



# From Spins to Pictures to Digital Organs

## The PHRT Deep Data Collection Initiative

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## Prelude

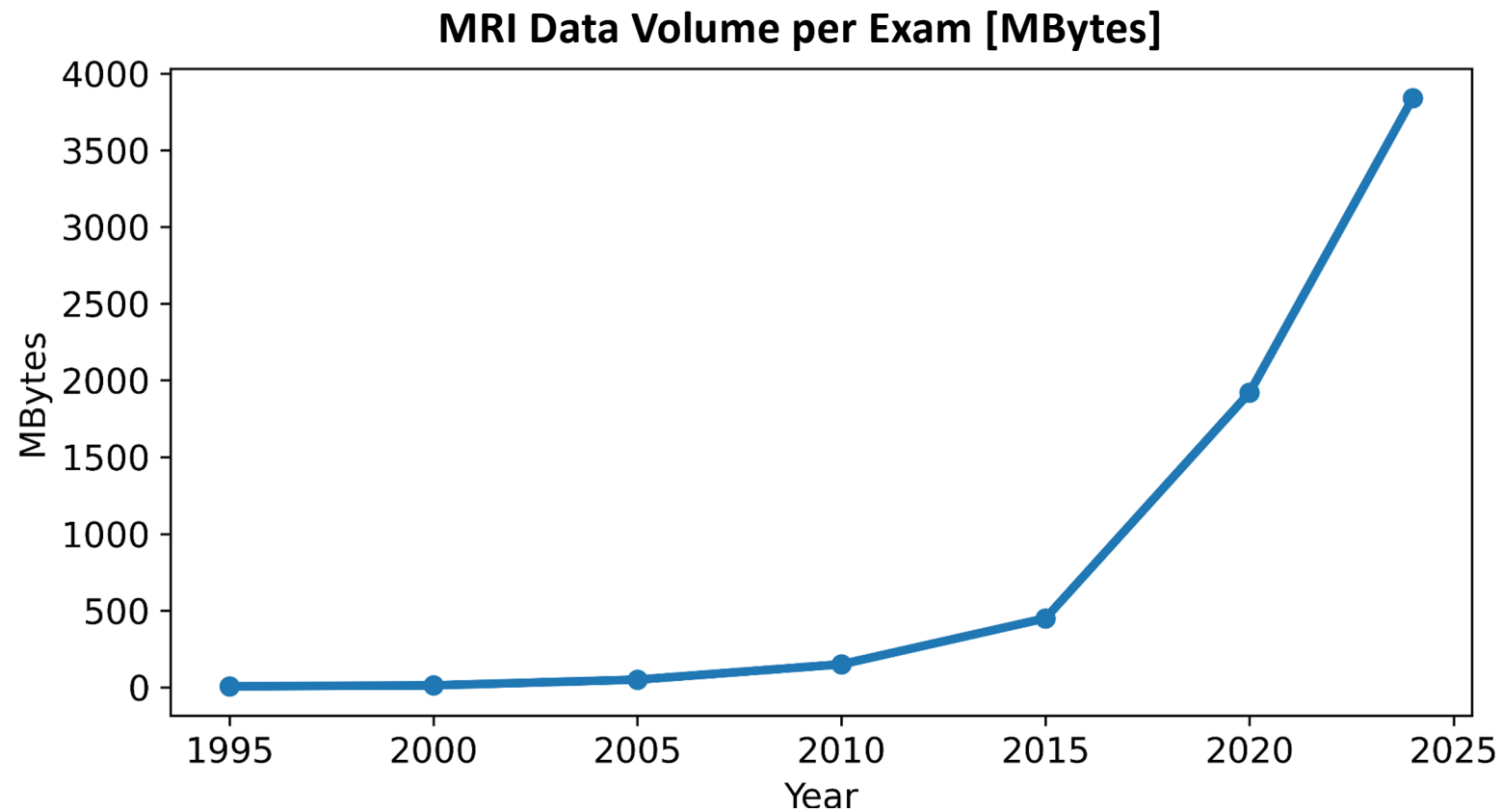
**“I think that if you work as a radiologist ... you’re already over the edge of the cliff, but you haven’t yet looked down ... It’s just completely obvious that in five years deep learning is going to do better than radiologists. It might be ten years.”**

— *Geoffrey Hinton, Nov 2016*



*Geoffrey Hinton, Nobel prize, Oct 2024*

## What's past is prologue

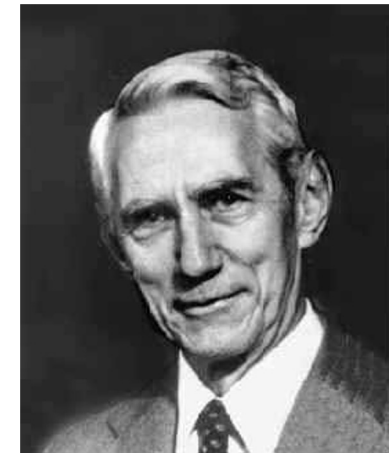


## Is more imaging data more information?

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

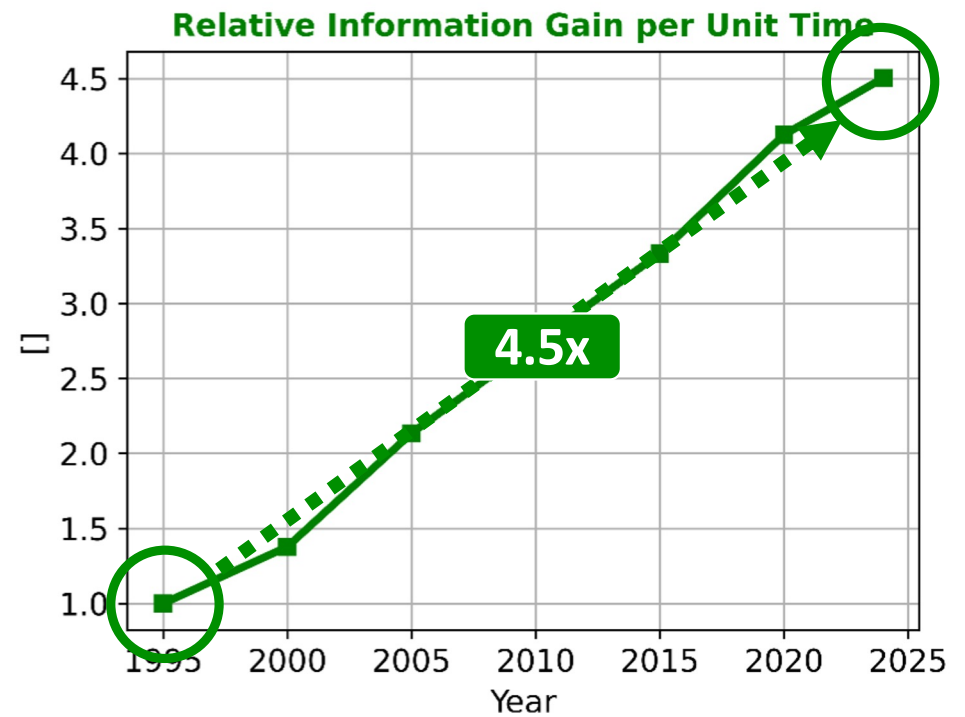
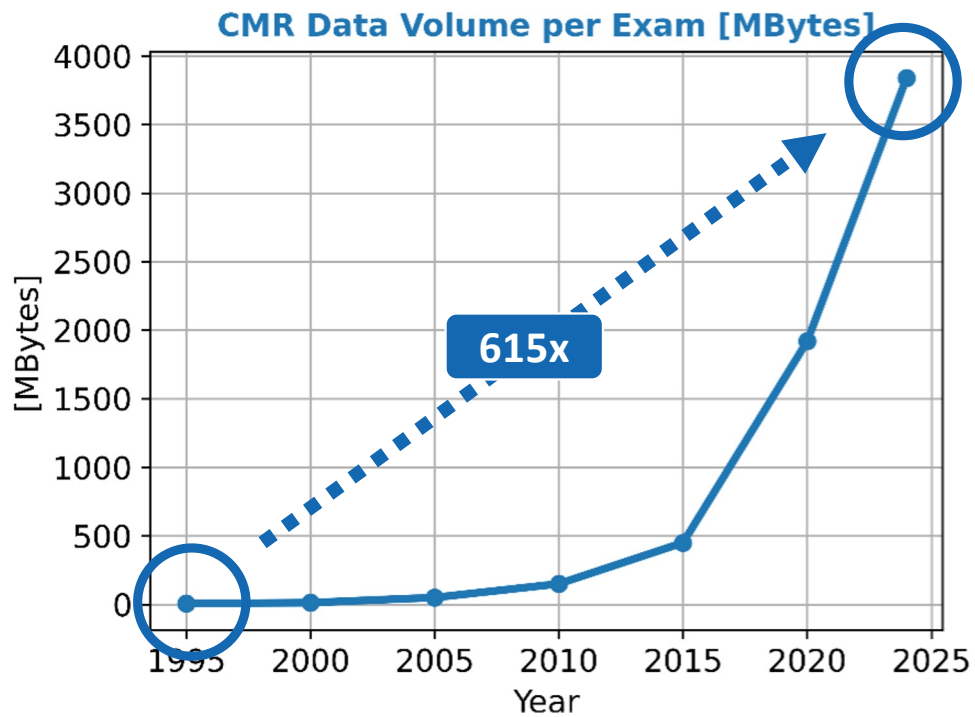
$$\text{Entropy: } \mathbf{H(X)} = - \sum_{\mathbf{x} \in \mathbf{X}} \mathbf{p(x)} \log_2 \mathbf{p(x)}$$

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

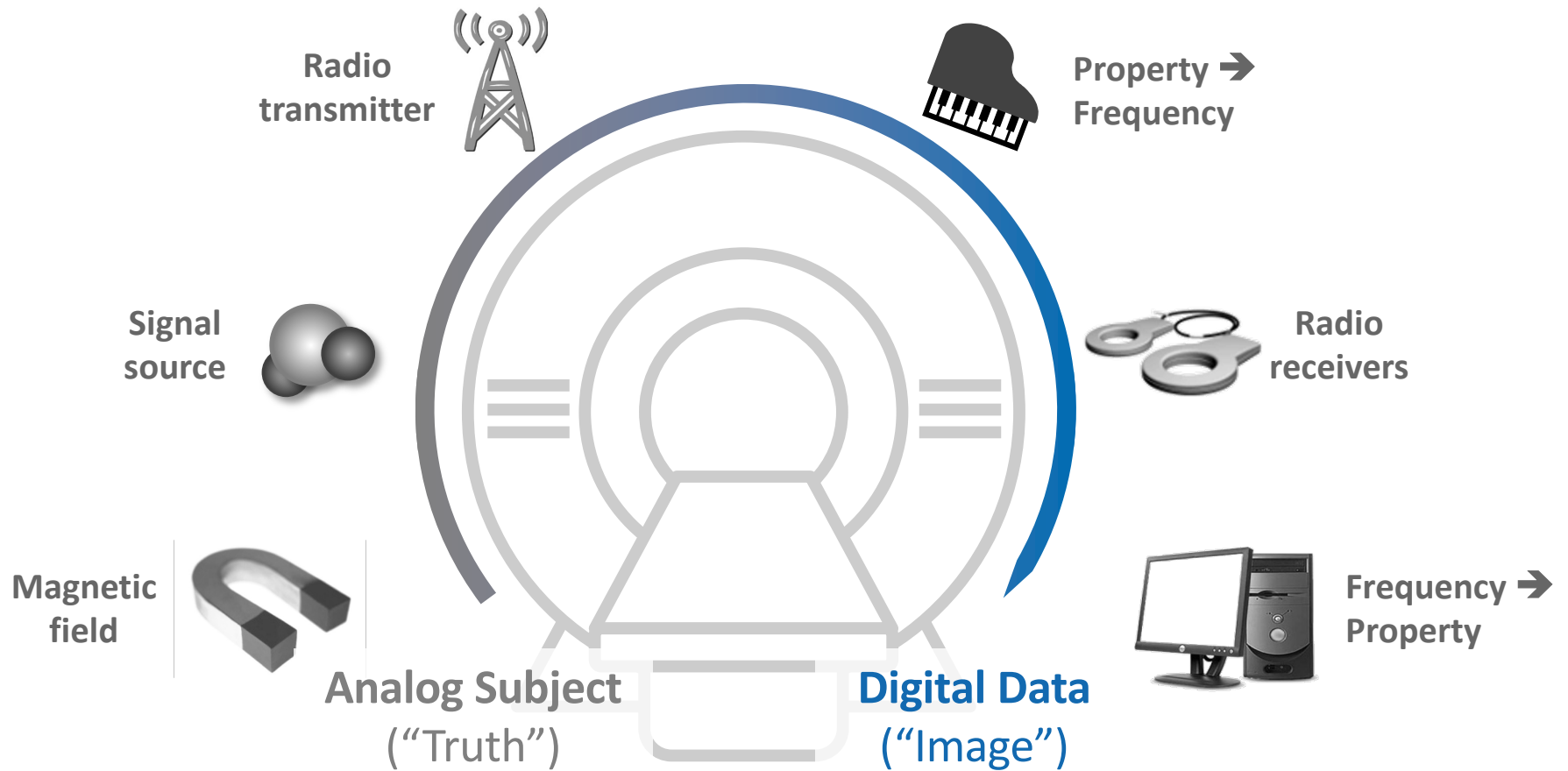


— Claude Shannon, 1948

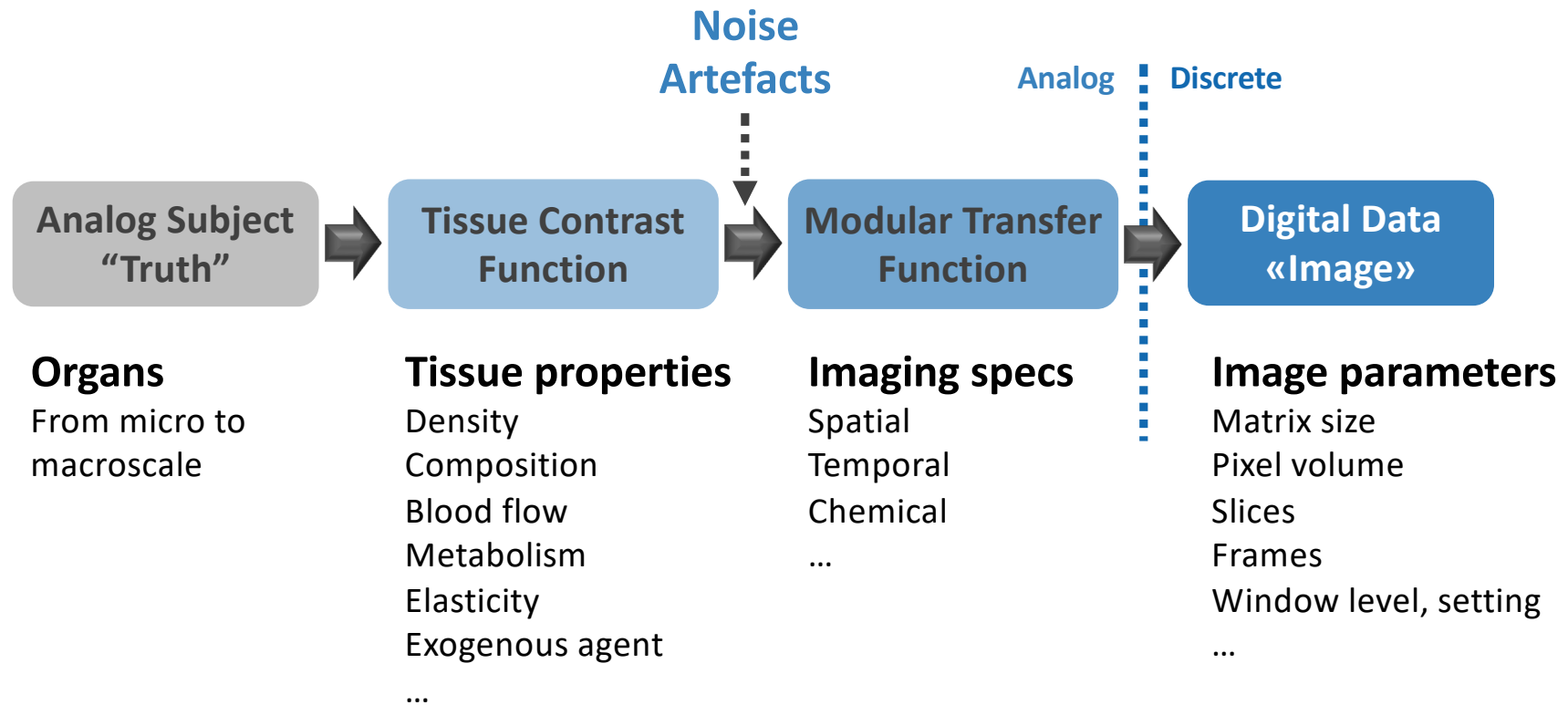
# Data volume vs information gain



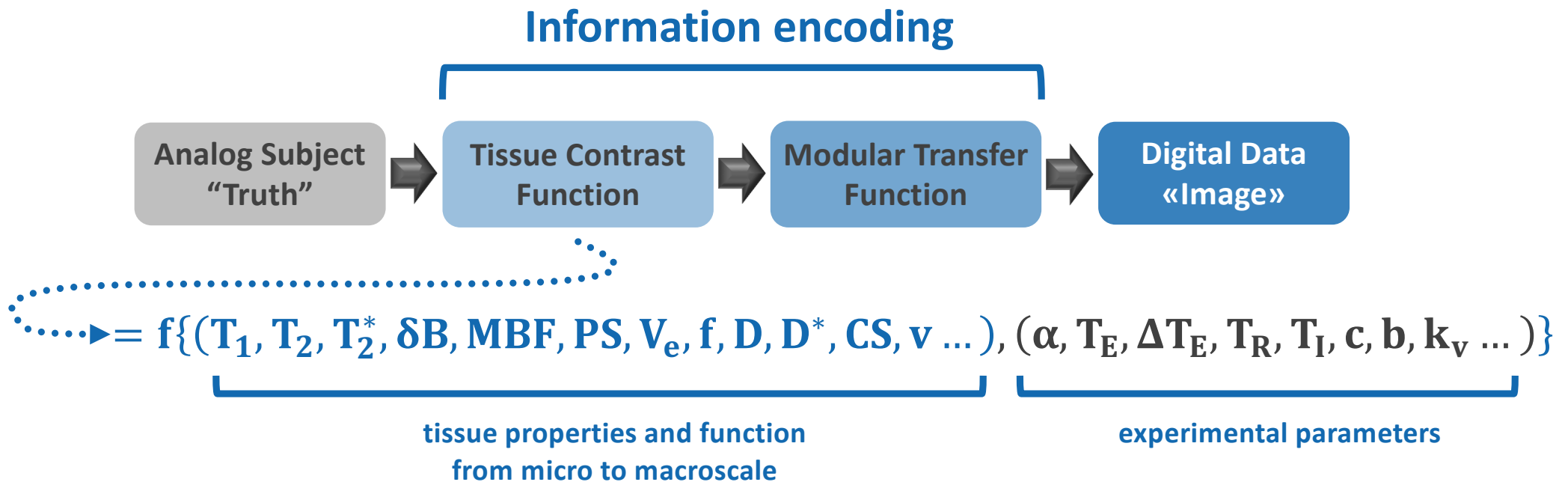
# Data production



# Data production

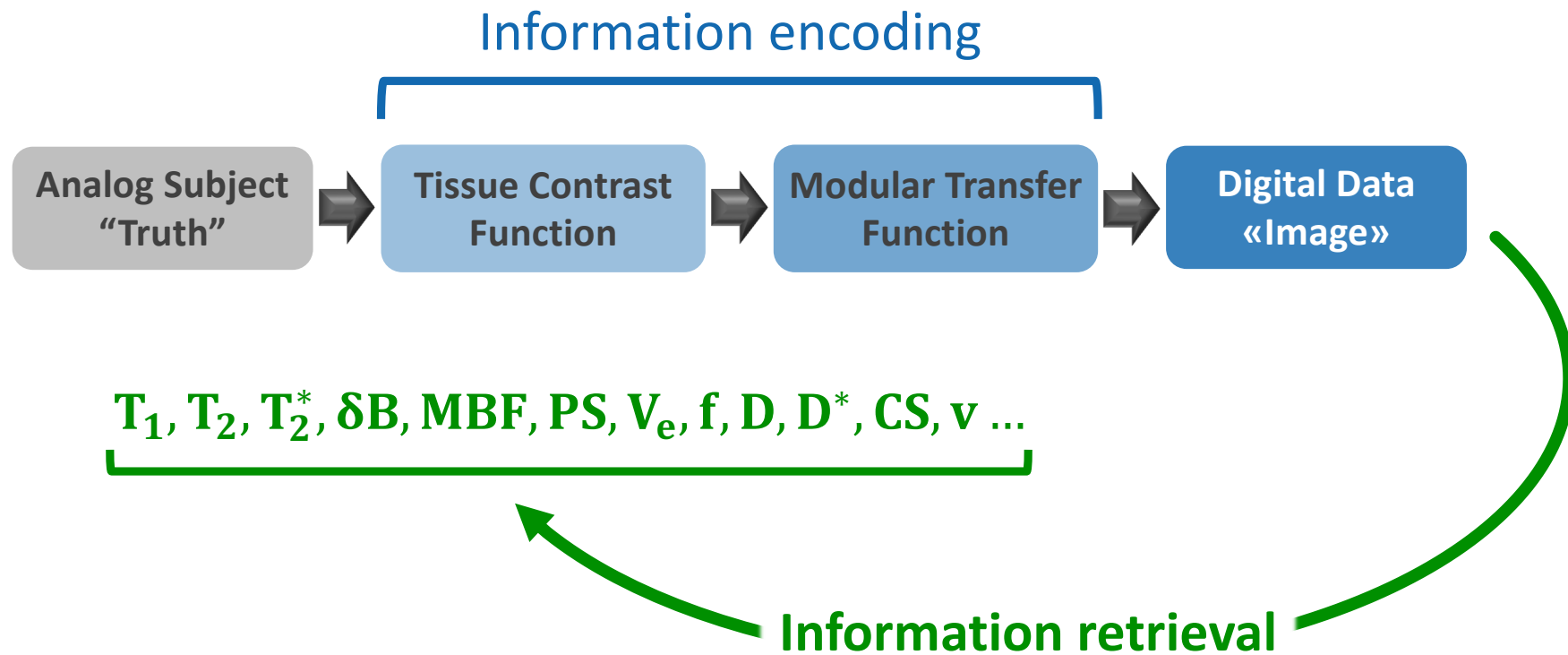


# Information encoding





# Information retrieval



## Intermezzo

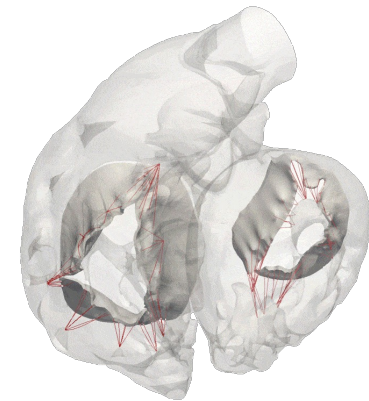
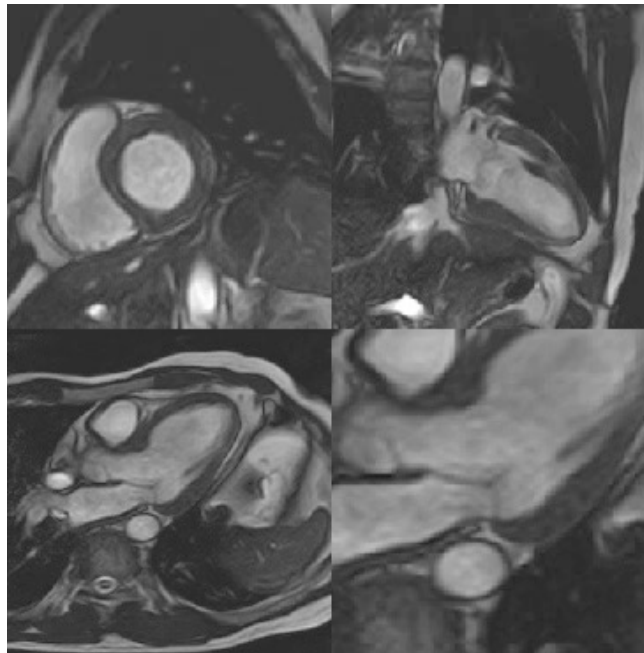
Information retrieval can at best recover information encoded!

**To add value, encode more** information!

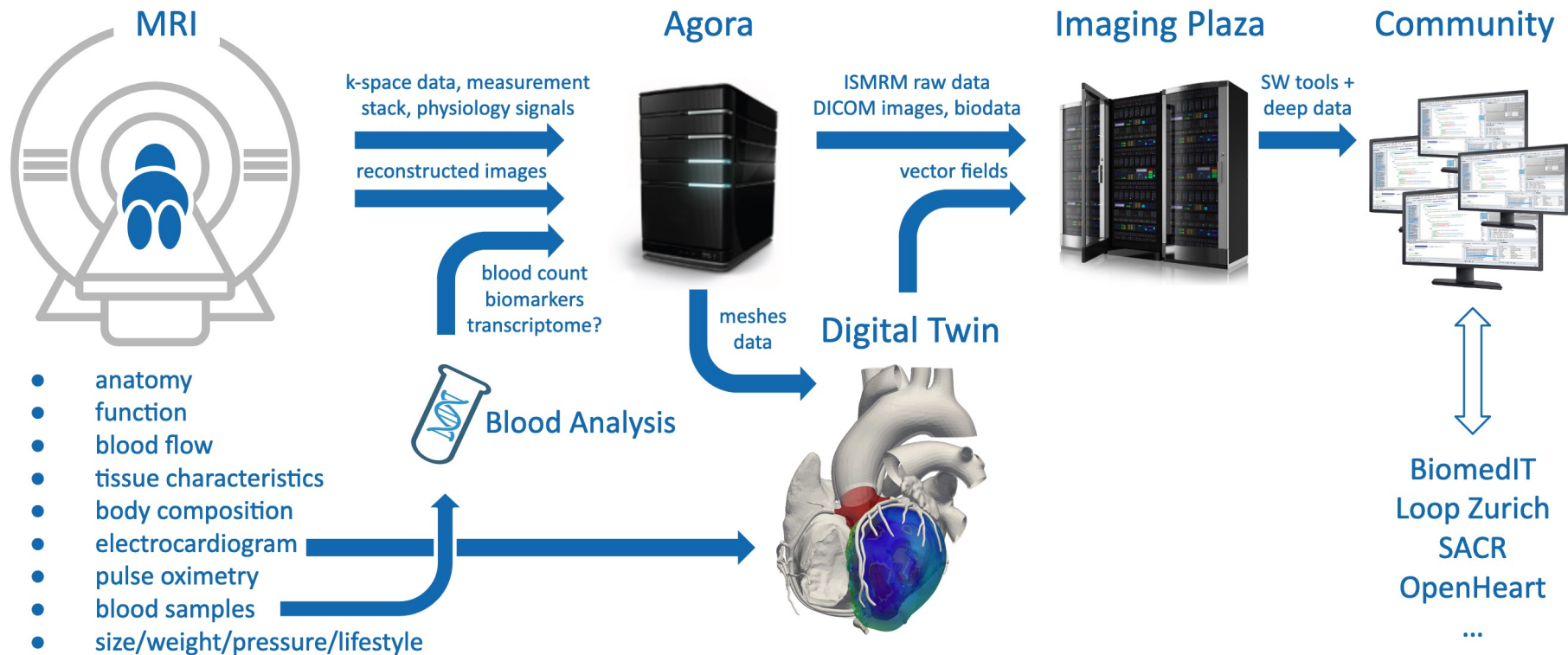
**Deep Imaging Data Collection (DIDC)**

# Deep Imaging Data Collection (DIDC)

## Deep Imaging-Based Functional Digital Twinning



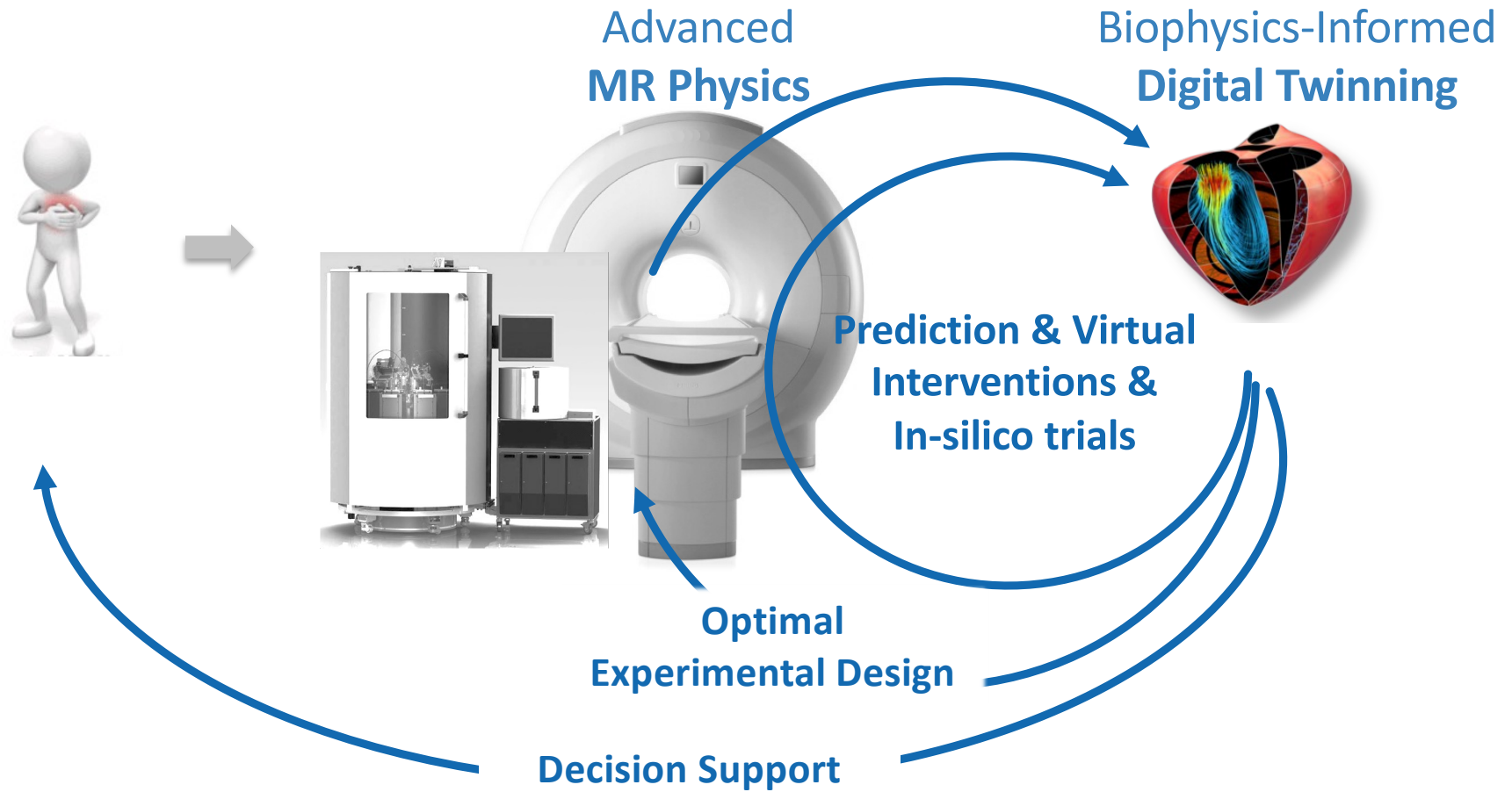
# Deep Imaging Data Collection (DIDC)



## 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



# Acknowledgments

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- CMR Zurich Team
- SPHN/PHRT

