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# Leveraging Big Data To Improve Cardiovascular Care – The SingCLOUD Journey

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CARDIOVASCULAR MEDICINE AND SOCIETY

# Improving the National Cardiovascular Data Registry's Value to Elevate the Quality of Cardiovascular Care



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performance with other NCDR participants. These data have also served as a foundation for generating new scientific insights into the care and outcomes of patients with cardiovascular disease, with more than 700 published manuscripts. The foundation for its use in quality assessment, accreditation, payment programs, regulatory approval, procedure reimbursement, and scientific inquiry is the veracity of its underlying data. In this issue of the *Journal of the*

**FIGURE 1 Opportunities to Improve the Value of the NCDR**

**Engaging Patients through:**

- SDM Tools
- Assessing QoL Outcomes

**Improving Outcomes through:**

- Prospective Risk Calculators
- Evidence-based protocols of care
- Creating a Culture of Improvement
- Supporting Improved Payment Structures
- Achieving Equity in Care

$$\text{Value} = \frac{\text{Patient Experience} + \text{Outcomes}}{\text{Cost}}$$

**Lowering Costs through:**

- Integrated Data Collection through EMR
- Reducing Required Data Elements
- Leveraging Data to Generate Reports

Value in health care is proportional to patients' experiences and outcomes, divided by costs. Different strategies can be used by NCDR to assist providers in deriving more value from participation. EMR = electronic medical record; NCDR = National Cardiovascular Data Registry; QoL = quality of life; SDM = shared decision making.

# Why

- Quality Improvement
- Identify Gaps
- Improve Value
- Reduce Cost
- Manage Demand
- Research



# SingCLOUD

Clinician-led **cardiac** research and quality improvement programmes that encompass restructured hospitals and polyclinics

13 institutions



Index patients tracked from  
2007 to 2021

Areas of focus



Suspected or proven CAD,  
CHF, SCDB EPS w/wo AF Data

~95%



Data Quality Audit Agreement

13 Institutions



~858,000  
Patients

Data Elements\*

Data Sources

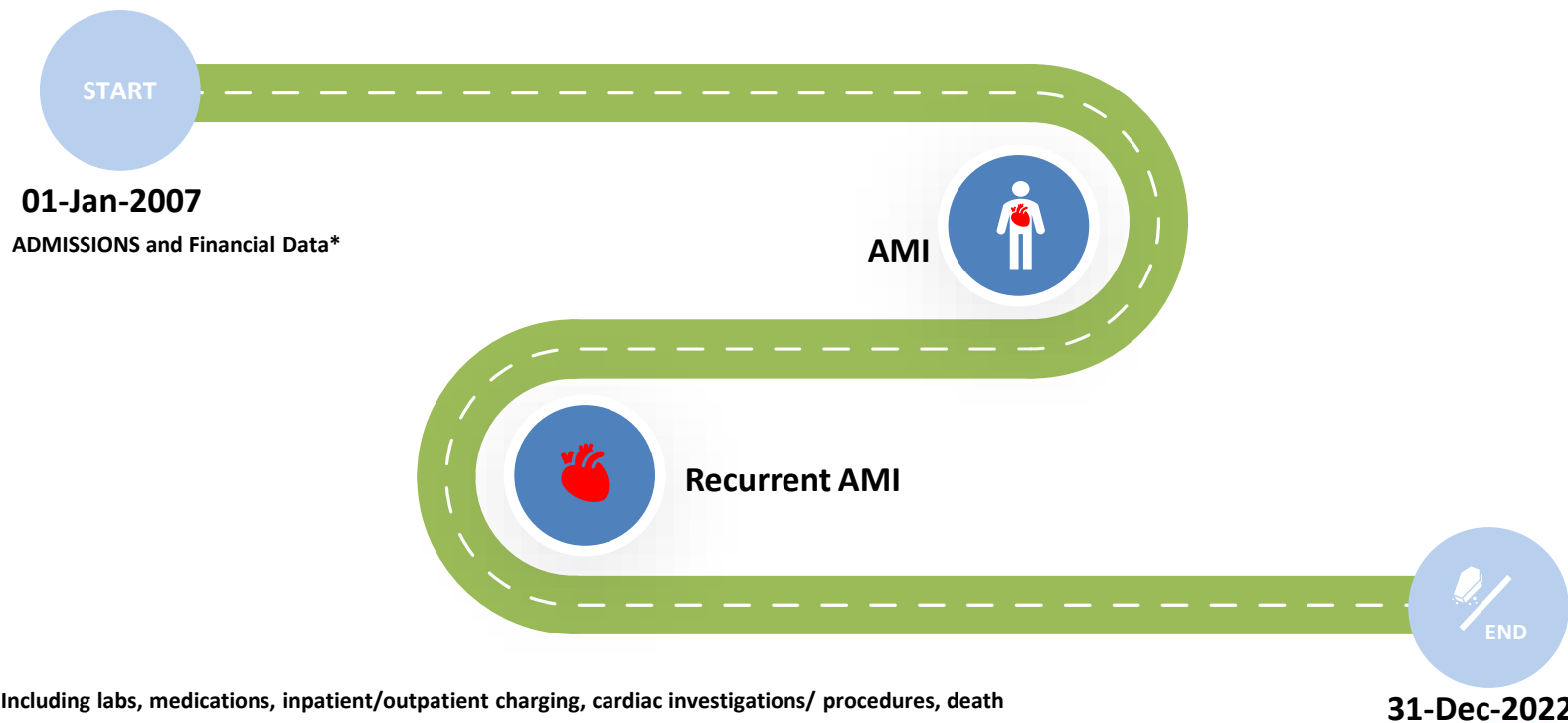


● NEHR ● Omnibus  
● EDW ● National Registry  
● Ehints

- Patient Demographics
- Events and Diagnosis
- Laboratory
- Medication
- Procedure Data (PCI, CABG)
- Heart Failure
- Nuclear/Echo
- Financial (Inpatient, Outpatient, Medication)
- Admissions/Procedural
- SCDB EPS w/wo AF Data
- Mortality (National Registry of Birth & Deaths)

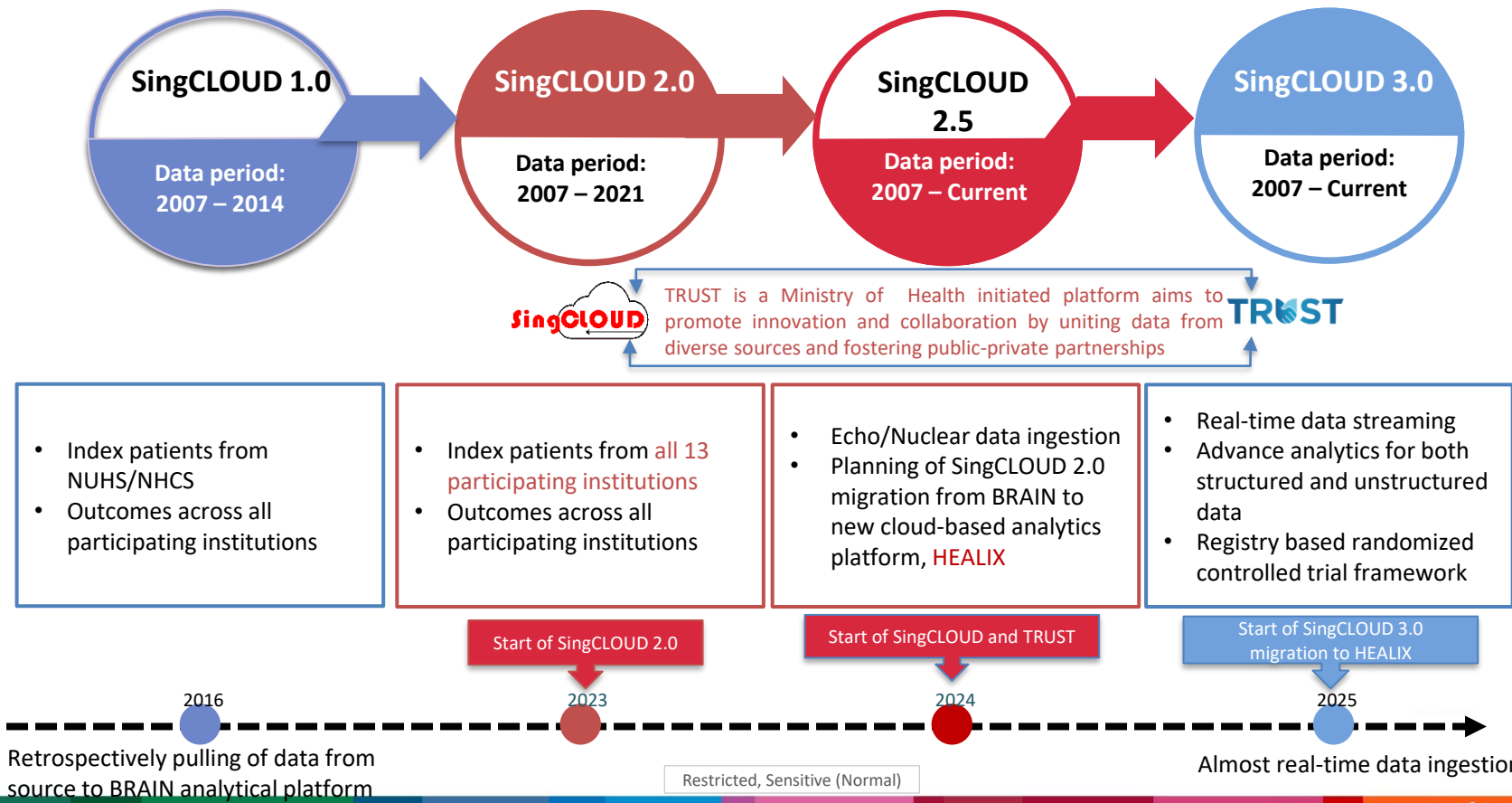
\* > 2000 data fields

# SingCLOUD Patient's Journey



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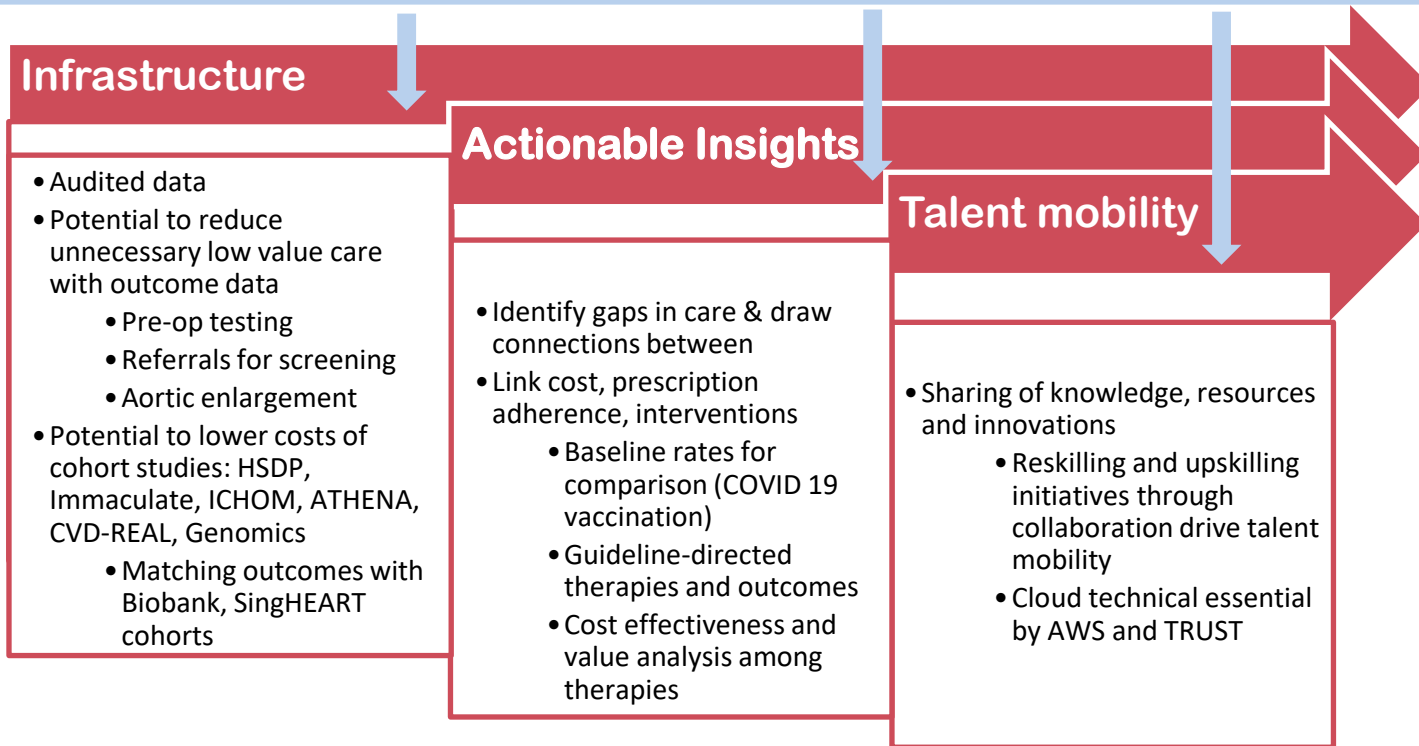
# SingCLOUD Timeline





# Achievements

Data driven care to support population health & value driven care as we move towards capitation



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# Collaborations

**33** Projects approved **14** RCA executed

## Overview of collaborator



|   |  |
|---|--|
| <p>SingCLOUD 2.0 onboarding to</p>   | <p>First batch of data has been uploaded to the TRUST platform and provision to users for linkage to other datasets in TRUST platform for analysis.</p>  |
| <p>Novartis Foundation</p>     | <p>Understanding which determinants drive cardiovascular health risk factors and outcomes in diabetic, acute myocardial infarction and heart failure patients. Quantify the effect of these determinants on health outcomes</p>              |
| <p>Covid19-CVD Outcome Study, Collaboration with PREPARE</p>             | <p>COVID-19, Dengue and Influenza infections on AMI and HF incidence, Severity and Outcomes</p>  |
| <p>Clinical and cost effectiveness of treatments for heart failure</p>   | <p>Evaluate the clinical and cost-effectiveness of different pharmacological treatment regimens for heart failure</p>  |
| <p>Ischemic heart disease (IHD) MOH workgroup</p>                    | <p>Determine gaps in treatment or processes that can then be improved upon and tracked accordingly in patients with IHD. The workgroup will also establish reference data points so that data can be compared and benchmarked over time.</p> |

# Funding

- Stakeholder engagement
- Industry engagement
- Win-Win scenarios

# Why co-fund SingCLOUD?

- An unparalleled resource for CV research and QI on a national scale
  - One-stop platform with governance, analytical infrastructure and data. Critical for identifying gaps in CV care
  - Potential to reduce unnecessary low value care
  - Ability to rapidly answer important cardiac questions relevant to policy making eg. COVID19 vaccine related myocarditis
  - Reduce cost of work of NRDO
- Allow linkage to other cohorts and match for CV outcomes
  - Potential to lower costs of cohort studies eg. RHS cohorts, DM, renal failure and genomic cohorts

# ACTIONABLE INSIGHTS

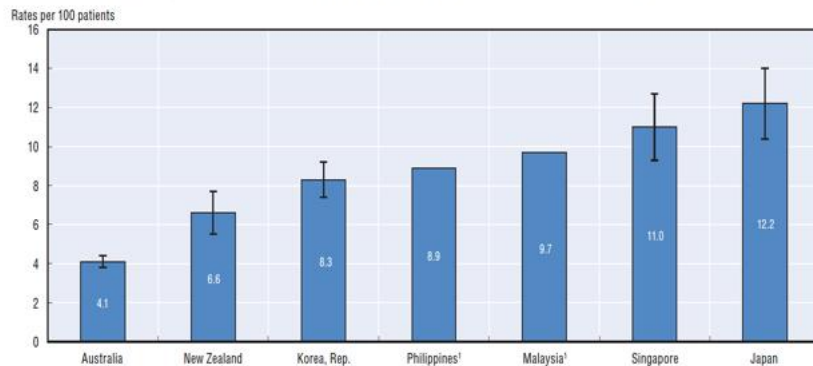
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# #1: Gaps in MI Care in Singapore



IN-HOSPITAL MORTALITY FOLLOWING ACUTE MYOCARDIAL INFARCTION AND STROKE

5.4. In-hospital case-fatality rates within 30 days after admission for AMI, 2013 (or nearest year)



**The problem statement:**

In OECD report, Singapore has relatively worse mortality compared to other Asian countries.

# Actionable Insights

- Identified a gap for intervention. LDL reduction by at least 40% is associated with lower risk for mortality and MACE.
- Physician prescription of statins is suboptimal.
- Next steps: identify interventions that can improve compliance and evaluate for efficacy of such steps

# #5: Supporting the NRDO SMIR (Singapore MI Registry)



National Registry of Diseases Office



**NRDO AMI registry report 2013**

**vs.**

**SingCLOUD AMI data**

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# Matching Against Other Cohorts

- SingCLOUD 2.0 built with capability for matching against other cohorts for cardiac events.
- Reduces overall research costs and accelerates research.
- Eg. matching with RHS cohorts, DM, Renal Failure, Eye, Genomic cohorts.
- Will be used for matching outcomes in AMI-HOPE study.

# Building for the Long-Term

- SingCLOUD for the future – research, policy and planning
- Demonstrate value
- Re-usable
- Benefits whole country, and across multiple disciplines

# What Worked

- Common and long-term vision
- Finding like-minded partners: IHiS, MOHH, MOH
- Team-work, strong leadership support
- Shared roles, equal votes
- Hurdles are meant to be crossed
- Work with and through the laws
- Persistence, patience

# What for the Future?... SingCLOUD 3.0

- Better and more data (ECG, wearables, voice/retina images)
- Real-time or near-real time data
- Advanced analytics for both structured and unstructured data
- Data lake concept
- Harmonized approvals for IRB, IT, Data and Governance
- Registry-based randomized controlled trials



## Thrombus Aspiration during ST-Segment Elevation Myocardial Infarction

Ole Fröbert, M.D., Ph.D., Bo Lagerqvist, M.D., Ph.D., Göran K. Olivecrona, M.D., Ph.D., Elmir Omerovic, M.D., Ph.D., Thorarinn Gudnason, M.D., Ph.D., Michael Maeng, M.D., Ph.D., Mikael Aasa, M.D., Ph.D., Oskar Angerås, M.D., Fredrik Calais, M.D., Mikael Danielewicz, M.D., David Erlinge, M.D., Ph.D., Lars Hellsten, M.D., Ulf Jensen, M.D., Ph.D., Agneta C. Johansson, M.D., Amra Kåregren, M.D., Johan Nilsson, M.D., Ph.D., Lotta Robertson, M.D., Lennart Sandhall, M.D., Iwar Sjögren, M.D., Ollie Östlund, Ph.D., Jan Harnek, M.D., Ph.D., and Stefan K. James, M.D., Ph.D.



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# SingCLOUD Summary

- Retrospective
- Long gestation with governance and funding requirements
- Multi-domains of data
- National level
- Large numbers and outcomes tracking across MOH and all public hospitals
- Beginning to show fruits in supporting research and policy



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