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POPULATION
HEALTH



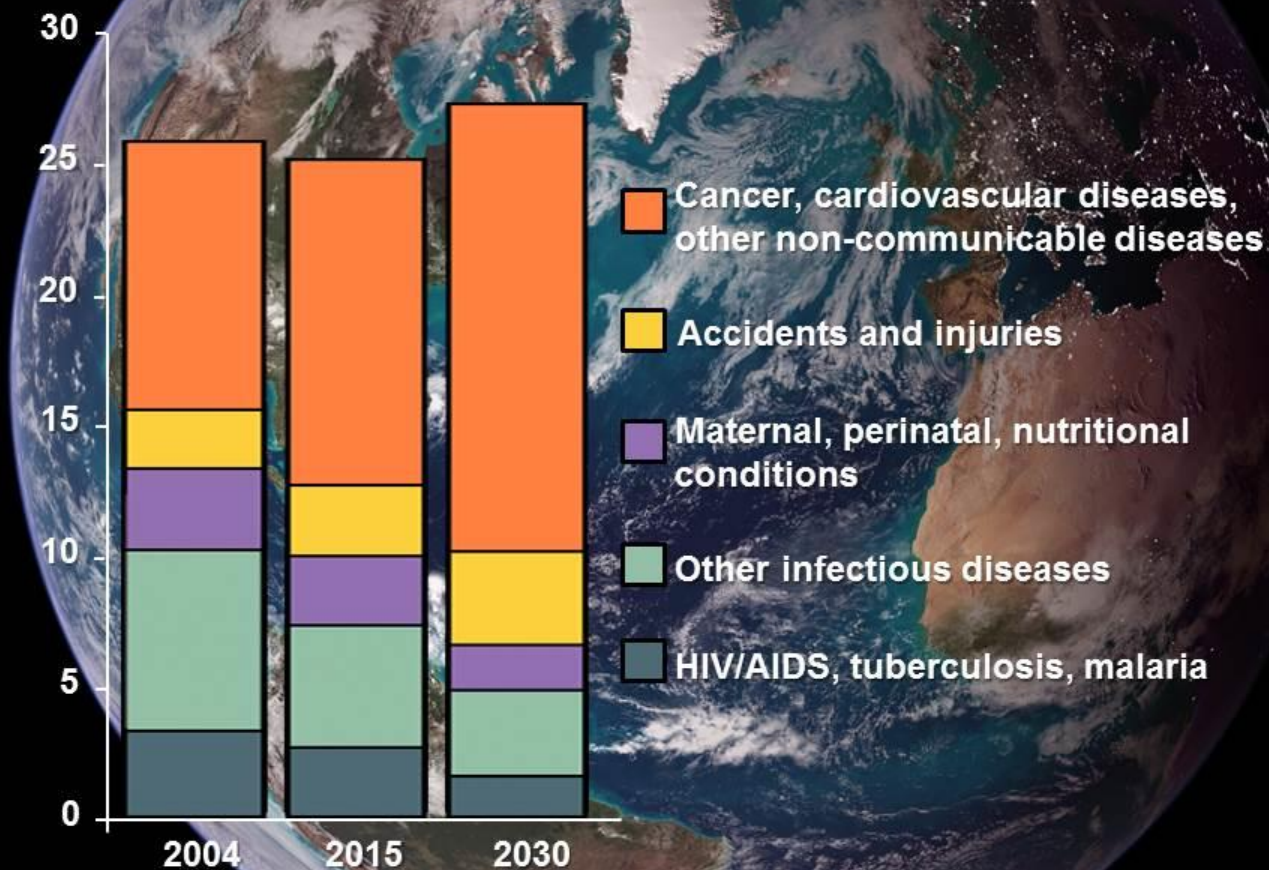
Achieving Better Outcomes: Prioritising Policies for Action on Chronic Diseases

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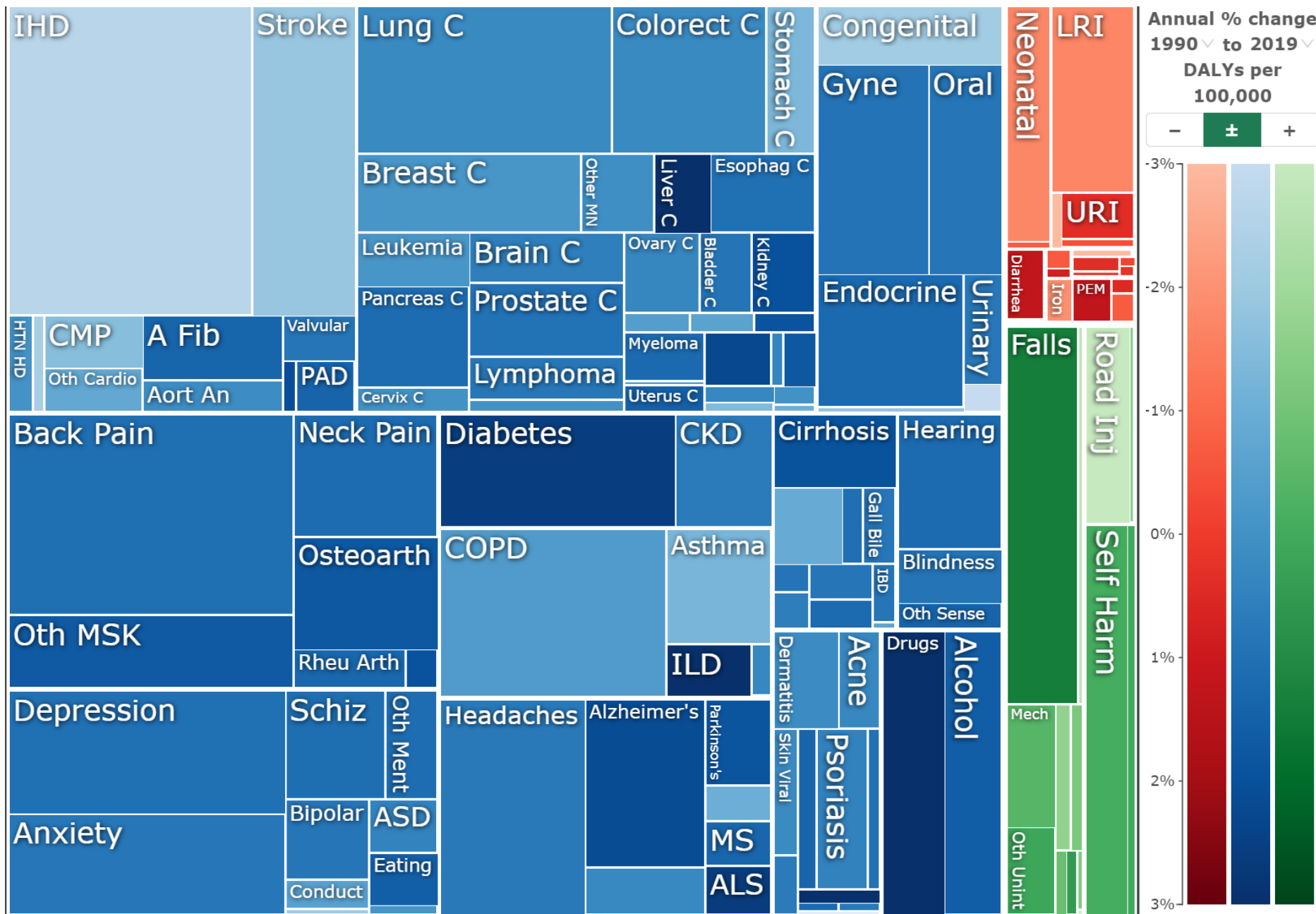




Contemporary attributes

- Multifactorial aetiology
- Survival increasing dramatically
- Persistent prevalence even where incidence is decreasing
- Develop over decades from youth
- Early-onset obesity and diabetes and social inequalities are particular impediments
- Multimorbidity (or MLTCs) as by-products of greater survival without better underlying health

The Diversity of Factors Contributing to Loss of Disability-Adjusted Life Years in Ireland



GBD Compare;
Institute of Health
Metrics and
Evaluation

Diversity of dynamics in the problems we face

- Some problems consistently growing and seemingly intractable (e.g. obesity, type 2 DM, inequalities)
- Others rise dramatically then have remarkable wins (e.g. Hep C, HIV, Covid19, other cancers)
- Other have successes over decades through multiple interventions and then stagnate (CVD, DM complications)
- Others rise surreptitiously and become evident and persistent (opioid abuse, youth suicide)
- Some we accept as price for modern life? (road fatalities and injuries, bad air)
- Some are rare, but linked through a common solution may be collectively common
- Other problems are emerging, yet remain undetected



How to approach the problem systematically?

What should a population-based prevention look like?

- Identify efficient **conduits** (or risk factors) of common or multiple conditions.

Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017

A Both sexes

Leading risks 1990

Leading risks 2007

Mean percentage change in number of DALYs, 2007–17

Mean percentage change in all-age DALY rate, 2007–17

Mean percentage change in age-standardised DALY rate, 2007–17

Leading risks 2017

Mean percentage change in number of DALYs, 2007–17

Mean percentage change in all-age DALY rate, 2007–17

Mean percentage change in age-standardised DALY rate, 2007–17

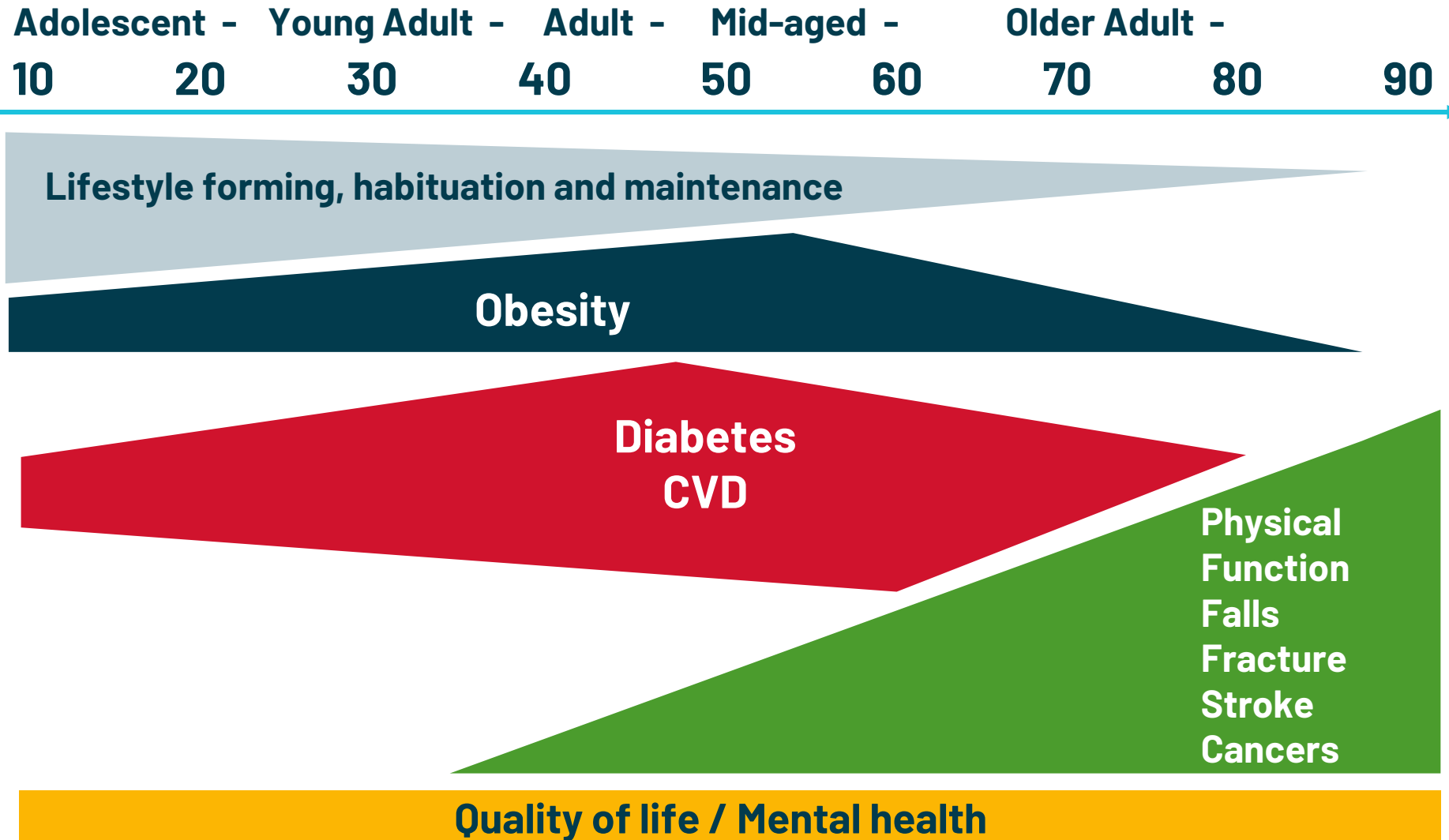
Leading risks 1990	Leading risks 2007	Mean percentage change in number of DALYs, 2007–17	Mean percentage change in all-age DALY rate, 2007–17	Mean percentage change in age-standardised DALY rate, 2007–17	Leading risks 2017	Mean percentage change in number of DALYs, 2007–17	Mean percentage change in all-age DALY rate, 2007–17	Mean percentage change in age-standardised DALY rate, 2007–17
1 Child wasting	1 High systolic blood pressure	22.0	-2.8	-19.4	1 High systolic blood pressure	20.0	6.3	-8.0
2 Short gestation for birthweight	2 Short gestation for birthweight	-24.2	-39.6	-24.2	2 Smoking	8.2	-4.1	-16.4
3 Low birthweight for gestation	3 Smoking	10.3	-12.1	-25.8	3 High fasting plasma glucose	25.5	11.2	-3.2
4 Smoking	4 Child wasting	-47.7	-58.3	-47.9	4 High body-mass index	36.7	21.1	6.8
5 High systolic blood pressure	5 Low birthweight for gestation	-22.5	-38.2	-22.7	5 Short gestation for birthweight	-21.3	-30.3	-24.0
6 Unsafe water source	6 High fasting plasma glucose	51.4	20.7	0.8	6 Low birthweight for gestation	-21.8	-30.8	-24.7
7 Household air pollution	7 High body-mass index	66.2	32.5	11.7	7 Alcohol use	5.5	-6.6	-13.1
8 Child underweight	8 Alcohol use	37.4	9.5	-2.9	8 High LDL cholesterol	17.2	3.8	-9.3
9 Unsafe sanitation	9 Unsafe water source	-38.2	-50.7	-41.8	9 Child wasting	-40.1	-46.9	-43.1
10 Vitamin A deficiency	10 Unsafe sex	302.2	220.6	187.4	10 Ambient particulate matter	12.8	-0.1	-9.3
11 High fasting plasma glucose	11 High LDL cholesterol	17.2	-6.6	-22.8	11 Low whole grains	15.5	2.3	-9.7
12 No access to handwashing facility	12 Household air pollution	-37.1	-49.9	-47.0	12 High sodium	22.7	8.7	-5.9
13 Child stunting	13 Ambient particulate matter	17.3	-6.5	-8.8	13 Low fruit	7.7	-4.6	-15.7
14 Alcohol use	14 Low whole grains	23.4	-1.6	-17.0	14 Unsafe water source	-29.1	-37.2	-35.7
15 High LDL cholesterol	15 Unsafe sanitation	-41.2	-53.1	-44.6	15 Impaired kidney function	20.3	6.6	-5.4
16 High body-mass index	16 Low fruit				16 Household air pollution			
17 Ambient particulate matter	17 Child underweight				17 Unsafe sex			
18 Low whole grains	18 High sodium				20 Unsafe sanitation			
20 Low fruit	19 No access to handwashing facility							
30 Unsafe sex	20 Impaired kidney function							
	21 Vitamin A deficiency							
	23 Child stunting							

How to approach the problem systematically?

What should a population-based prevention look like?

- Identify efficient **conduits** (or risk factors) of common or multiple conditions.
- Identify synergistic **interventions** to efficiently impact multiple outcomes.

Potential impact of physical activity on diseases & conditions: Across the life span

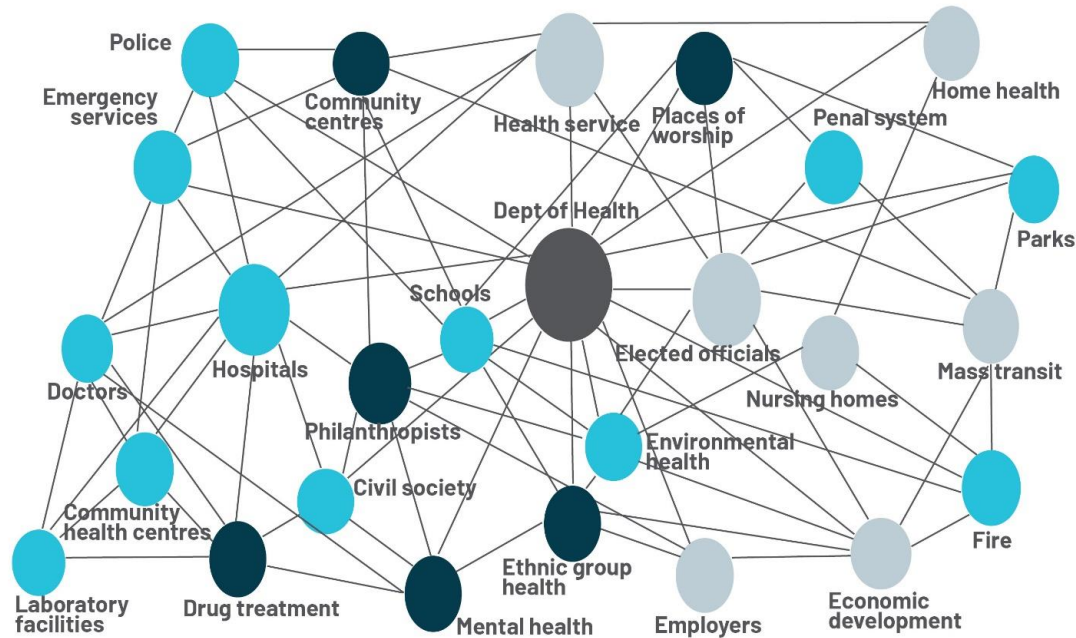


How to approach the problem systematically?

What should a population-based prevention look like?

- Identify efficient **conduits** (or risk factors) of common or multiple conditions.
- Identify synergistic **interventions** to efficiently impact multiple outcomes.
- Act through **diverse, multi-tiered avenues of action**, pairing population-wide with individual-targeted approaches.

Diverse solutions with multiple actors



Clinical services & health systems



Behavioural health promotion



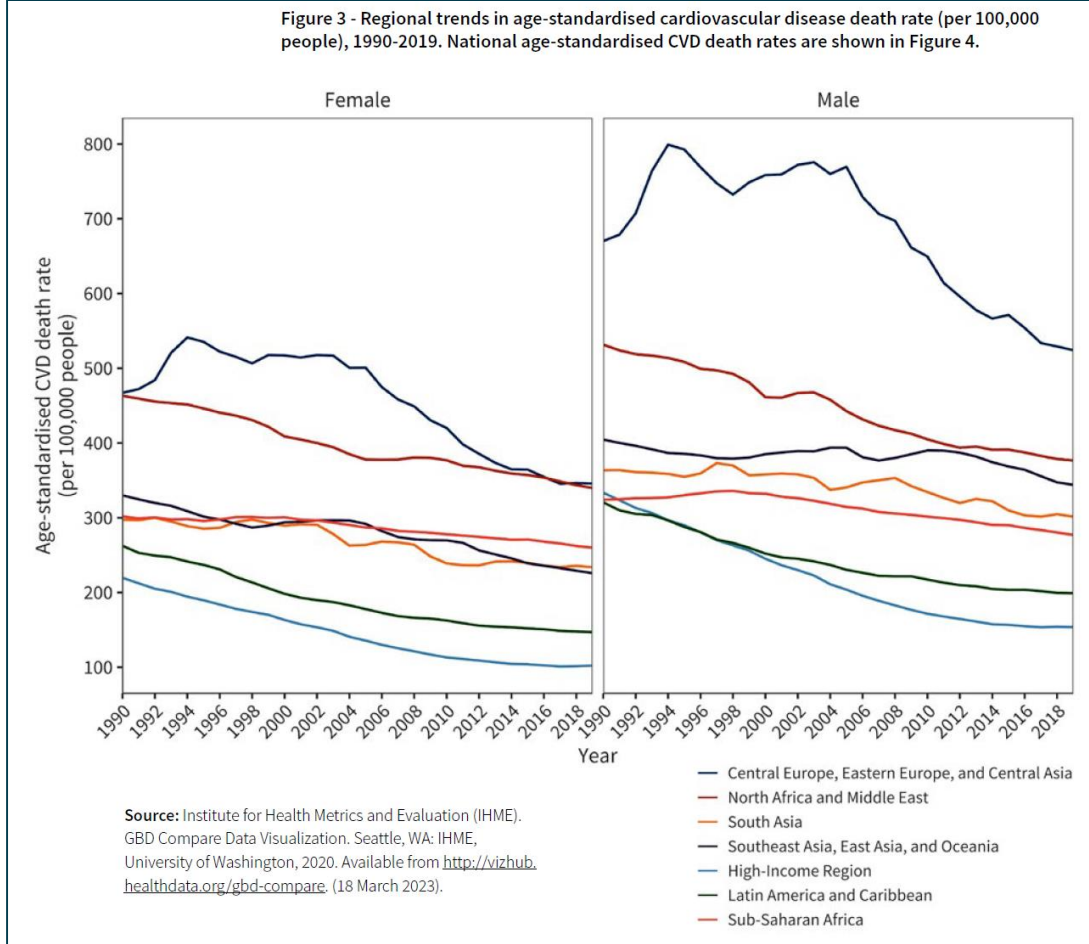
Environmental & community change



Health & governmental policies

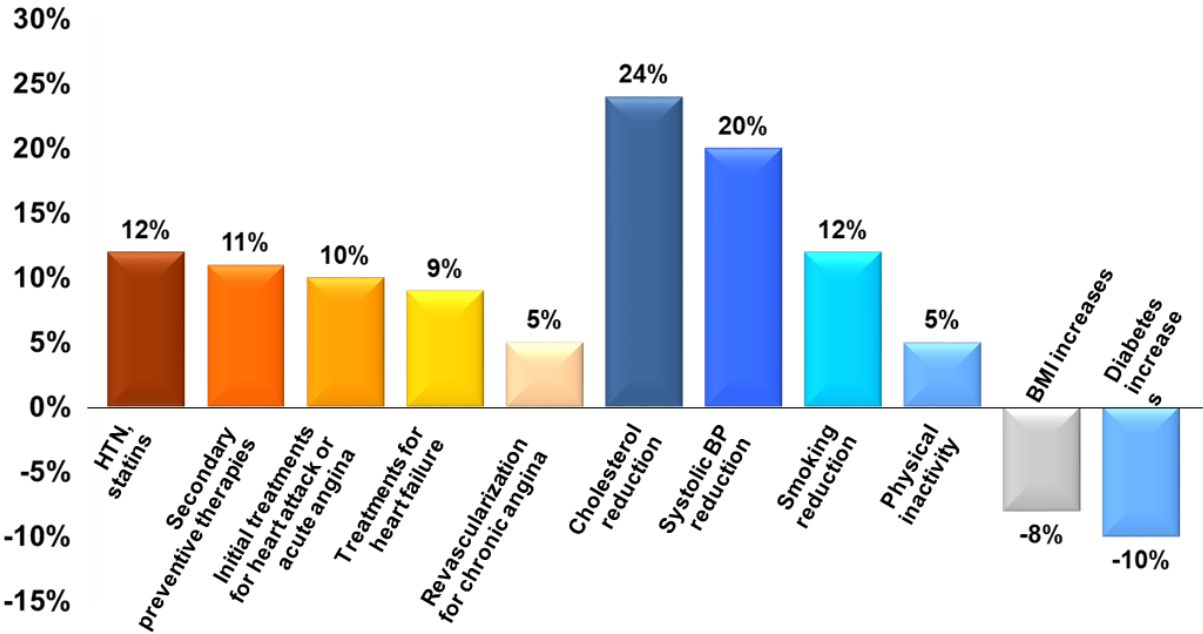
Cardiovascular disease as a population health success story

Figure 3 - Regional trends in age-standardised cardiovascular disease death rate (per 100,000 people), 1990-2019. National age-standardised CVD death rates are shown in Figure 4.



SPECIAL ARTICLE

Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980–2000

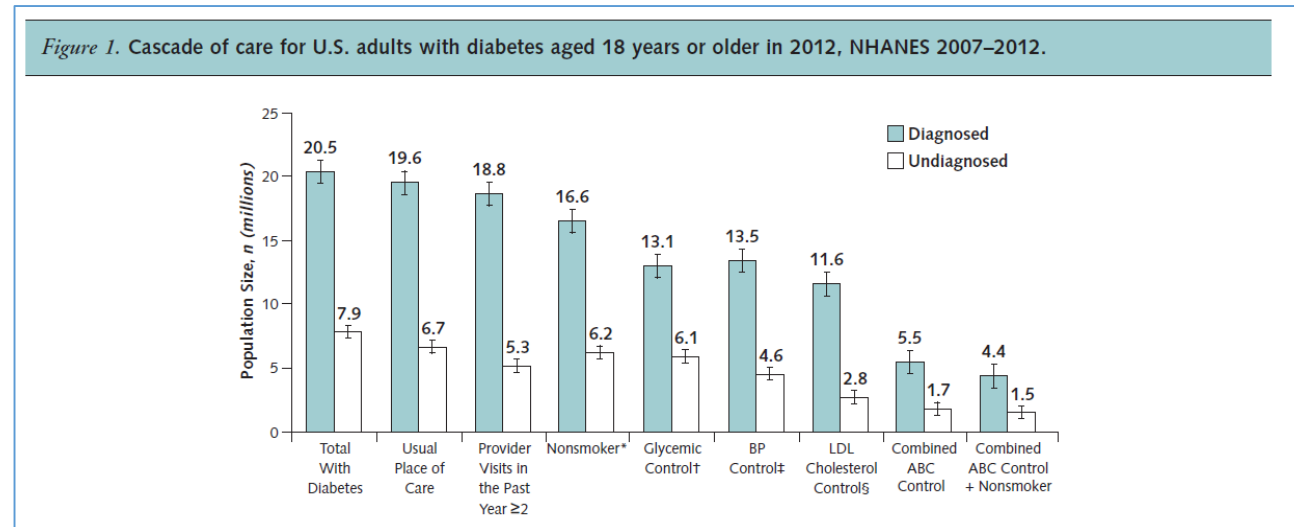
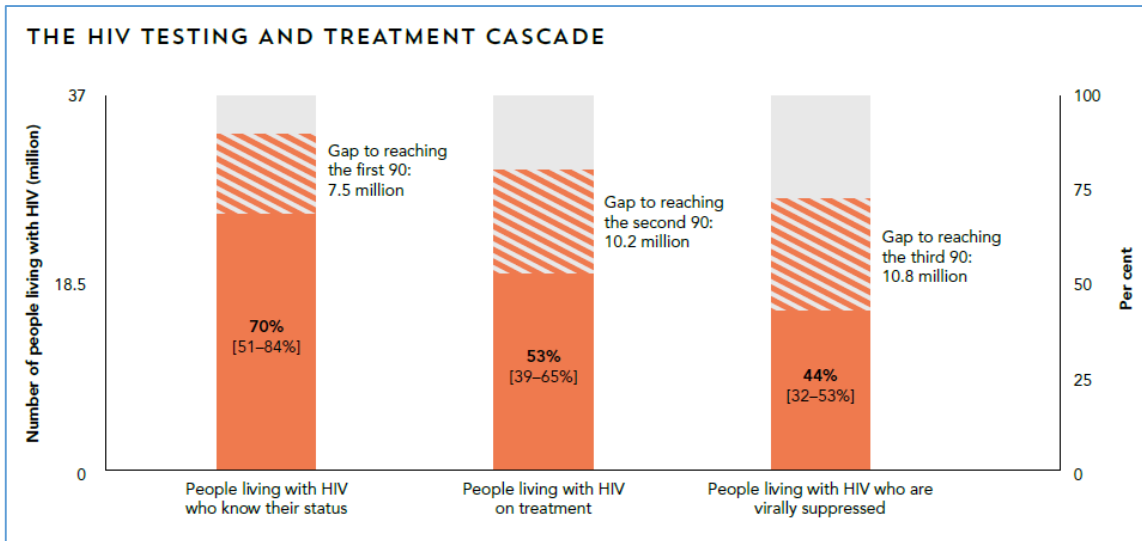


Four priority problems to solve for progress in chronic conditions

- Reducing the steep cascade of care



The cascade of care metric as a driver of population health action



Cost-effectiveness of Interventions to Manage Diabetes: Has the Evidence Changed Since 2008?

Karen R. Siegel,¹ Mohammed K. Ali,^{1,2}
 Xilin Zhou,¹ Boon Peng Ng,^{1,3}
 Shawn Jawanda,¹ Krista Proia,¹
 Xuanping Zhang,¹ Edward W. Gregg,¹
 Ann L. Albright,¹ and Ping Zhang¹



Diabetes Care 2020;43:1557–1592 | <https://doi.org/10.2337/dci20-0017>

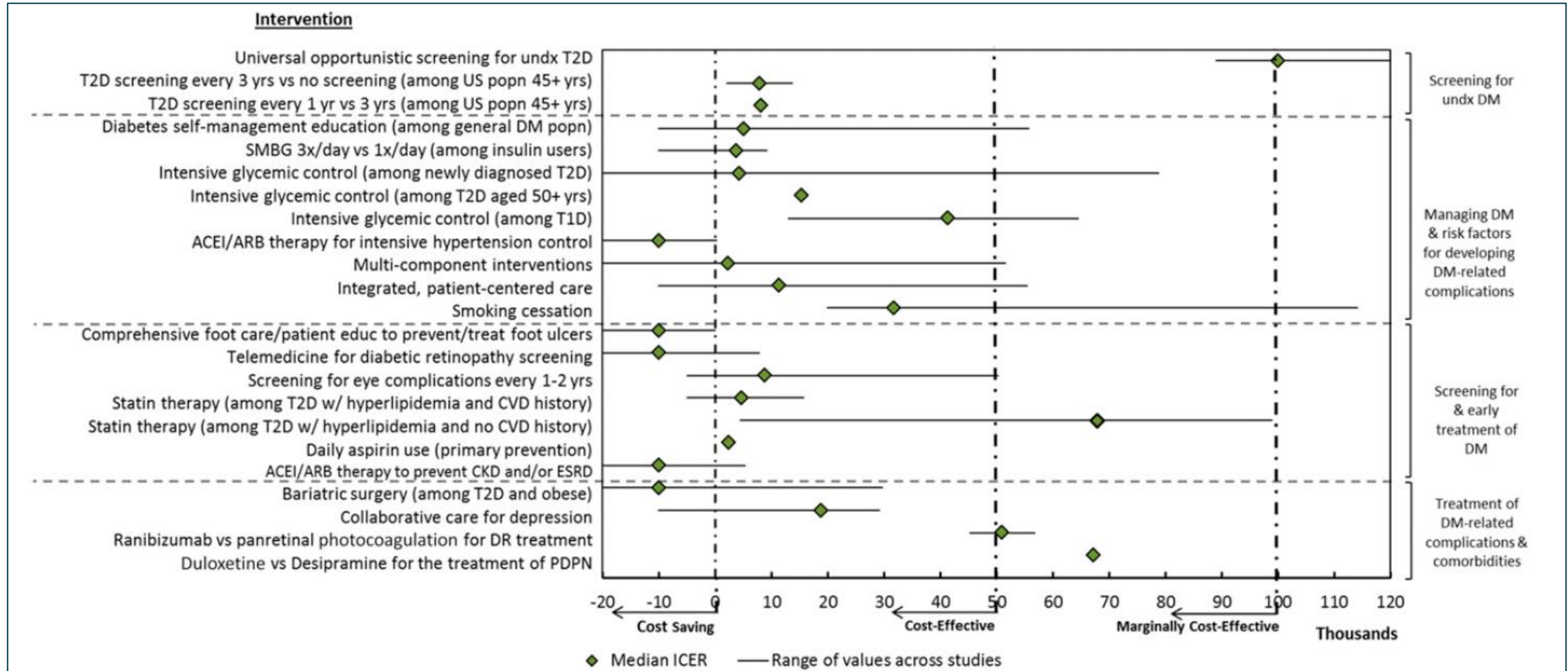
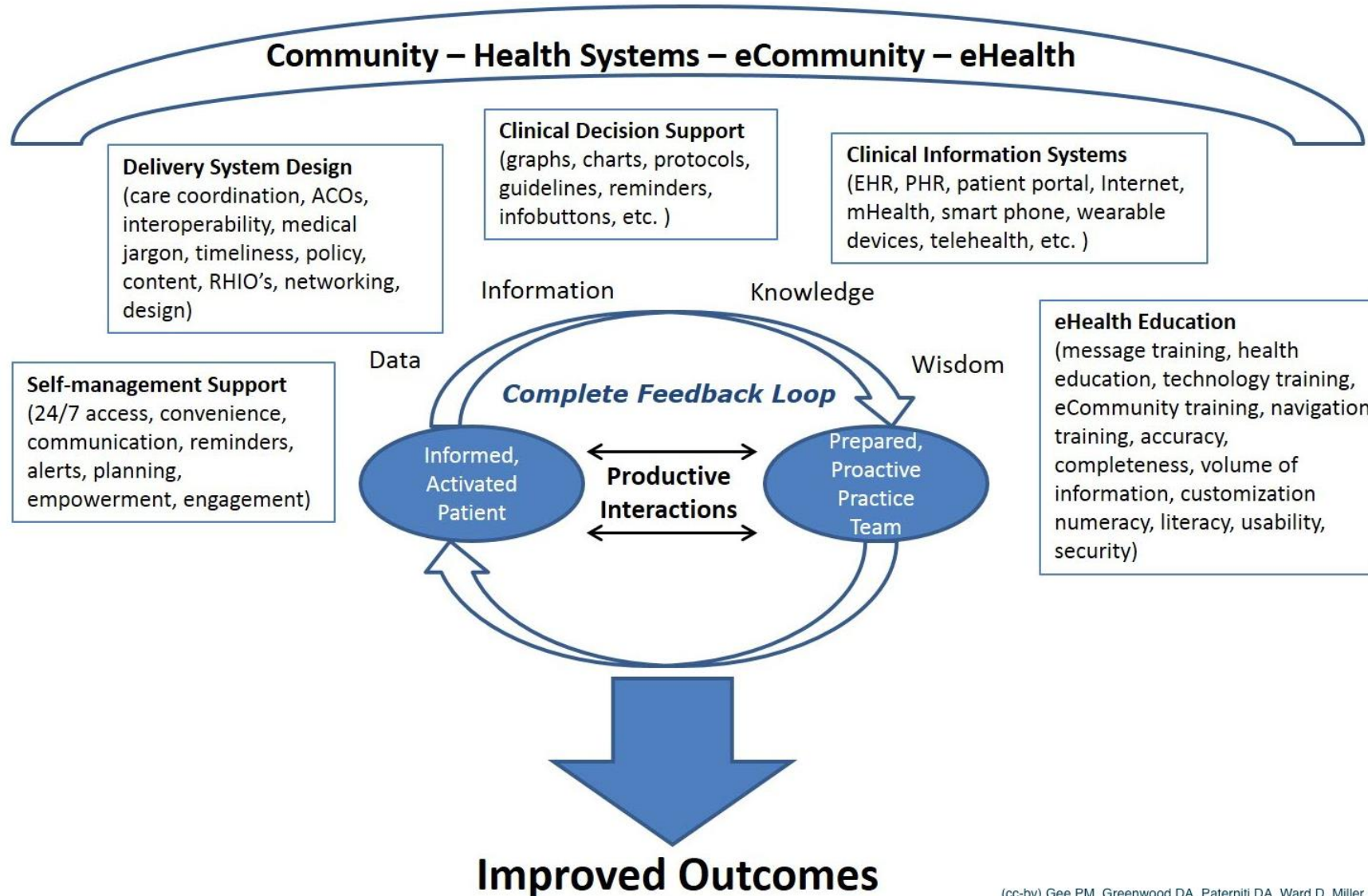
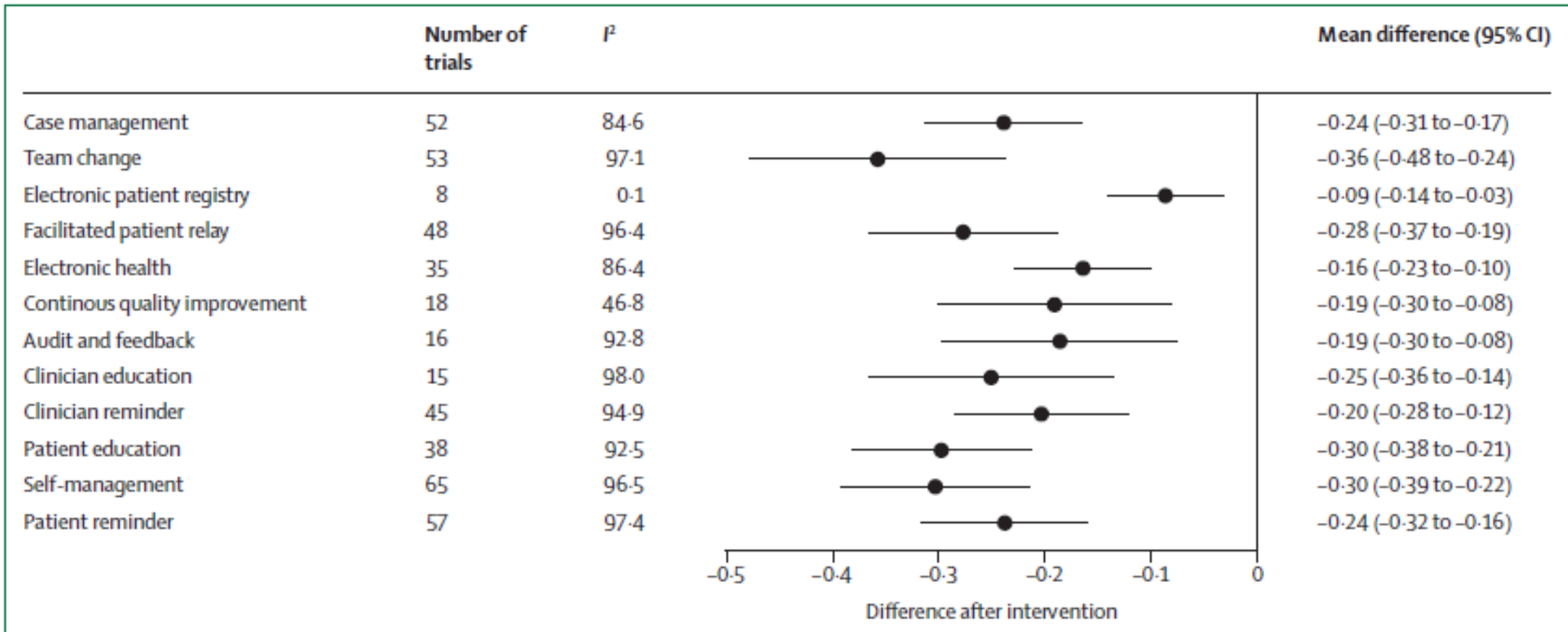


Figure 2—Summary of the CE of interventions (strong evidence only). CKD, chronic kidney disease; DM, diabetes; DR, diabetic retinopathy; PDPN, painful diabetic peripheral neuropathy; undx, undiagnosed.

The eHealth Enhanced Chronic Care Model (eCCM)



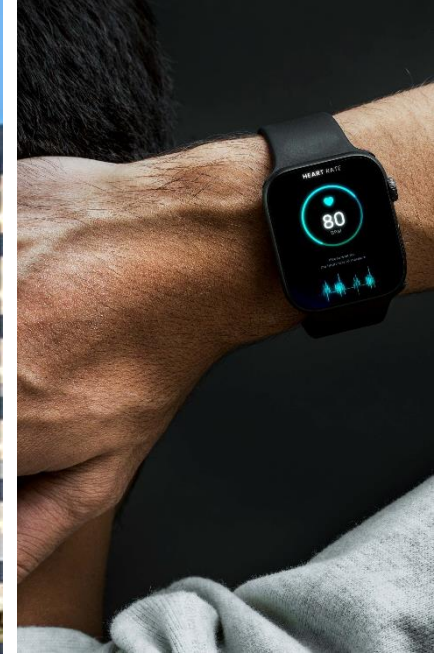
Impact of team-based care, self management & provider-patient communication on risk factor management



Adapted from Lim LL et al Diabetes Care 2018
Chan JC et al Lancet 2020

Four priority problems to solve for progress in chronic conditions

- Reducing the steep cascade of care
- Find the formula to change lifestyle behaviours



Summary of evidence and effect sizes for the benefits of combined diet and physical activity interventions on major morbidity

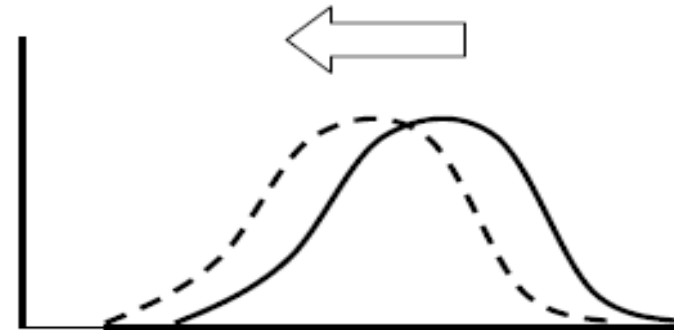
Morbidity	Adult Prevalence	RR Reduction	Evidence for Benefit
Diabetes	12%	40-60%	Strong
Hypertension	29%	20%	Strong
Moderate disability	25%	20-40%	Moderate
Chronic kidney disease	16%	30%	Moderate
CVD incidence	10%	20%	Unclear

References: ¹Knowler et al., NEJM, 2002; ²Welton et al., Arch Intern Med, 1997; ³Rejeski et al., NEJM, 2012; ⁴Look AHEAD Study Group, 2014; ⁵Look AHEAD Study Group, 2013; ⁶National Diabetes Fact Sheet; ⁷National Chronic Kidney Disease Fact Sheet.

Population and high risk approach



Identify and treat those beyond a threshold for risk factor



Shift the whole population distribution of risk factor

Conditions best for a high risk approach

- Steep risk factor-outcome relationship is steep
- Interventions more effective among high risk
- Efficient risk stratification approaches exist
- No practical, safe, policy lever exists

Conditions best for a population approach

- Gradual, continuous risk factor gradient
- Low-risk, low-cost interventions exist to alter the risk factor
- Presence of a strong policy implementation levers exist

Summary of the cost-effectiveness of fiscal policies to prevent T2DM

Category	Intervention	Study, n	CE outcome
Fiscal policy			
SSB tax	20%, penny-per-ounce, 10%, or \$0.5/L tax on SSB	9	CS
Sugar tax	\$0.99/100mL ice cream; \$0.9/100g other products	1	CS
Subsidy	30% or 0.15/100g subsidy for fruit/veg consumption	4	CS to worse health
Combination tax and subsidy	Tax SSB, sat fat., sodium, sugar; subsidy fruit/veg	1	CS
Environmental change			
Fresh food in low-income area	Open supermarket	1	CS
Workplace healthy food	Provide healthy food in cafeteria	1	CS
Enhanced phys act access	Increase facilities for physical activities	1	\$36k/QALY
Health promotion			
Campaign	Community-wide, mass media, or internet campaign to promote physical activity	4	\$87k/QALY to CS
Healthy eating education in low-income community	Diet education and cooking classes	1	More QALY but no change in cost
Social support PA promotion	Use organised groups to promote physical activity	3	\$35 – 50k/QALY
Physical activity promotion for targeted population	Encourage walking and reduce car use using tailored educational information	2	\$17,658/QALY – CS

Risk Stratification for Public Health Efforts in Diabetes Prevention

Risk Level	Adult Prevalence	10y Diabetes Risk (%)	Risk Indicators	Approach
Very High	10-15%	30 +	A1c \geq 5.7% FPG \geq 110 History of GDM	Structured Lifestyle Intervention in Community
High	20%	20 to 30	FPG \geq 100	Intensive and maintained health coaching
Moderate	30%	10 to 20	2+ risk factors	<ul style="list-style-type: none"> • Risk counseling • Taxation • Food/menu labeling • Crop subsidy policies
Low	35%	0 to 10	0-1 risk factor	<ul style="list-style-type: none"> • Urban planning and design • Community Incentives • School food and PE policies

Synergies in prevention: Risk factor management and lifestyle behaviours as fundamental driver and opportunity

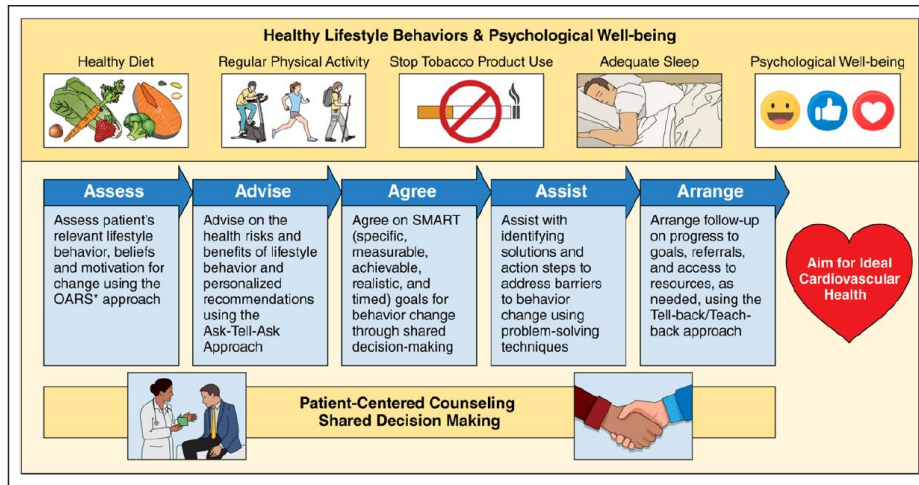


Figure. The 5A Model for lifestyle-related behavior change counseling in clinical settings.
CVD indicates cardiovascular disease.
*OARS, open-ended question/affirm what patient says/reflect what patient says/summarize.

Life's Simple 7

1. Avoid smoking and using tobacco products
2. Be physically active every day
3. Eat a heart-healthy diet
4. Keep a healthy weight
5. Keep your blood pressure healthy
6. Keep your total cholesterol healthy
7. Keep your blood sugar healthy

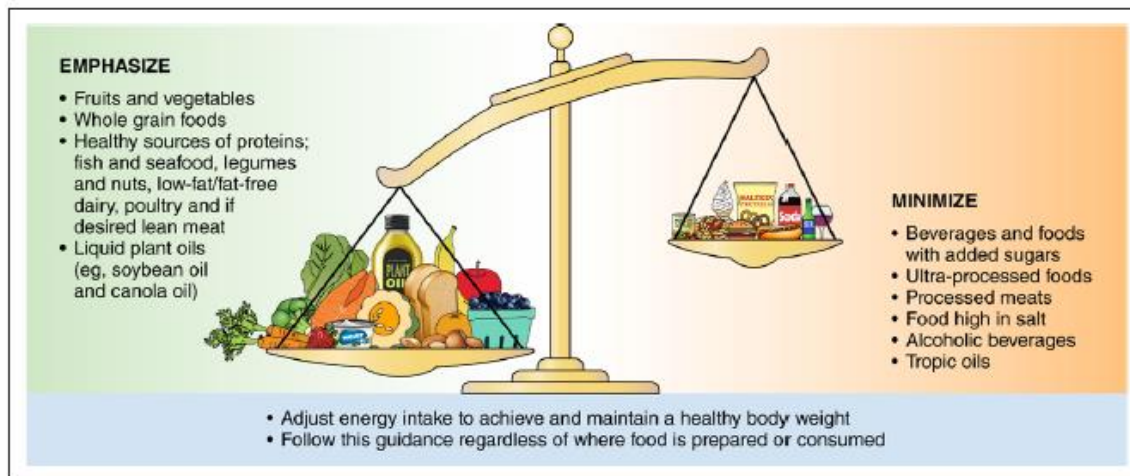


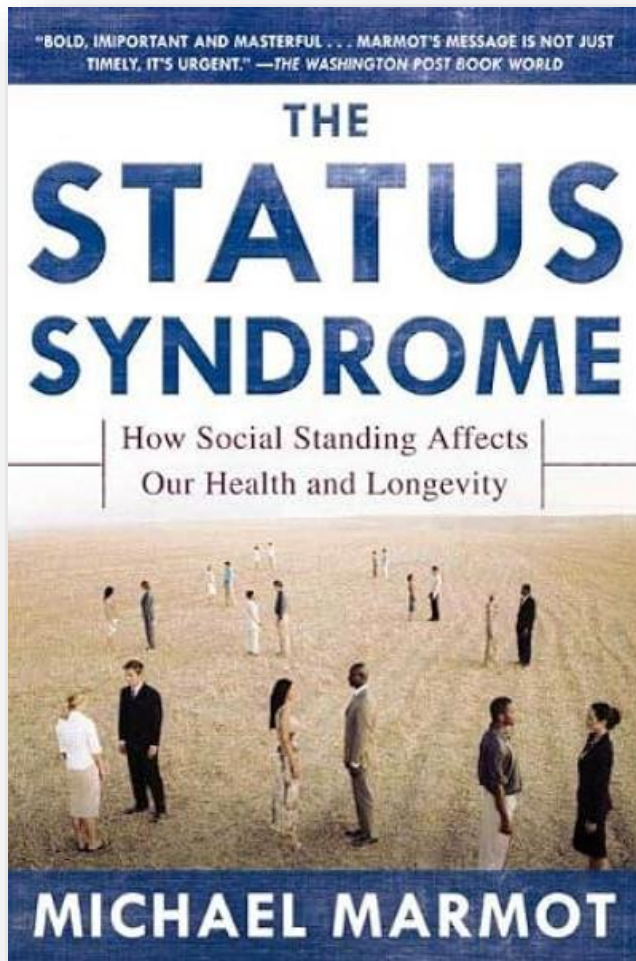
Figure. Dietary patterns to promote cardiovascular health.



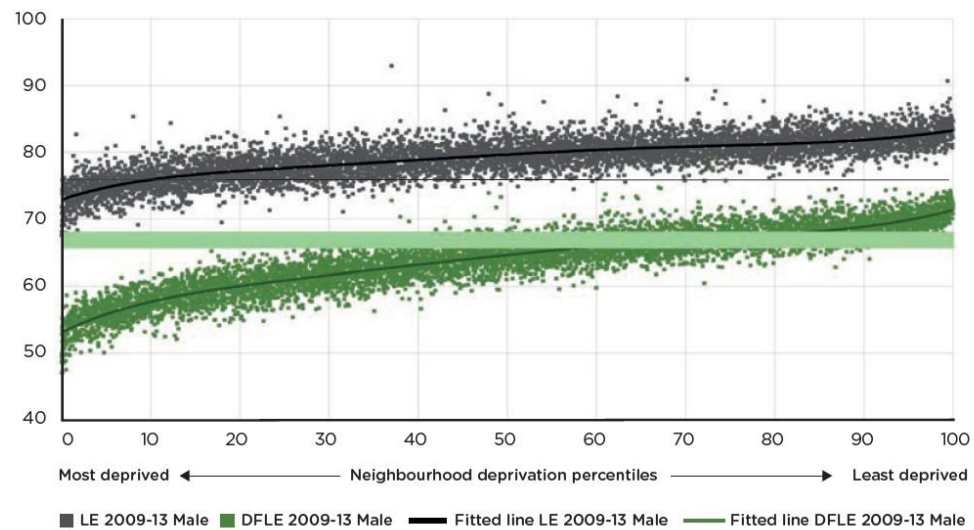
Four priority problems to solve for progress in chronic conditions

- Reducing the steep cascade of care
- Find the formula to change lifestyle behaviours
- Mitigate the effects of social determinants of health

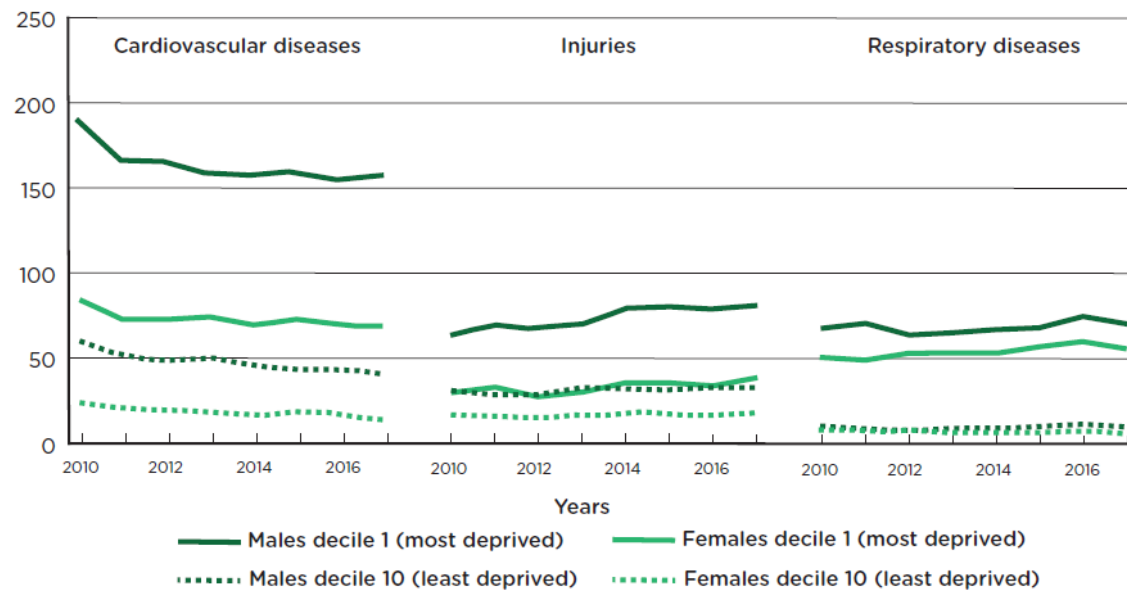




Life years

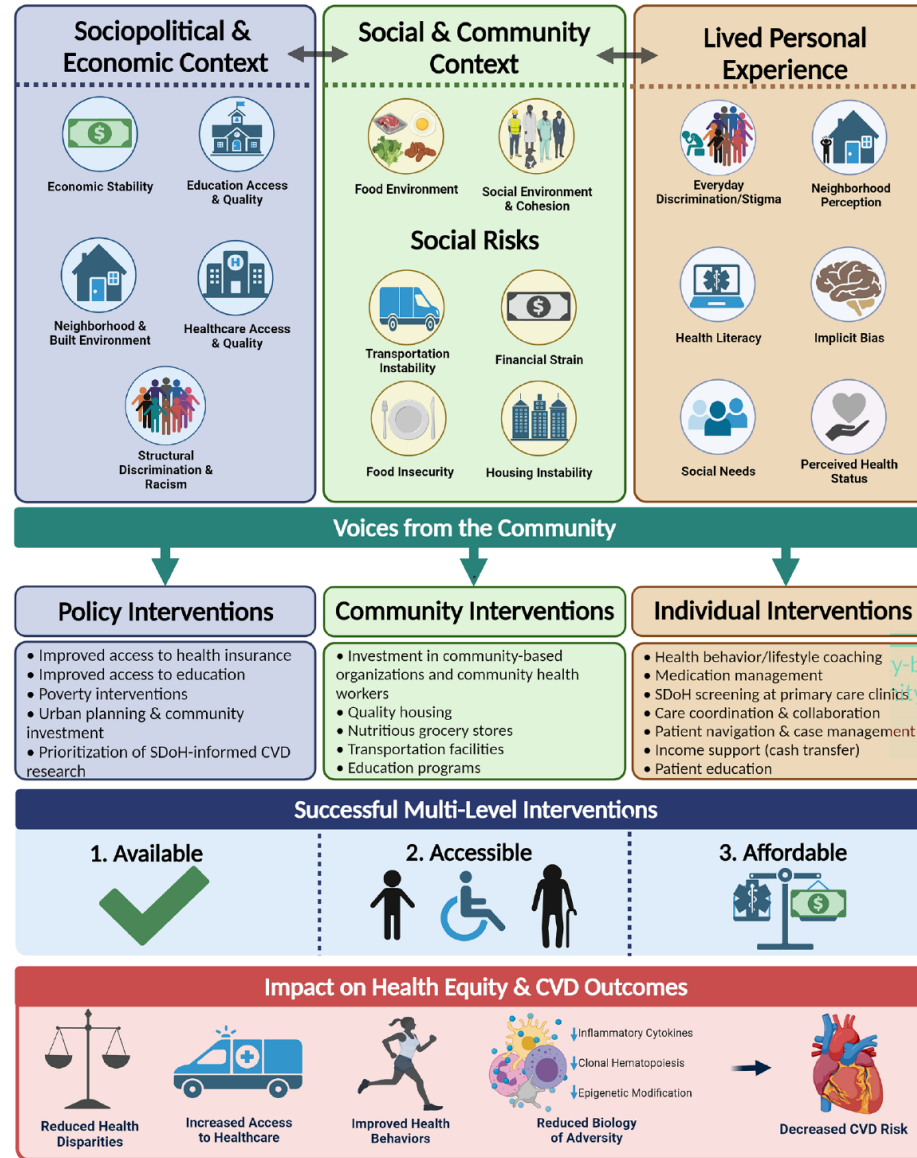


Age-standardised mortality rates per 100,000 population

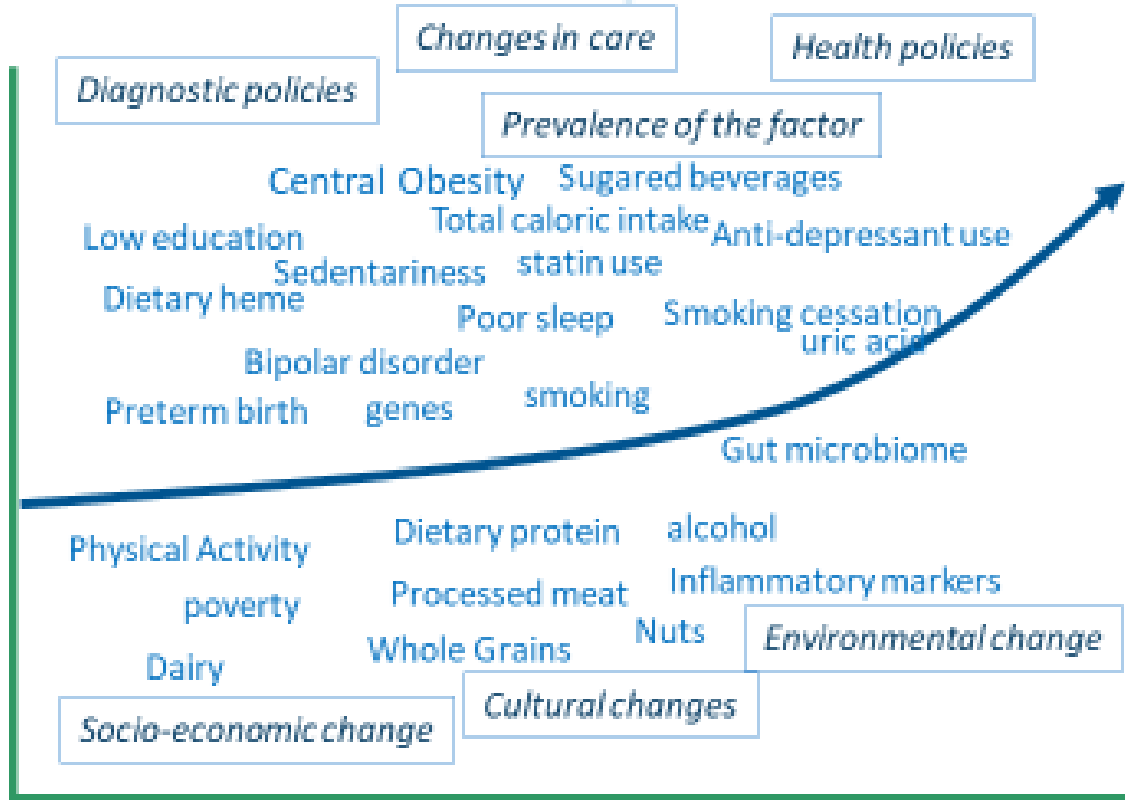


Social Determinants of Cardiovascular Disease

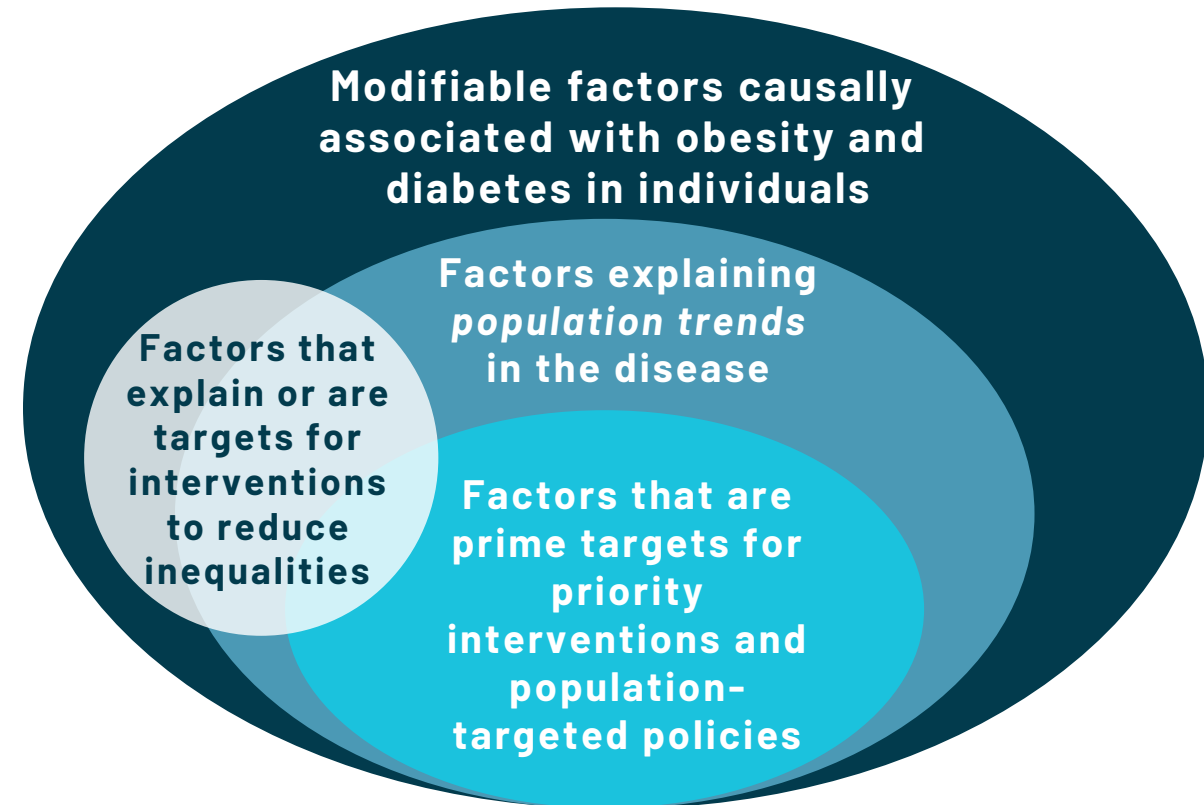
Tiffany M. Powell-Wiley, Yvonne Baumer, Foster Osei Baah, Andrew S. Baez, Nicole Farmer, Christa T. Mahlobo, Mario A. Pita, Kameswari A. Potharaju, Kosuke Tamura, Gwenyth R. Wallen



Factors Driving Changes in the Epidemic Individual Risk and Progression of Diabetes



Spheres of risk factors



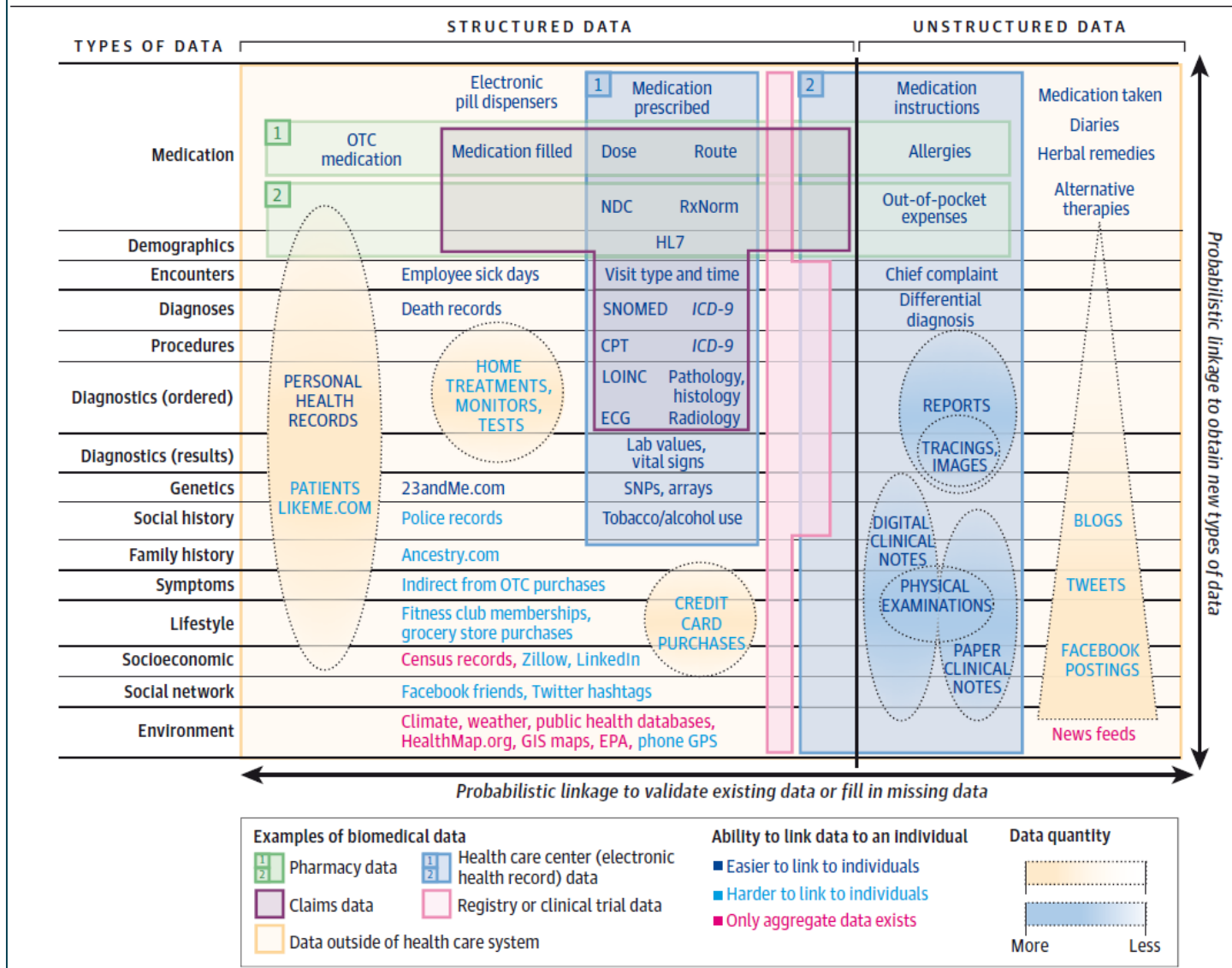
Four priority problems to solve for progress in chronic conditions

- Reduce the steep cascade of care
- Find the formula to change lifestyle behaviours
- Mitigate the effects of social determinants of health
- Exploit new opportunities in science



Finding the Missing Link for Big Biomedical Data

Figure. The Tapestry of Potentially High-Value Information Sources That May be Linked to an Individual for Use in Health Care



New Opportunities in Population Health Science

- Real-world data
- Multi-omic large scale observational studies
- Natural Experiments
- Comparative effectiveness
- Personalised medicine and population health
- Population-wide implementation research
- Digital health assesement

Summary and conclusions

- Chronic conditions present an enormous challenge because of their diversity, the impact of declining mortality, their changing character, and their roots in social factors.
- The essence of population health approaches for chronic diseases are to identify efficient targets and synergistic interventions.
- Four current priorities to advance chronic disease prevention are include:
 - Reducing the steep cascade of care with modern integrated care.
 - Achieve lasting lifestyle behaviour change through multi-faceted avenues.
 - Mitigate the effects of social determinants of health.
 - Exploit new areas of science for effective decision-making.



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Thank you

Professor Ed Gregg, PhD

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