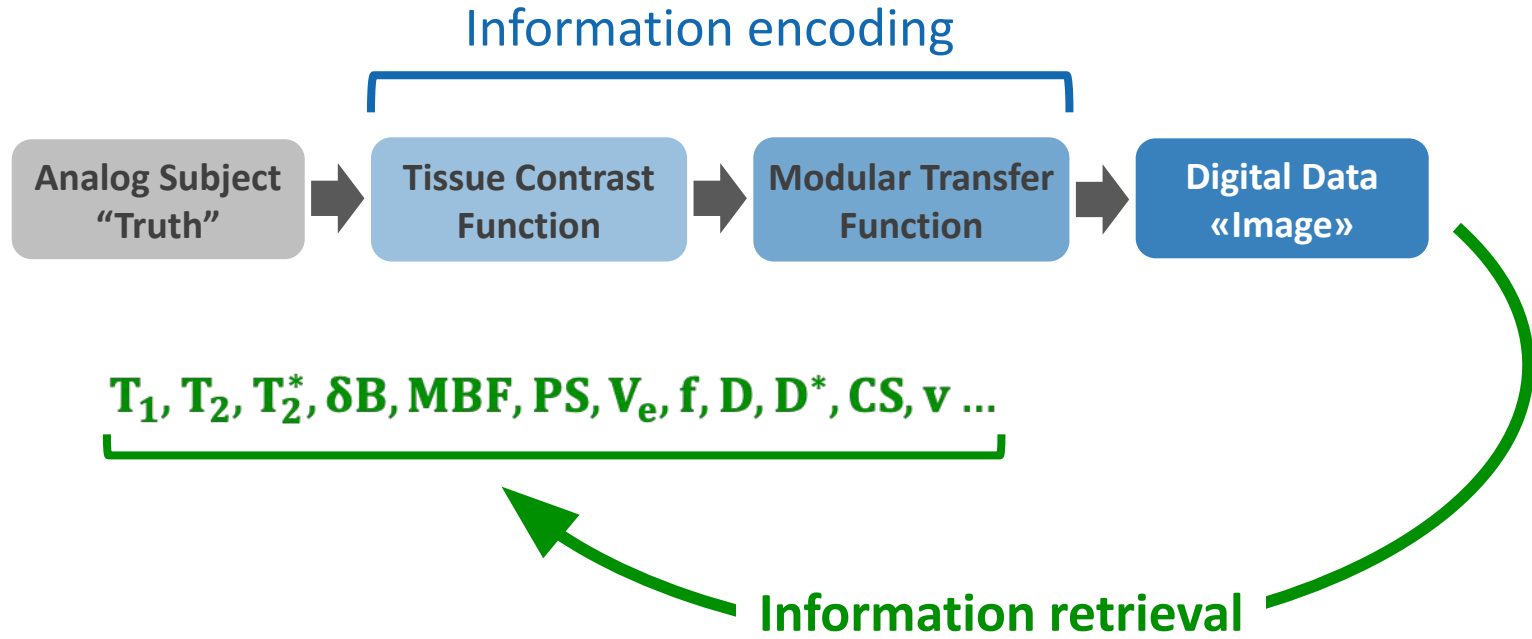


$$= f\{(\mathbf{T}_1, \mathbf{T}_2, \mathbf{T}_2^*, \delta\mathbf{B}, \mathbf{MBF}, \mathbf{PS}, \mathbf{V}_e, \mathbf{f}, \mathbf{D}, \mathbf{D}^*, \mathbf{CS}, \mathbf{v} \dots), (\alpha, \mathbf{T}_E, \Delta\mathbf{T}_E, \mathbf{T}_R, \mathbf{T}_I, \mathbf{c}, \mathbf{b}, \mathbf{k}_v \dots)\}$$

tissue properties and function
from micro to macroscale

experimental parameters

Information retrieval



Intermezzo

Information retrieval can at best recover information encoded!

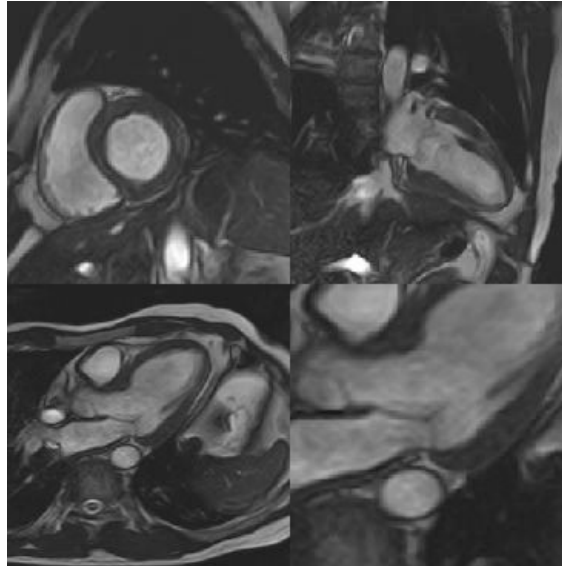


To add value, encode more information!

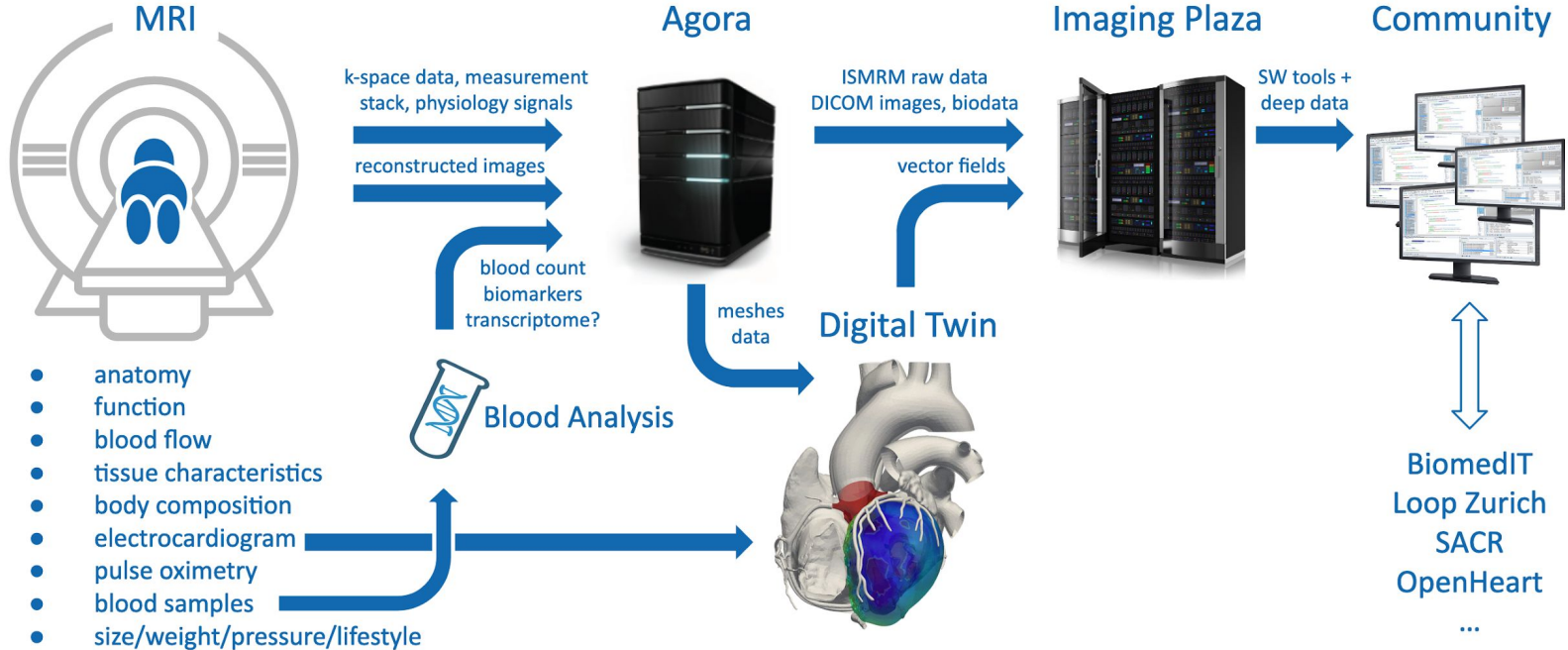
Deep Imaging Data Collection (DIDC)

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Deep Imaging-Based Functional Digital Twinning



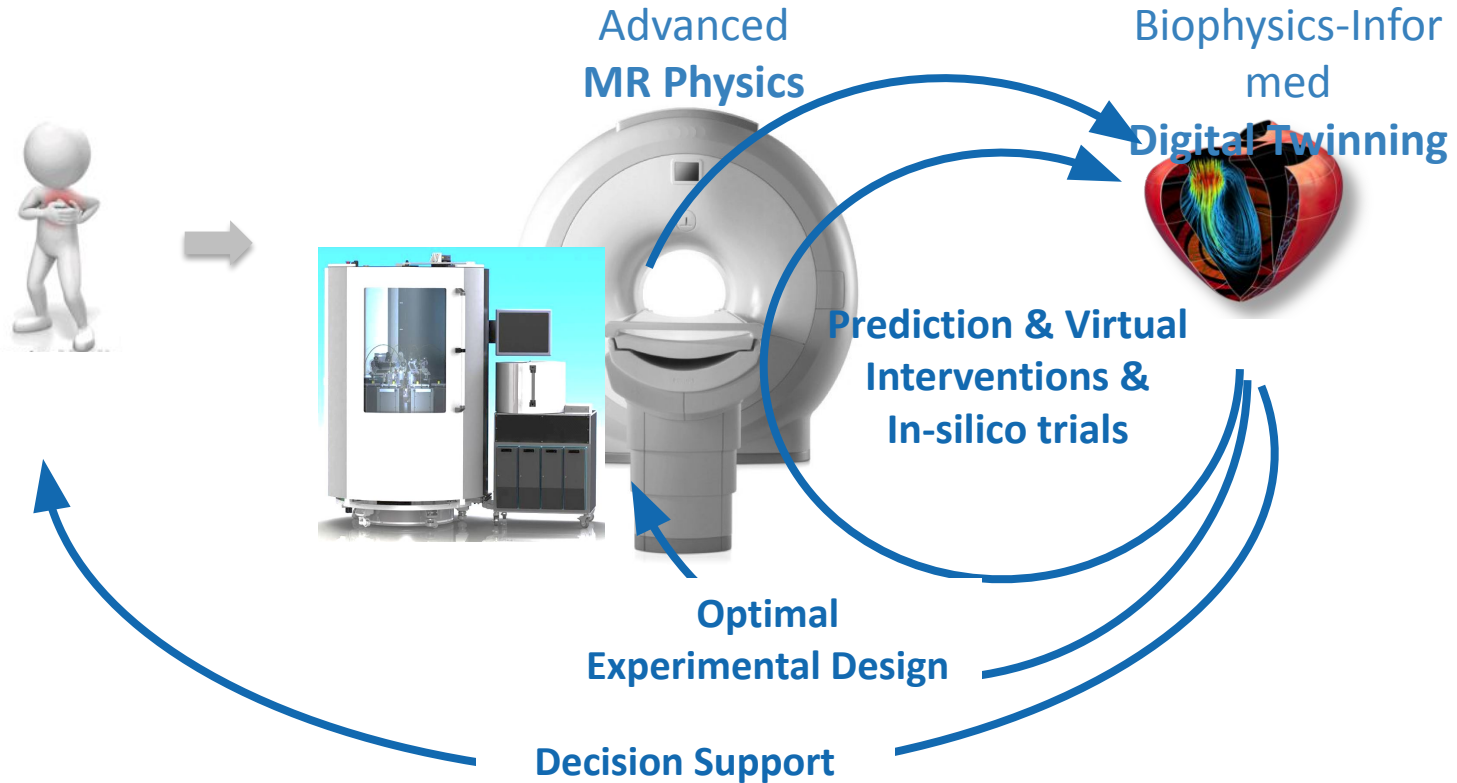
Deep Imaging Data Collection (DIDC)



DIDC Value

- Deep MR imaging stacks + physio data in 500 volunteers
- Raw k-space data + imaging data for imaging research
- Pairing of imaging data and functional digital twins for clinical research
- Distribution of deep data via Imaging Plaza to support reproducible research
- Starting point for longitudinal cardiovascular imaging in a Swiss cohort

DIDC Vision



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