

# Fast CMR: clinical practice and unmet needs

EACVI/SCMR AI in CMR Summit, 5-6 May 2022

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**EACVI**  
European Association of  
Cardiovascular Imaging  
European Society of Cardiology

# Disclosures

- **None**



# Graduate school - 1990s



CVGIP: Image Understanding  
Volume 57, Issue 1, January 1993, Pages 81-98

CVGIP: Image  
Underst...

Regular Article

Hypothesizing Structures in Edge-Focused  
Cerebral Magnetic Resonance Images Using  
Graph-Theoretic Cycle Enumeration

Raman, S.V., Sarkar, S., Boyer, K.L.

IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 10, NO. 2, JUNE 1991

109

Tissue Boundary Refinement in Magnetic Resonance  
Images Using Contour-Based Scale Space Matching

S. V. Raman, Student Member, IEEE, S. Sarkar, Student Member, IEEE, and K. L. Boyer, Member, IEEE

- **Early days of AI (computer vision)**
  - Limited computational power
  - Limited access to big data
- **“QED” mindset**
- **Work in relative isolation**
  - Engineers + radiologists: not enough

# Speedway, Indiana - 2020s



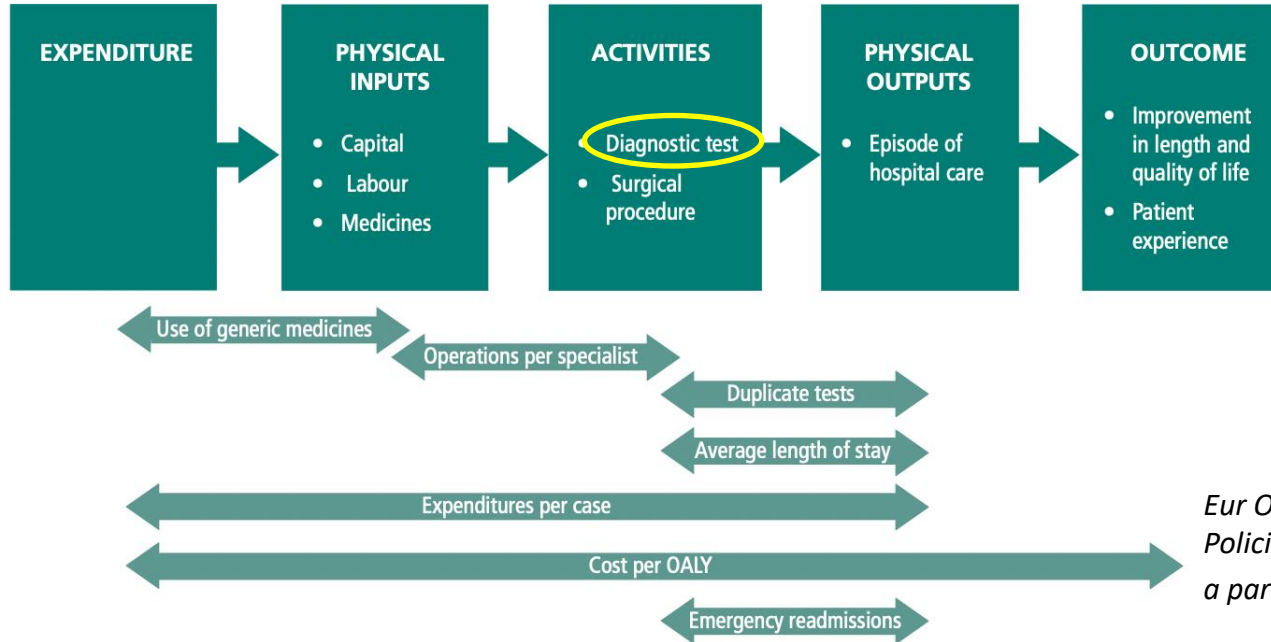
**Top speed: 380 km/hr**

**Acceleration: 0-100 km/h in ~3s**



# Need for speed: Healthcare Efficiency

- **Relationship between resource inputs (e.g. labor, capital) and -**
  - Intermediate outputs e.g. number treated, wait to access healthcare
  - Final health outcomes e.g. lives saved, life years gained



*Eur Observatory on Health Systems & Policies, Policy Brief 27; 2017.  
a partnership hosted by WHO*

# Who benefits from faster CMR?

- **Patients**
  - Less time in the scanner
  - Easier to schedule amidst other events
- **CMR operators**
  - Technologists/radiographers' workflow
  - CMR physicians' workflow
- **Administrators**
  - Efficient use of facilities and staff
  - Increase market share
- **Society**
  - More equitable access → less health inequity

# Prototypical community-based practice



- **CMR scheduled on multipurpose scanner**
  - Best case – dedicated blocks of time for CMR
  - Worst case – random accommodation of CMR requests
- **CMR physicians multitasking**
  - Cardiologists – reading echos, seeing patients
  - Radiologists – reading chest CTs, doing other procedures
- **CMR staff multitasking**
  - Answering the phone
  - Patient prep, stress, transfer

# Prototypical referral/academic practice



- **Dedicated CMR scanner**
  - Still accountable for return on investment (ROI)
  - ROI needed to support further expansion, additional investments
- **CMR physicians multitasking**
  - Larger volume → more chart review, staff & referring clinician queries
  - Working on grants, papers
  - Trainees' time and effort
- **Master research agreement**
  - Access to newest techniques/technology → 'protocol bloat'



# Other things that slow down CMR

- **Patient takes longer, arrives late, etc.**
  - Esp if CMR runs in series vs parallel
- **Unexpected findings on prescribed scans**
  - Need for additional acquisitions
- **Staff difficulty in connecting to CMR physician for assistance**
  - Difficulty seeing what's been done if off-site
- **Congenital add-on**



# Opportunities for speed across -

- Acquisition
- Postprocessing
- Analytics/Reporting
- Standardization

*Consider how AI could also help -*  
*Predict delays, claustrophobia*  
*Address access across regions*

# Acquisition

- **Patient preparation**
  - Gating
  - Monitoring
- **Scanning**
  - Less or no planning
  - Real-time detection & in-line improvement of quality
  - All-together vs multiple sequential scans
  - Patient-specific vs generic protocols
- **Reconstruction**

# Postprocessing

- In-line or transferred to a separate node?
- Zero clicks – myth or reality?
- Same measures of underlying state despite variations in –
  - Acquisition
  - Reader

# Analytics/Reporting



- **Embed analysis in reporting solution**
- **Personalized reports enhanced by population-scale data**
  - Image processing → image understanding
  - Not just diagnosis but treatment response

# Standardization

Kramer et al. *Journal of Cardiovascular Magnetic Resonance* (2020) 22:17  
<https://doi.org/10.1186/s12968-020-00607-1>

Journal of Cardiovascular  
Magnetic Resonance

RESEARCH

Open Access

Standardized cardiovascular magnetic  
resonance imaging (CMR) protocols: 2020  
update



Schulz-Menger et al. *Journal of Cardiovascular Magnetic Resonance* (2020) 22:19  
<https://doi.org/10.1186/s12968-020-00610-6>

Journal of Cardiovascular  
Magnetic Resonance

POSITION STATEMENT

Open Access

Standardized image interpretation and  
post-processing in cardiovascular magnetic  
resonance - 2020 update



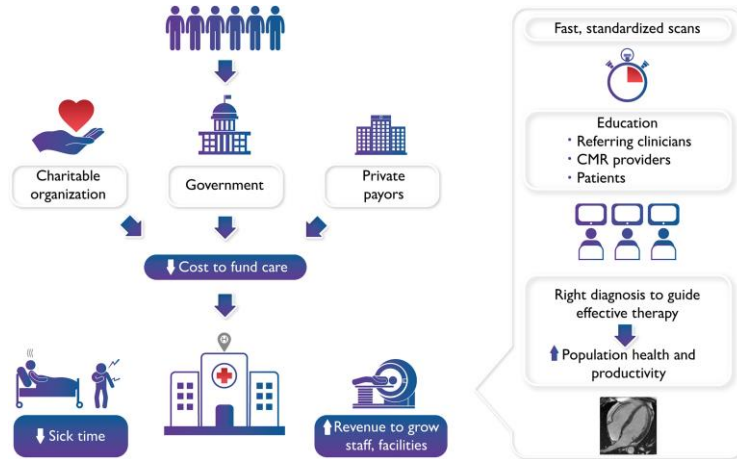
*Can speed afforded by AI close gaps between  
guidelines and practice?*

# What else helps you get up to speed?



- **Business model to accelerate CMR**
  - Know your local expenses & income sources
  - Engage facility/practice administrators
- **With model, you can secure e.g. enabling software**
  - Installation, per-scan, & maintenance costs; training time?
  - Can costs be recouped by the facility directly (is it paid for as part of the cost of each CMR study) *or*
  - Does higher volume/throughput help make the financial case?
- **CMR investment in the broader context**
  - Distinguishing feature of what your organization prioritizes e.g. cardiovascular centers of excellence
  - Can you provide actionable phenotypes at point of care?

# Summary



- Think of speed in the broader context of healthcare & outcomes
- Faster CMR offers value for all stakeholders; multiple points for acceleration
- Consider the margin needed to support your mission