NUHS
National University Health System

NMRC Research Symposium 2024

Advancing Population Health Research

Strategy mapping from needs to intervention in Metabolic Health

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COI Disclosure Information

Advisory Board

BMS, Gilead, Novartis, Abbvie, MSD

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Gilead, Novartis, Abbvie
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Perspectum, AMRA, Histoindex

What is Population Health?

Policy Approach

Identify subpopulation

(i) Multidimensional determinants of Health
(ii) Health inequalities
(iii) Service Provision and access
(iv) Targeted Strategies
(v) Sustainbility
(vi) Collaborate across services

Population's Health

Accountability-
Health of a population

(i) Basis of 3 cluster health system
(ii) Focus on bottomline for health outcomes
(iii) Shift focus from disease to health

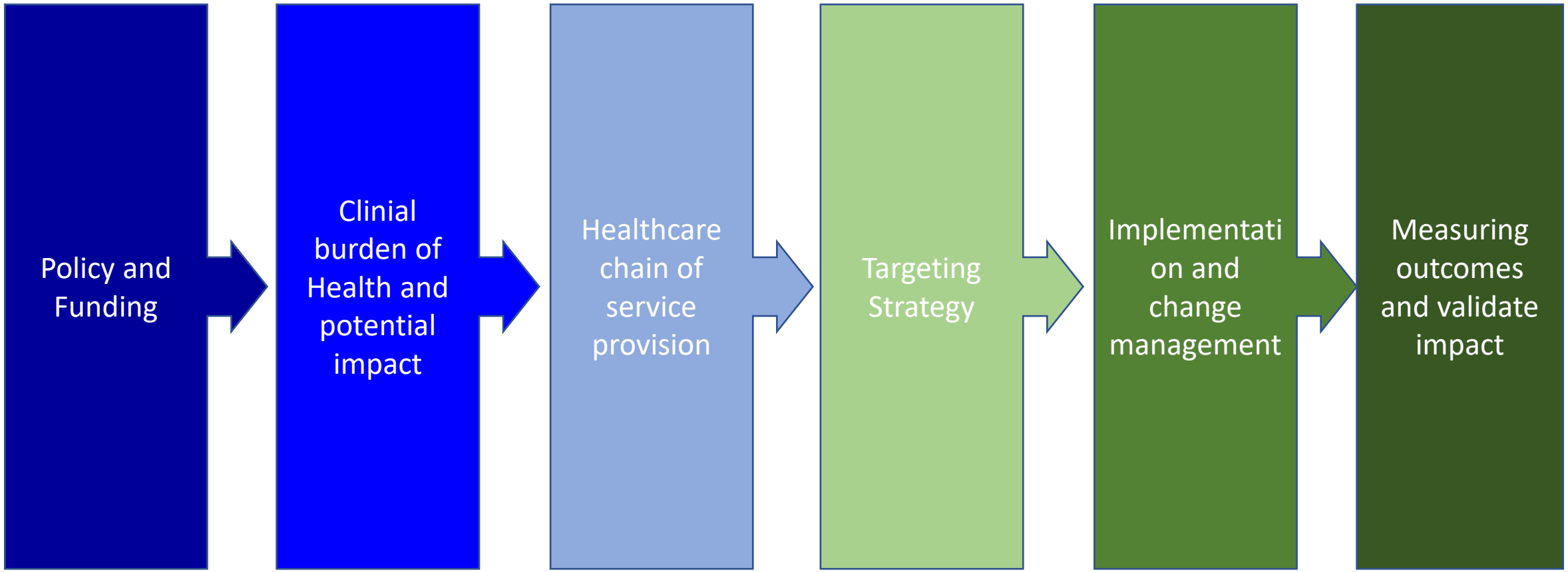
Focus on Action

Identify subpopulation

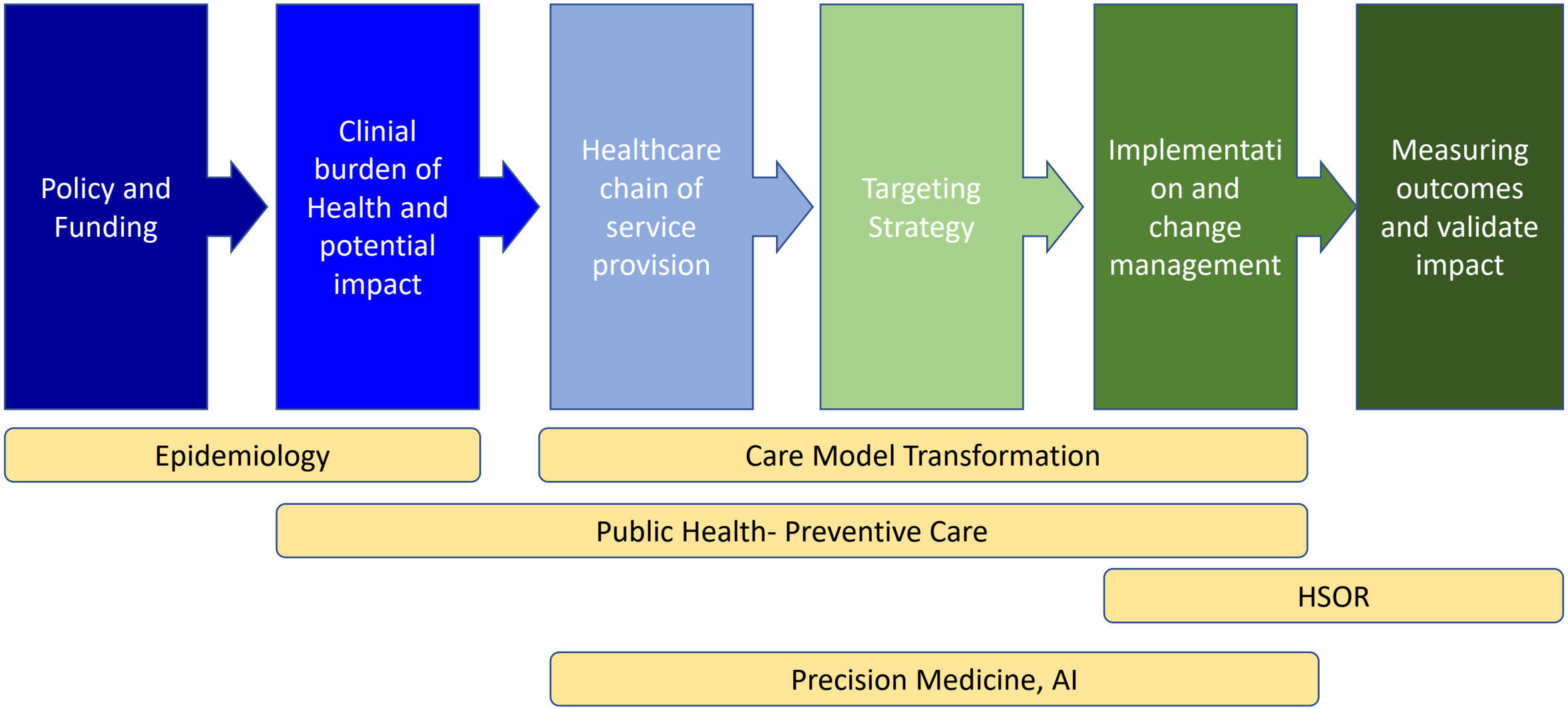
(i) Encourages holistic longitudinal care over single contact care
(ii) Shift to upstream preventive care
(iii) Integrated care
(iv) Community engagement
(v) Evaluation and Improvement

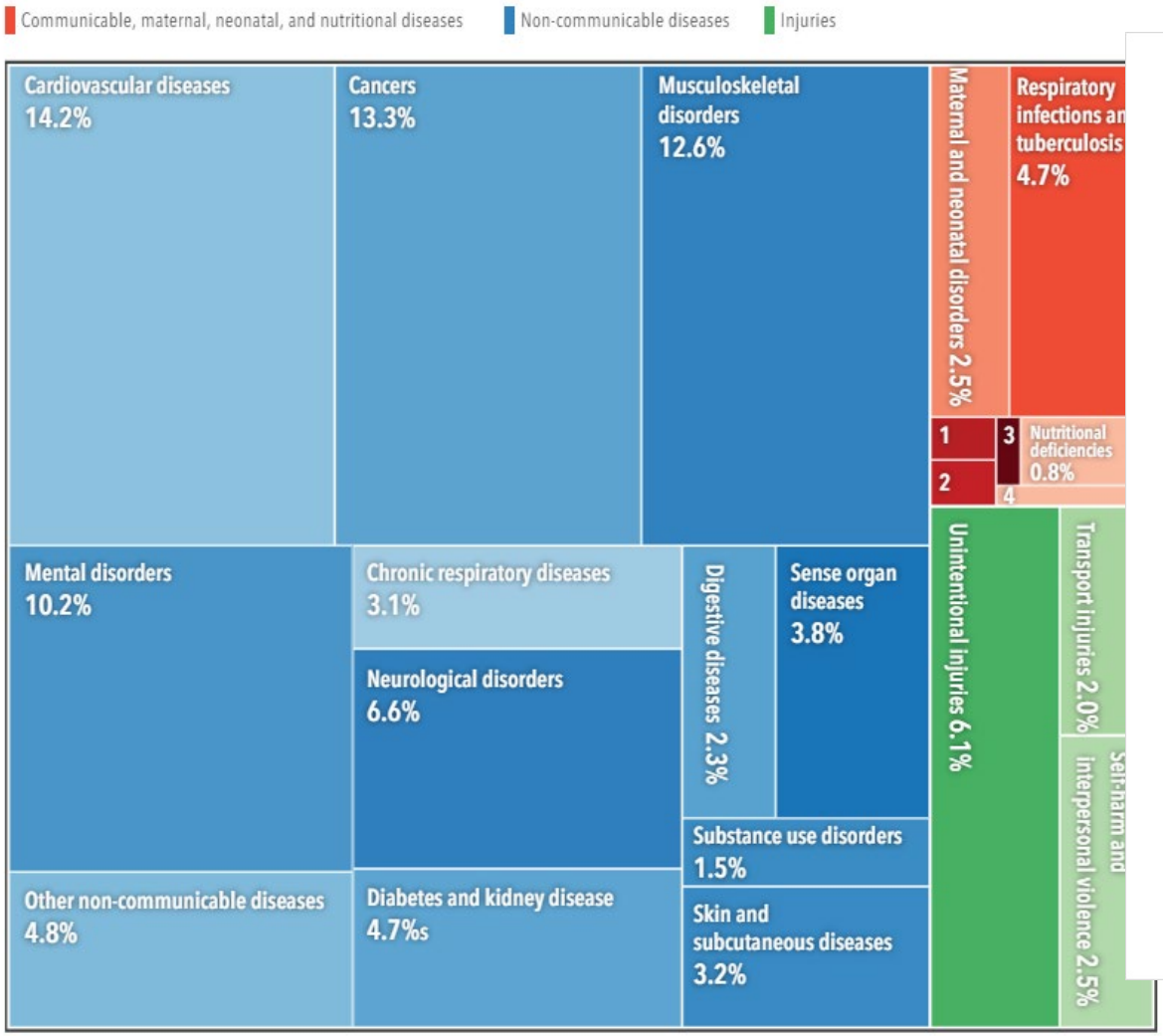
Population Health

Mapping Singapore's Population Health Challenge

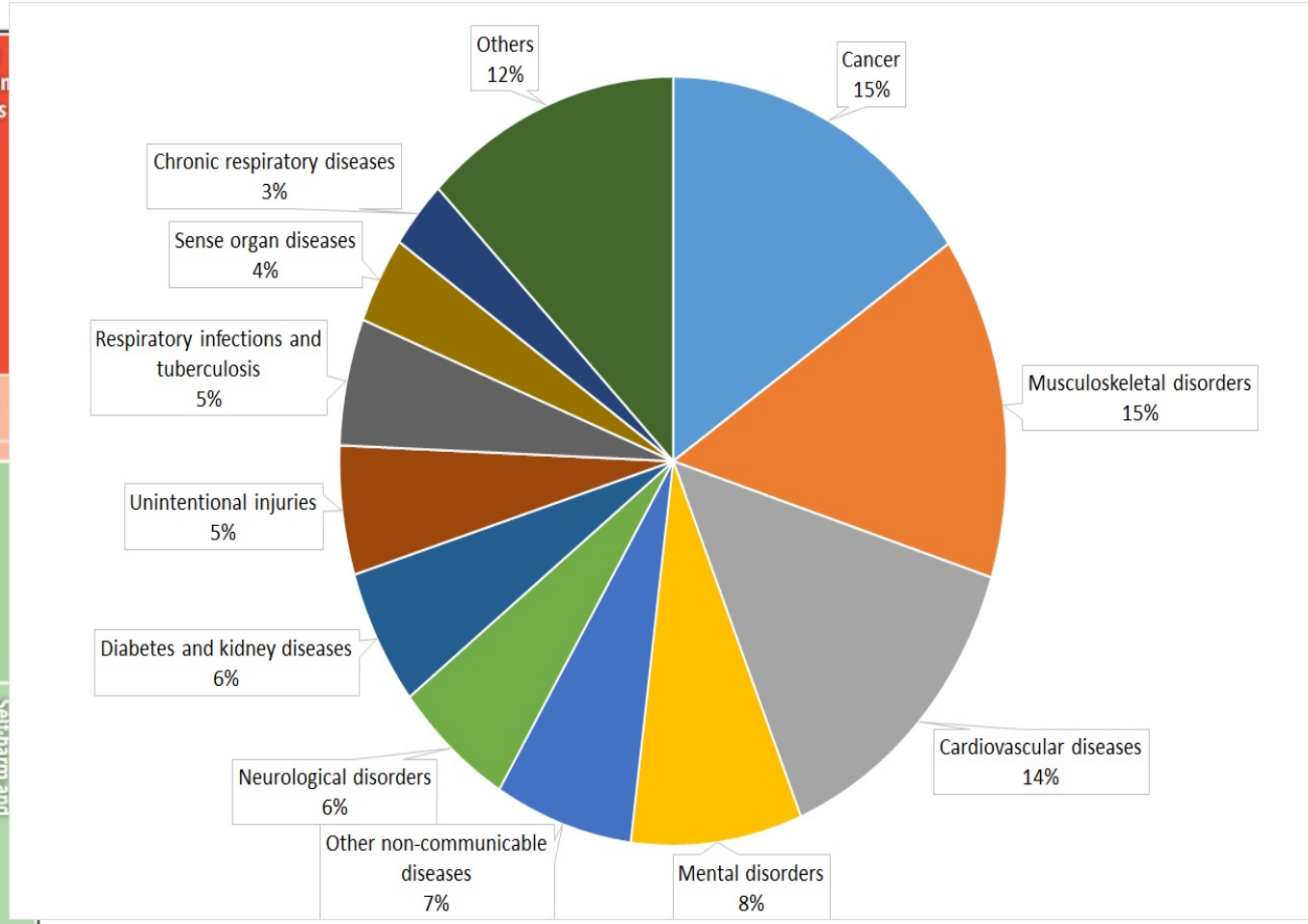


Mapping Singapore's Population Health Challenge





The Burden of Disease in Singapore, 1990–2017
IHME, MOH 2017



MOH Burden of Disease 2022

Societal Cost of health by disease

Loss of Economically productive years from premature health event

Poor healthspan affecting QOL
Increased healthcare cost

Cost of dependence on care and basic needs

Total of 1,047,768 life-years lost due to mortality and ill-health in 2019

- Elderly care
- Dementia
- Stroke
- End-organ disease

Where are we heading?

RIE 2020

Health and Biomedical Science (HBMS)

(i) Cancers
(ii) cardiovascular diseases
(iii) diabetes mellitus and other metabolic / endocrine conditions
(iv) infectious diseases
(v) neurological and sense disorders

RIE 2025

Human and Health Potential

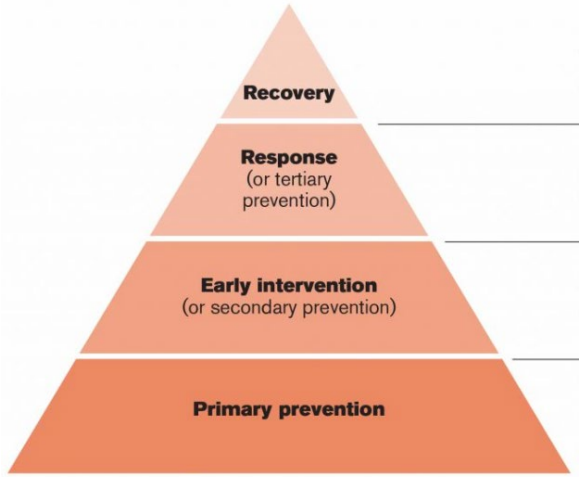
(i) Childhood Development
(ii) Aging

Platforms

(i) PREPARE
(ii) PRECISE
(iii) Population Health: Connected clinical networks
(iv) Health Service Outcomes
(v) Health Tech

? RIE 2030

Finding the soft belly for key diseaes



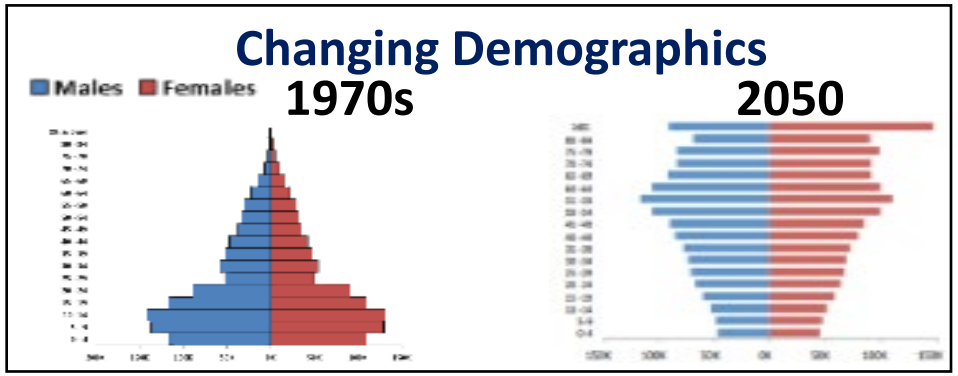
Who are the ones in trouble?
Can we find them?

Why are they in trouble?
What are the modifiable risk factors?

What can we do and how to do it

Stake Holders

The impetus for transformation



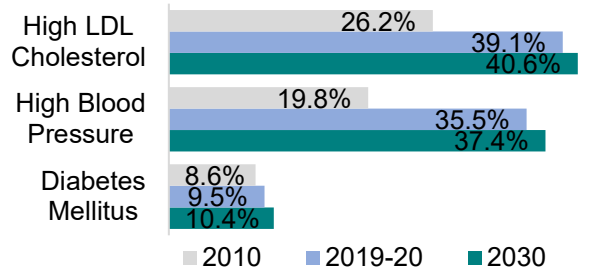
2006 — **6.9** citizens of working age to 1 older adult

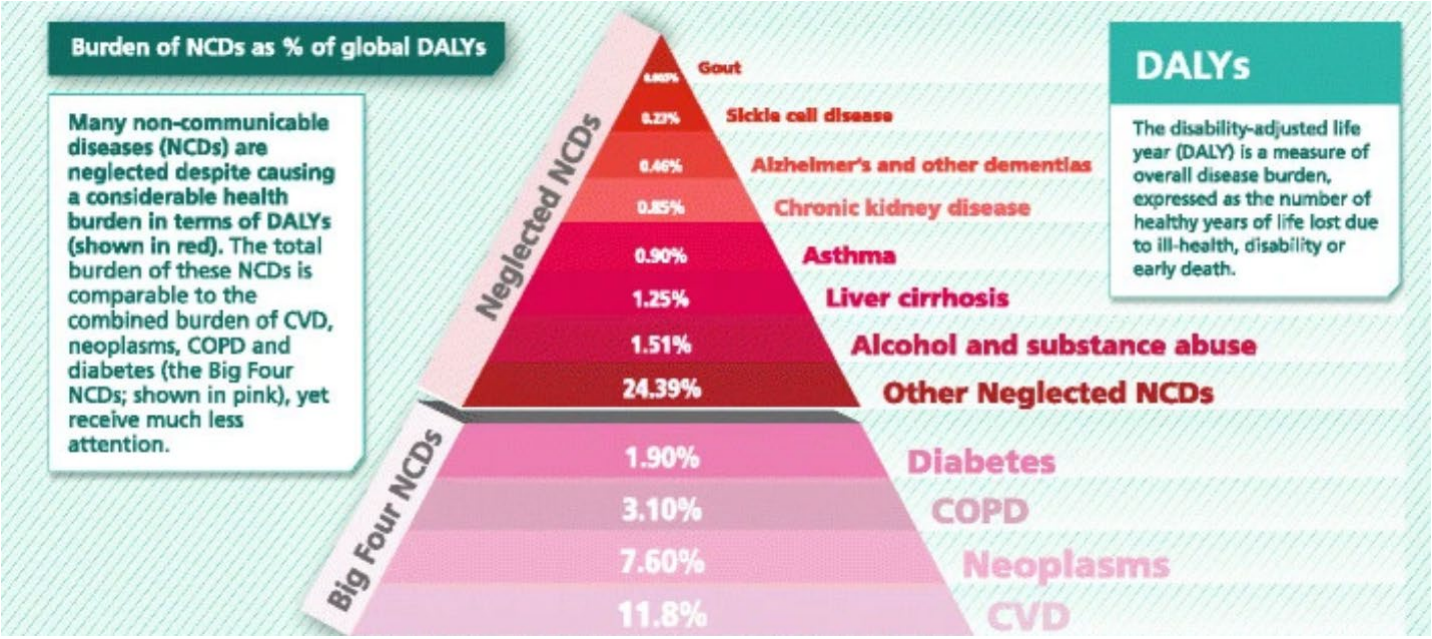
2016 — **4.7** citizens of working age to 1 older adult

2030 — **2.3** citizens of working age to 1 older adult

Singapore took only 19 years to go from 'ageing' to 'aged', and reached this milestone in 2017.
We are projected to attain 'super aged' status in 2026.
By 2030, 1 in 4 citizens will be aged 65 and above.

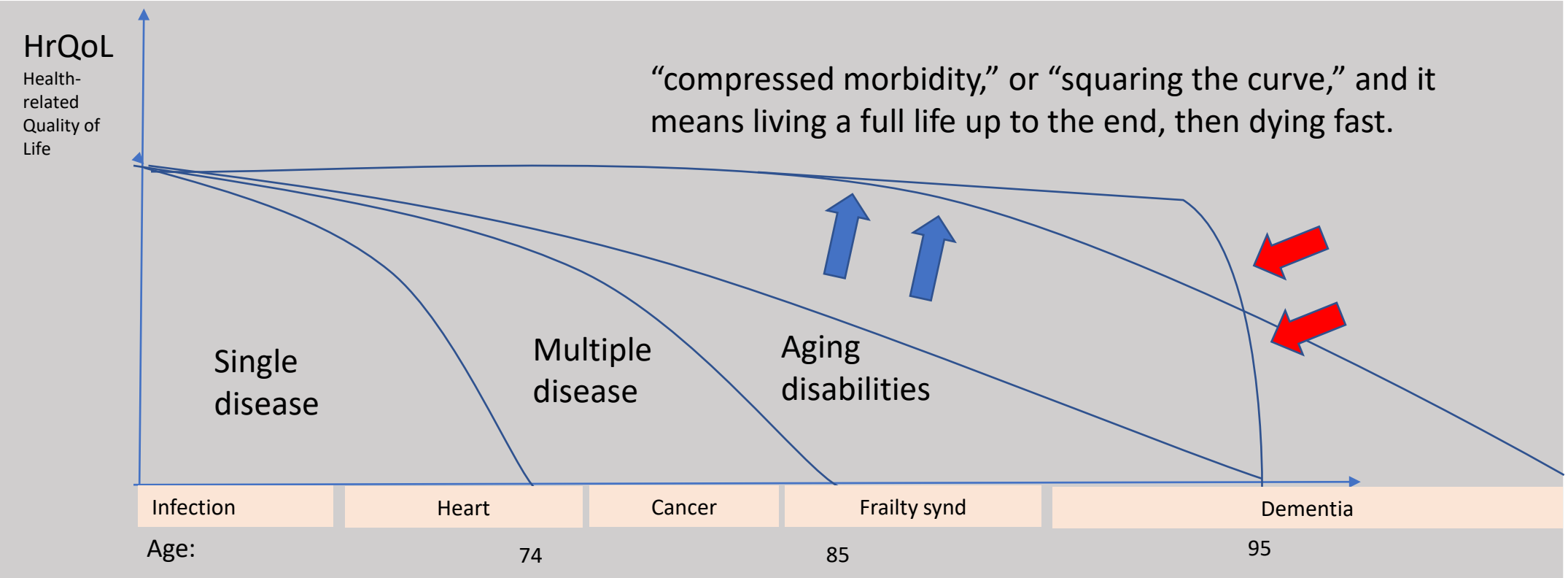
Crude Prevalence of Chronic Diseases for Residents Aged 18-74 will continue to increase





How can research advance this approach?

- The conundrum of better care



1. Paradox of swapping diagnosis as cause of death
2. Cumulative cost over time may be more expensive

Targeting the high risk population

- Age, Gender, family history , Race
- Modifiable: lifestyle, diet, smoking, drinking
- Metabolic profiling = obesity, metabolic syndrome

- Socioeconomic status (health awareness, attention and access)
  - Rental flat, income band
- Social isolation. Retired (male)
- Persons with disabilities, night shift workers, taxi drivers
- "Frequent flyers", social and financial needs

Genomics, phenomics, environomics
Geographical access to hawker center (fast food), exercise facilities, community activities, health facilities
Healthy diet and ecosystem

Beyond Healthcare to Health (Aging)

Healthier SG

Healthy SG

LIVE WELL AGE WELL

Aging in Place

Assignment through cluster

Primary Care Transformation

Data sharing

Premise Neutral Care

Aging Support in Communuty

EOL Care

Community partners

Health Financing

Team based care

Patient enrolment

One GP

One Health plan

Frailty

Dementia

Preventive Care

Care Protocols

QI Accountability

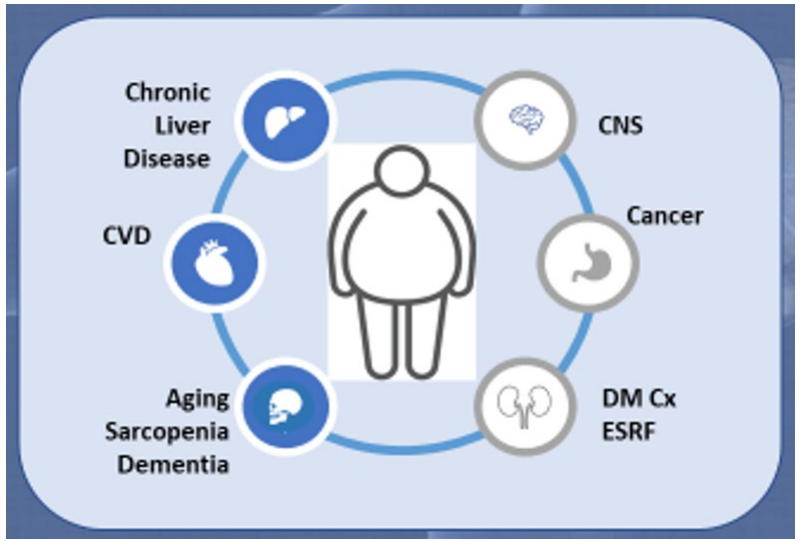
Social isolaton

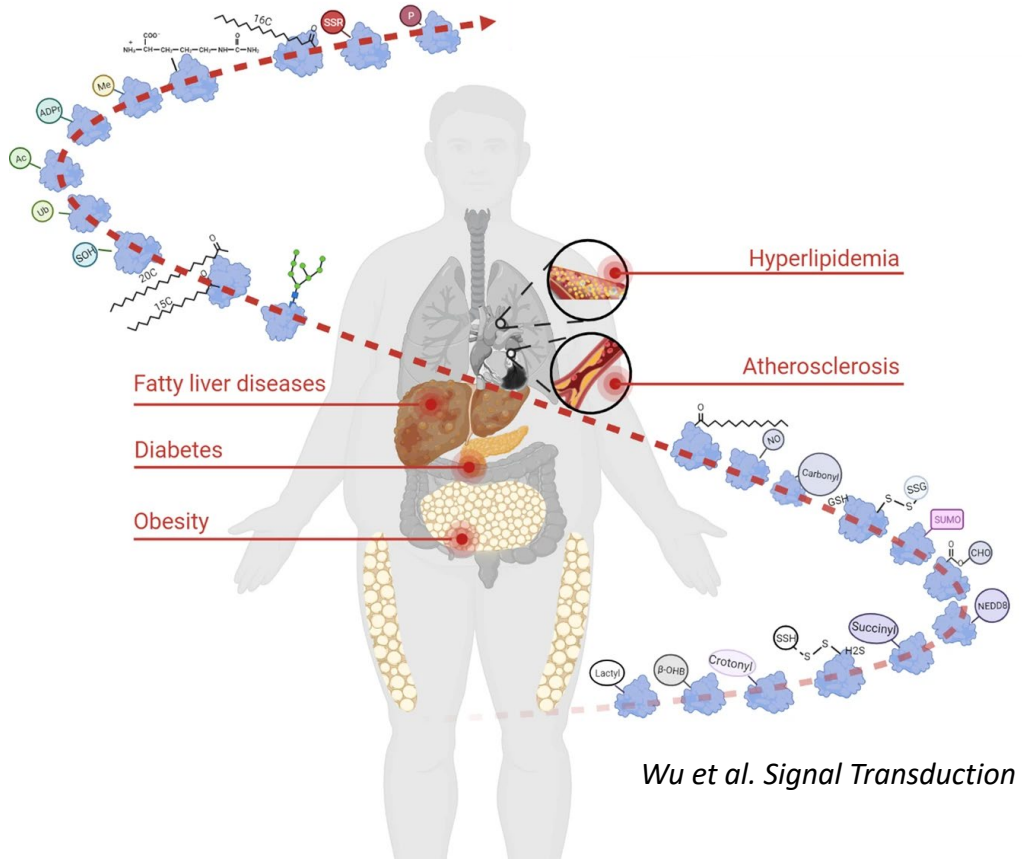
Improvement in disease prevalence/ outcomes

Improve population health span

Curtailing the rise in demand and cost

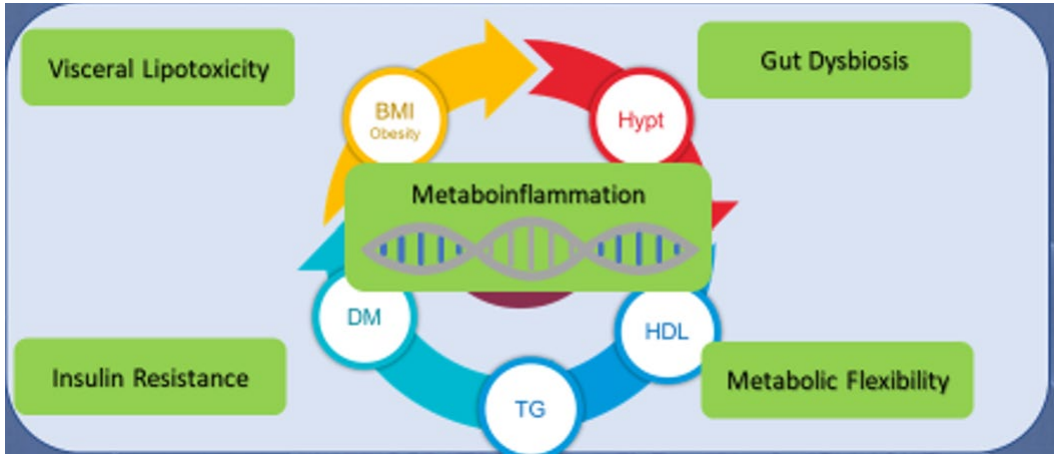
Can we go upstream to target process of premature/ accelerated aging/ orgain injury





Wu et al. Signal Transduction and Targeted Therapy 2023

Obesity is chronic process of low grade systemic inflammation

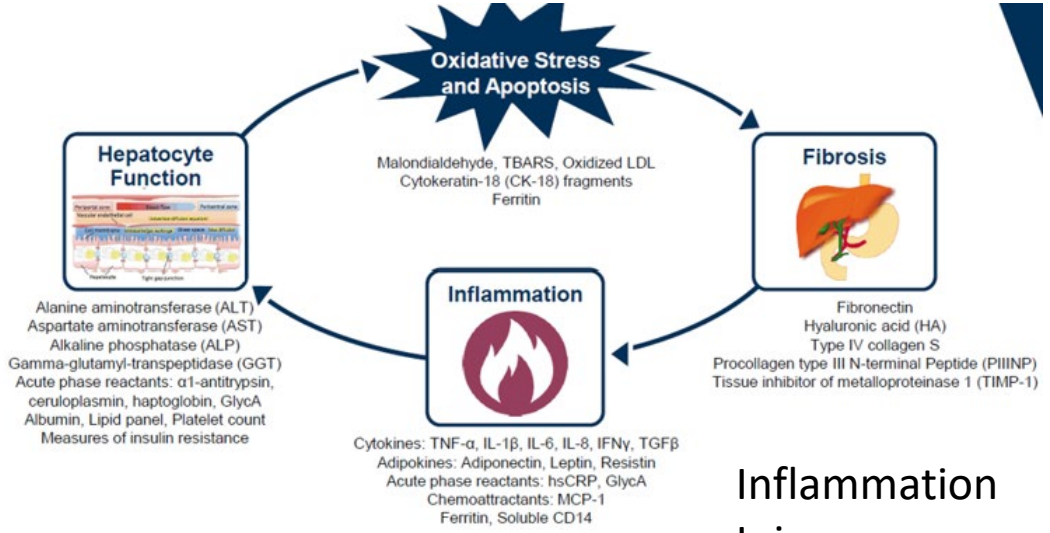


Smurfless CVD
Lean steatotic liver disease

Genetic + metagenomics

Diet
- Proinflammatory diet
- Imbalance

- Sarcopenia
- Sedentary lifestyle

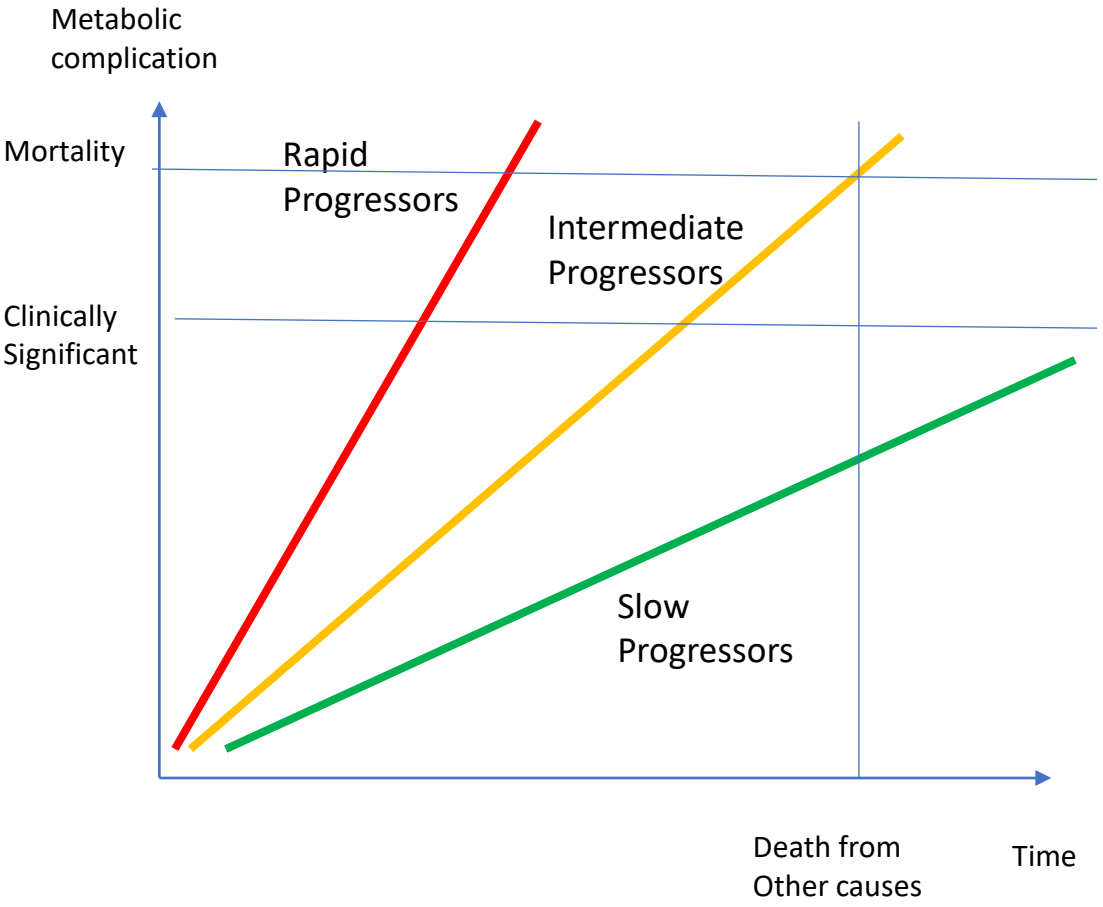


Metabolic flexibility
Ectopic fat

Inflammation
Injury
Fibrosis

Liver
Endothelium
Heart
Kidney
Lung
Brain
Joints
Muscle

Population Segmentation



Personalised Humanomics of Metabolic Disease

- Genomics
- Metagenomics
- Phenomics
- Nutrition
- Lifestyle
- Asscociated Factors

Personalisation of risk
Patient empowerment
Lifestyle support for intervention

Example: Targeting taxi drivers

- Male taxi drivers are a particularly high-risk group because of their typically unhealthy behaviours, such as poor eating habits, smoking and sedentary lifestyle.

McMahon Pilot and Feasibility Studies 2022

- Thirty-one per cent, 36% and 24% reported none, one and two medical conditions, respectively. These included hypertension (56%), eye disease (25%; cataracts 19%), diabetes (24%), corrected hearing impairment (14%), hyperlipaemia (12%) and heart disease (9%). Deafness ($P < 0.001$)

Chan et al. Occup Med (Lond). 2019

- HPB and ComfortDelGro: 10-month “One for One: Check Car, Check Body!” Health Screening and Intervention Programme
- AHS, in collaboration with SMRT and Health Promotion Board, has run a preventive health screening and coaching programme. 50% have made medical appointment

Validation → Cost-effectiveness → Scale up → How many healthy life years saved?

I. Justification of basis, capability and aim

What are the basis and aims for focusing on chosen POC tests?

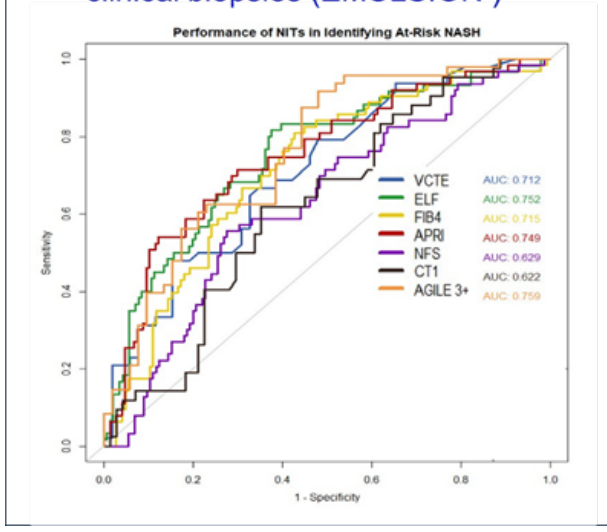
Aim : Develop and validate community assessment to identify at-risk patients following preliminary data of visceral lipotoxicity and metaboinflammation

1. Visceral Adiposity as measure of metabolically at-risk patients

At-risk NASH	Visceral Adipose Tissue (VAT) ratio – AUC 0.745	**F3-4**	Visceral Adipose Tissue (VAT) ratio – AUC 0.737
	Visceral Adipose Tissue (VAT) volume- AUC 0.673		Visceral Adipose Tissue (VAT) index – AUC 0.658
	Visceral Adipose Tissue (VAT) index – AUC 0.668		Abdominal Subcutaneous Adipose Tissue (ASAT) volume – AUC 0.645
	Liver Fat – AUC 0.631		Total Adipose Tissue (TAT) volume – AUC 0.635
	Abdominal Subcutaneous Adipose Tissue (ASAT) volume – AUC 0.628		Visceral Adipose Tissue (VAT) volume – AUC 0.630

2. Surrogate of visceral adiposity predict progression

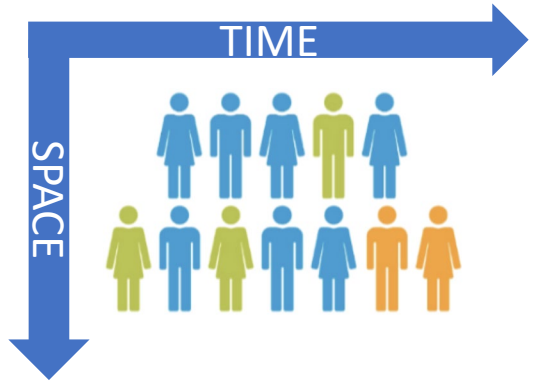
NIT Predicting at Risk NASH from clinical biopsies (EMULSION)



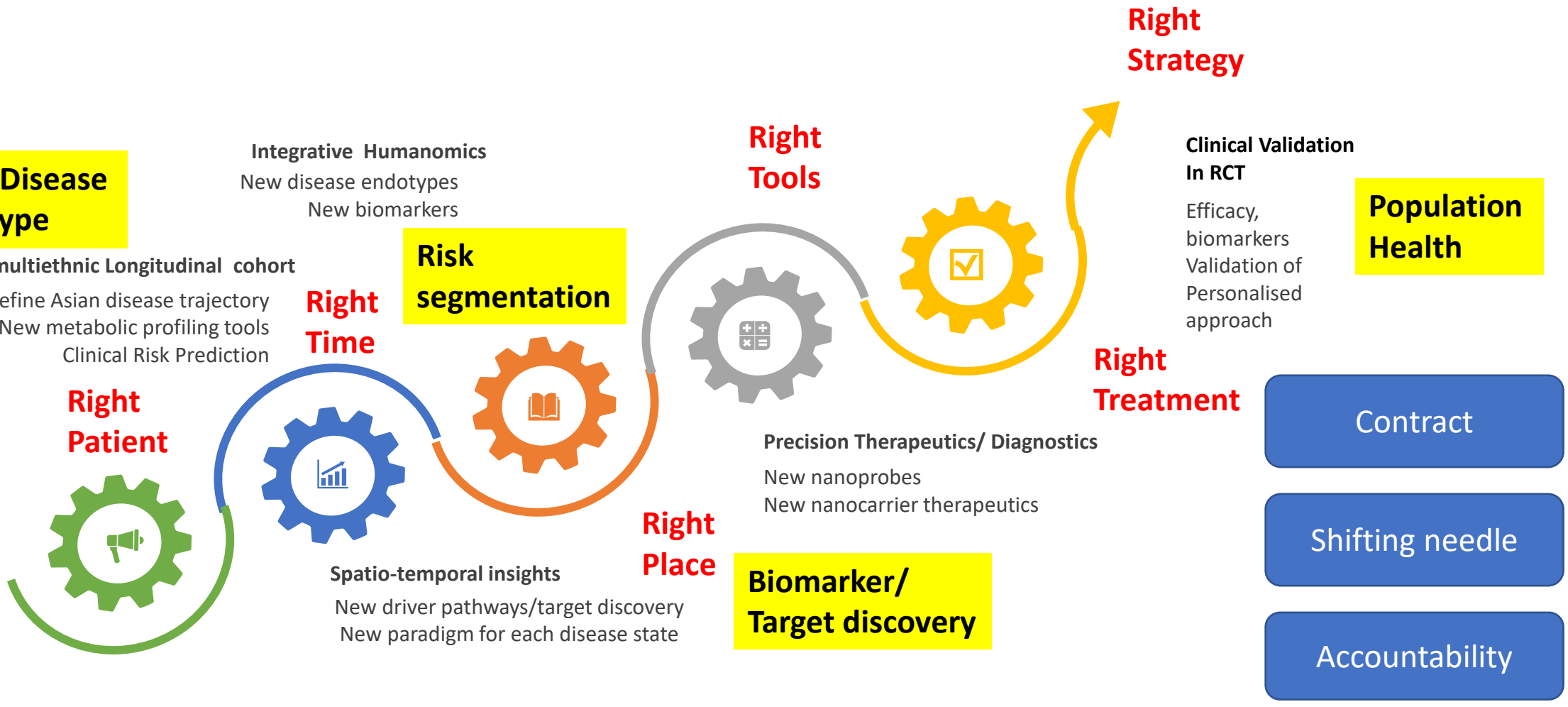
NIT Predicting progression in steatofibrosis in community cohort (based on VCTE over 5 years FLAP-D)

Multivariate regression of **baseline** factors associated with worsening in fibrosis as compared to stable/improvement in fibrosis

Variable	exp	95%CI		p
Weight	1.019	0.981	1.057	0.339
SD	0.846	0.707	1.012	0.068
WC	1.15	0.991	1.071	0.135
HC	0.99	0.956	1.027	0.596
hs-CRP	1.15	1.051	1.266	0.00257
ALT	1	0.97	1.005	0.12815
Uric acid	0.996	0.996	1.004	0.866
Total cholesterol	1.32	0.974	1.784	0.073
Triglyceride	1.02	0.638	1.621	0.936
Fasting C-peptide	0.998	0.996	1	0.021
MI_BW1	0.002	3.75x10^-8	123.52	0.271



Tracking our Asian sub cohorts through dimensions of time, space and biology



Population Screening
-Age, family history
-Metabolic manifestation
- Lifestyle

Phenotyping for baseline risk and trajectory
- Visceral adiposity
- Metabolic inflammation

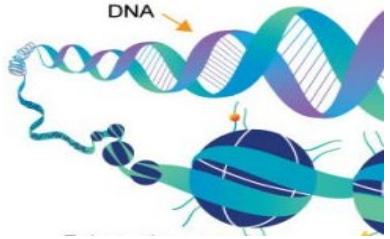
Secondary Prevention – lifestyle support and, intervention

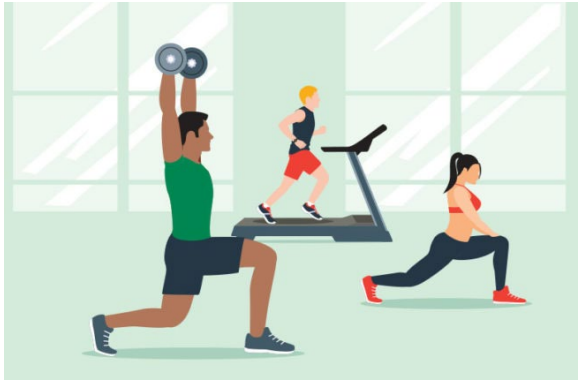
Community Assist

Personalised Therapy for metabolism subtype

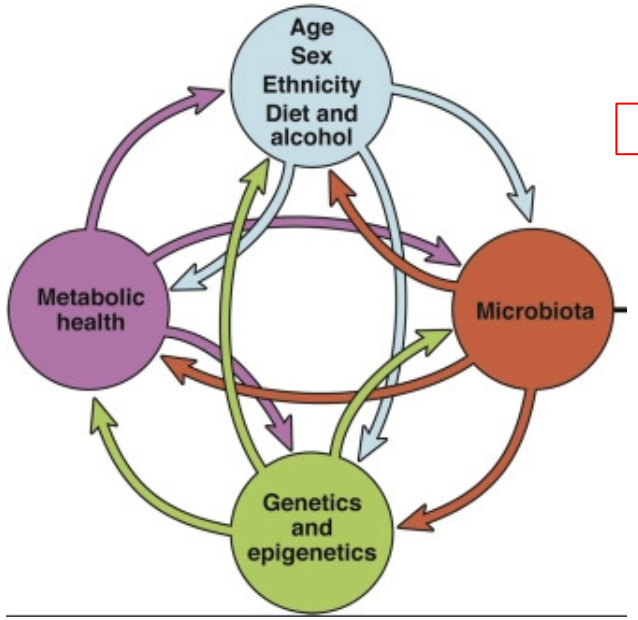
Genomics

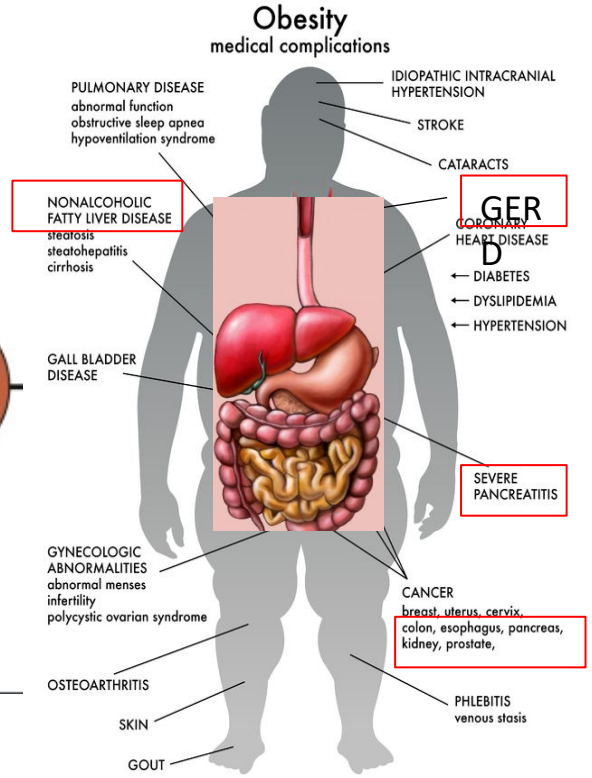
Epignomics





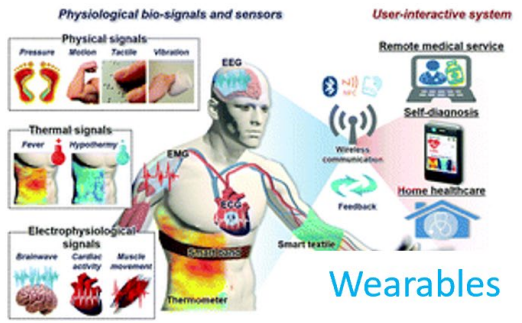
Metagenomics

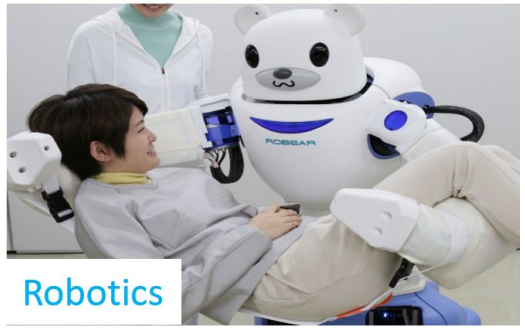


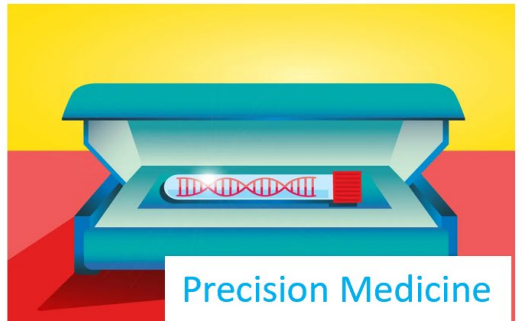


Common Challenges in Pop Health Research?

- Focusing on the tools
  - Wearables/ Data and AI
  - Teleconnectivity
  - Telenudging/ coaching
  - Care Concierge and co-ordinators
  - Precision Medicine







Common Challenges in Pop Health Research?

- Proving the hypothesis
  - What's the use case?
  - What's the hypothesis
  - Over-emphasis on the surrogate indicators
  - Targeting and recruiting the right audience.
  - Powered incorrectly
  - Collecting the right data esp for CEA
  - Extension ad lib
  - Running out of steam

Common Challenges in Pop Health Research?

- Real world challenges
  - Care Champions are not clonable
  - Incentivisation and real world limitations
  - understanding the inflection point
  - Using powerpoint to boil the ocean
  - Should do and will
  - Incentivisation and real world limitations
  - Empowering patient
  - Myth that people want to be healthy
  - Underestimating the ecosystem, universe and KPA

Thank You