SIPHER Consortium

Systems science
In Public Health and
Health Economics Research

Choosing the SIPHER health indicators

January 2022

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Background

The overarching aim of the SIPHER (Systems science In Public Health and health Economics Research) consortium is to use a complex systems perspective to foster and support a wider perspective on Public Health and the ways in which policy can shape this[1]. The three key research questions SIPHER aims to tackle are:

1. How can we capitalise on recent advances in complex systems science and multi-criteria optimisation to maximise the health-generating potential of public policy?
2. How can we design complex systems research processes, models and decision tools to be most useful to academic and policy audiences?
3. Which pathways and strategies best translate complex systems science evidence into policy?

An important step in the pathway to answering these questions in practical terms is to establish an agreed definition of 'health'. Modelling and evaluating the impact of public policy on health requires a shared understanding of how we conceptualise and measure health as an outcome. This short report describes the process and outcomes used to develop a set of 'health indicators' for use within SIPHER.

Methods

Identifying the requirements

We held an initial meeting with SIPHER team members in order to identify the properties that were considered essential or desirable in a health indicator. The results of this discussion are summarised below:

Interpretability – any indicator should be accessible and meaningful to decision makers.

Sensitivity to policy – any indicator should be sufficiently sensitive that it is plausible it may show an effect of public policy.

Sensitivity to COVID – any indicator should be sufficiently sensitive that it can capture the impacts of the COVID pandemic on health.

Timeliness – any indicator should reflect the situation as it is now, rather than as it was several years ago.

Historic – any indicator should have an available historic time series (or allow that one can be derived from available data) rather than only be available prospectively.

Separability – any indicator should be able to be separated into separate mental and physical health components.

Updateablility – any indicator should either be published on a regular and reliable basis (with an understanding that this is likely to continue into the future), or can be derived directly from data which itself is published regularly and reliably.

Comparability – any indicator should be comparable between areas (both at small geographies like neighbourhoods and larger geographies like Local Authorities) and, preferably, comparable between England and Scotland.

High resolution – any indicator should be available, or able to be calculated, for low levels of geography, with Local Authorities as a minimum level of resolution.

Disaggregatability – any indicator should be available, or be able to be derived, for different subgroups of the population – e.g. by age, gender or socioeconomic group to allow for an assessment of the effects of public policy on inequalities in health.

Modellablility – any indicator should be able to be realistically used as an outcome in the SIPHER WS 4 and 5 models.

Continuity – SIPHER WS 6, which is quantifying the relative value that people place on income, health and wellbeing and their aversion to inequalities in these things, requires a single, continuous measure of health to be used in the valuation process.

Future-proofed – as the aim of SIPHER is to create an enduring legacy which can continue to benefit policy and policy-makers beyond the end of the project, any indicator should be able to be obtained or derived by people working in Local Authorities, rather than having to be calculated by the SIPHER project team.

In the course of these initial discussions, it was clear that no one indicator was going to be able to satisfy or nearly satisfy all of these requirements. We therefore agreed on identifying one 'primary' measure, which would feed into the WS6 valuation work, alongside a 'basket' of supplementary indicators which would complement the primary measure and ensure that collectively our outcome indicators satisfied all of these needs.

In this meeting we also discussed the value of including explicit measures of inequality such as Gini coefficients, Slope or Relative Indices of Inequality within the indicator set. We concluded that this was unnecessary because the fact that out chosen measures should be high resolution and/or disaggregatable meant that users could already consider inequality and the impacts of policy inequality themselves without needing an explicit measure in the outcomes set. We were also keen that the final set of indicators remained fairly small so as not to become unwieldy.

Identifying candidate indicators

Having established what we *wanted* in a set of indicators, the next step was to review the available measures that we could use. After consultation with SIPHER partners we identified 6 potential sources for health outcome measures.

- Fair Society, Health Lives: The Marmot Review – this key text in health inequalities includes a set of indicators of health and health inequalities[2]
- The Greater Manchester Strategy incorporates an Outcomes Framework designed to monitor a range of broader outcomes, including "healthy lives"[3]
- Scotland has a National Performance Framework, which includes a range of indicators designed to monitor a range of outcomes, including health[4]
- In 2020 the Office for National Statistics announced the Beta release of an experimental new composite measure of health, the Health Index[5]
- The English Index for Multiple Deprivation, the most widely used measure of deprivation in England, is a composite measure which includes numerous indicators across a range of seven domains, including 'Health, Deprivation and Disability'[6]
- The Scottish Index of Multiple Deprivation is similar to the English Index of Multiple Deprivation, being a composite measure including indicators across seven domains, including health[7]

The health-related indicators associated with each source are presented in Table 1, illustrating the large number of different indicators in use and the low degree of overlap between the sources reviewed in terms of the indicators used in each. Only Healthy Life Expectancy appears in four of the six sources and only measures of risk behaviour and the prevalence of obesity appear in three out of six. The majority of indicators only appear in one of the six sources.

Table 1: Health indicators in current use

	Marmot health indicators	Greater Manchester Strategy Outcomes Framework	Scottish National Performance Indicators	ONS Health Index	IMD Health domain	SIMD Health domain
Healthy Life Expectancy	X	X	X	X		
Life expectancy	X					
Inequality in life expectancy	X					
Life satisfaction	X			X		
Age 5 development	X			X		
Age 5 development with free school meal status	X					
GCSE 5 x A*-C	X			X		
GCSE 5 x A*-C with free school mean status	X					
19-24yo NEETs	X					
Unemployment %	X			X		
Long-term JSA claimants	X					
Work-related illness			X			
Households below Minimum Income Standard	X					
Fuel poverty	X					
% of people using outdoor places for exercise/health	X					
Premature CVD mortality		X				
Premature cancer mortality		X				
Premature respiratory disease mortality		X				
Risk behaviours (smoking, alcohol, PA, diet)		X	X	X		
Alcohol-related admission episodes		X				X
Adult social care facilities rated 'good' or 'outstanding'		X				
% obese/unhealthy weight		X	X	X		
One-year cancer survival rate		X				
Self-reported levels of high anxiety		X		X		
Mental wellbeing score (WEMWBS)			X			
% meeting physical activity guidelines			X			
% journeys by active travel			X			
Quality of GP care experienced			X			
Premature mortality/PYLLs			X		X	
Avoidable deaths				X		
Prevalence of certain health conditions (e.g. dementia)				X		
Disability that impacts daily activities				X		
Difficulty completing Activity of Daily Living				X		
Frailty				X		
Life worthwhileness				X		
Happiness				X		
Suicide rate				X		
Prevalence of depression				X	X	
Prevalence of self-harm				X		
Poor working conditions				X		
Infant mortality				X		
Children's social, emotional and mental health				X		
Childhood obesity				X		
Low birth weight				X		X
Teenage pregnancy				X		
Child poverty				X		

Children in state care				🟥		
Pupil absence				🟥		
Cancer screening				🟥		
Vaccination coverage				🟥		
Sexual health				🟥		
Access to green space				🟥		
Local environment quality				🟥		
Household overcrowding				🟥		
Rough sleeping				🟥		
Housing affordability				🟥		
Access to GP services				🟥		
Access to pharmacies				🟥		
Access to sport & leisure facilities				🟥		
Personal crime				🟥		
Claimants of incapacity benefit					🟥	🟥
Emergency hospital admissions					🟥	🟥
Overall mortality rate						🟥
Drug-related hospital admissions						🟥
Prescriptions for anxiety, depression of psychosis						🟥

This Table also highlights that while some of the indicators used for health in these sources are direct measures of health, others are measures of risk factors likely to lead to poorer health and some are measures of factors likely to be correlated with poorer health. As some of these related aspects are already addressed elsewhere within SIPHER, we restricted our search to direct measures of health only.

In addition to these measures, we discussed our requirements with key stakeholders and SIPHER team members and identified a number of other potential indicators:

- The ONS Health Index itself – as an existing composite measure of health
- The health domain of the English and Scottish Indices of Multiple Deprivation (IMD)
- Disease-free life expectancy – a measure very similar to Healthy Life Expectancy and the UK government's preferred measure of health-adjusted lifespan
- Quality-adjusted life expectancy – an alternative to Healthy and Disease-free life expectancy[8]
- Self-reported physical health – a widely available measure in many national surveys
- SF-12 – a self-reported measure of health capturing both mental and physical health
- Hospital admissions for Non-Communicable Diseases (NCDs) – as SIPHER has a focus on NCDs and NCD-related ill health
- NCD multimorbidity – the prevalence of people with multiple NCDs as patients with multiple comorbidities are likely to be in poorer health and more complex to treat
- Premature NCD mortality – as early deaths associated with NCDs are more likely to be considered 'preventable'
- Emergency admissions to hospital for any cause - as an indicator both of health itself and also of how people choose to/are able to access healthcare services. More admissions coming through emergency, rather than referral routes may suggest poorer access to or lower use of wider healthcare services, such as primary care.
- Preventable hospital admissions – hospital admissions from causes deemed to be 'preventable'[9]
- Excess mortality – the number of deaths over and above some 'expected' baseline
- Lifespan inequality – a direct measure of the 'spread' of the distribution in the ages at which people die[10]

Table 2: Scores for candidate indicators against requirements

	Interpretability	Sensitivity to policy	Sensitivity to COVID	Timeliness	Historic	Separability	Updateability	Comparability	High resolution	Disaggregatability	Modellability	Continuity	Future-proofed
Healthy/Disability-Free Life Expectancy	10	5	8	5	10	0	7	10	5	5	8	10	10
Life expectancy	10	3	10	6	10	0	10	10	5	5	8	10	10
ONS' Health Index	7	4	7	4	5	10	6	5	2	2	8	10	2
Health domain of (S)IMD	7	6	7	3	5	8	5	6	8	1	8	10	7
QALE	8	7	10	5	5	0	10	10	6	7	10	10	8
Self-reported health	7	5	6	5	9	0	10	10	6	7	8	10	9
SF-12/GHQ	8	5	8	5	9	10	10	10	3	7	8	10	9
Hospital admissions for NCDs	10	7	3	8	7	5	10	8	6	5	8	10	9
NCD multimorbidity	8	4	4	8	7	3	10	8	6	5	6	10	9
Premature NCD-attributable mortality	9	5	5	6	10	0	10	9	5	5	8	10	9
Emergency hospital admissions	10	8	10	8	7	0	10	9	6	5	8	10	9
Preventable hospital admissions	9	7	5	8	7	5	10	8	6	5	8	10	9
Excess mortality	7	3	10	7	10	0	10	10	3	5	7	10	8
Lifespan inequality	5	4	10	6	10	0	10	10	5	5	7	10	8

Identifying the final indicators

In order to narrow down this long list of indicators, we selected those that appeared most likely to be appropriate as a primary indicator and scored those on a 10-point Likert scale against each of the requirements identified during the initial consultation meeting. The results are presented in Table 2. These scores reinforce the decision to select a basket of indicators rather than chose a single outcome measure as there is no one indicator which strongly meets all the requirements. They also reveal a few particularly problematic areas – separability, sensitivity to policy, high resolution and disaggregatability – which many of the indicators score poorly against.

These scores informed further discussions within the SIPHER team, leading to agreement on the final set of indicators, as presented below.

# The SIPHER health indicators

Primary outcome measure: Quality-Adjusted Life Expectancy (QALE)

Simply put, QALE is a variation on standard life expectancy, where the value of each single year of age is weighted by the average health of the population at that age (as measured on a 0-1 scale where 0 represents death, and 1 represents perfect health). Meaning that QALE is a measure of the cumulative expected health that somebody will experience over their lifetime. This contrasts with Health Life Expectancy (HLE) or Disability-Free Life Expectancy (DFLE) which is the age at which someone's health is expected to fall below a given threshold representing the point at which they are no longer in 'good or very good' health (for HLE) or have no 'limiting long-term illness' (for DFLE).

HLE/DFLE therefore represents a measure of how long somebody can expect to live in good health. This difference is illustrated in Figure 1 for a hypothetical individual whose health over their lifetime is represented by the solid black line and where the threshold for good health is denoted by the dashed line.

As such, QALE is a summary measure of health in a population, which encompasses both health *and* length of life. Unlike the more widely-used HLE (or DFLE), QALE captures health across the whole life course. As a result, QALE is sensitive to improvements in both health-related quality of life *at any point in people's lives* and also in length of life, whereas HLE is only sensitive to improvements which extend the period during which individuals are living in good health. This means that QALE can be influenced by interventions that target people at any stage of their life, from childhood to very old age, whereas HLE is largely influenced by interventions that target people in their 50s and 60s. A further benefit of QALE is that it is very closely aligned with the concept of a Quality-Adjusted Life Year (QALY) – one way of thinking about QALE is as an individual's future expected QALYs at birth. This has significant benefits for health economic modelling – a model that incorporates QALE can be more easily used for cost-effectiveness analyses.

Figure 1: A comparison of QALE and HLE
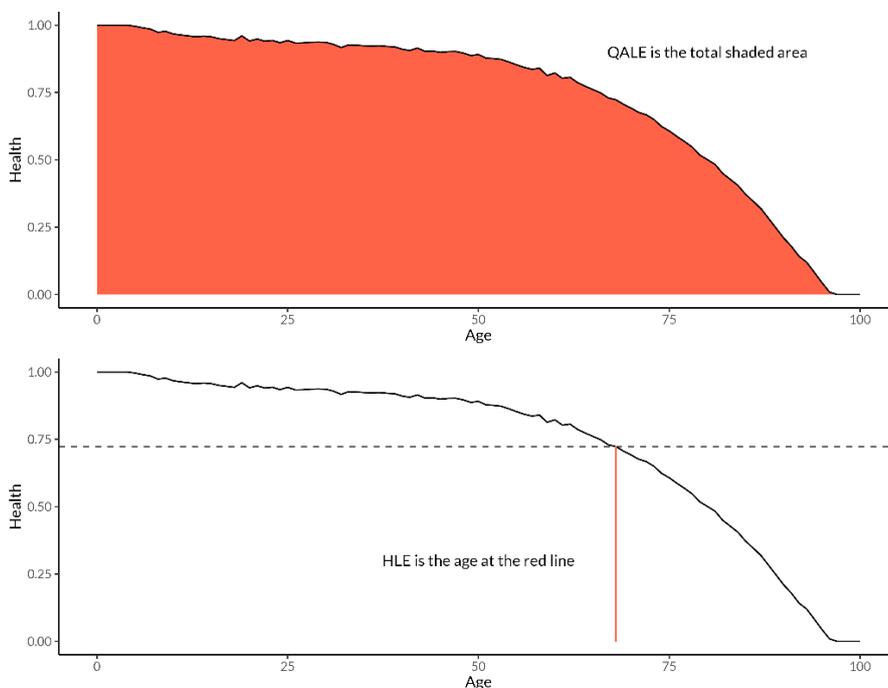
In terms of our list of requirements, QALE scores well on being Interpretable, Sensitive to both COVID and Policy, Updateable, Comparable, Disaggregateable, Modellable and it is a Single continuous measure. It scores less well on being Current (as there can be a delay between surveys being undertaken and being available to researchers), and High Resolution (although it can be calculated at any level within the SIPHER synthetic population[11]).

Supporting measures:

SF-12 Mental and Physical Health/Self-reported health

The SF-12 is a short-form health questionnaire that captures both physical and mental health. It is relatively commonly included in national surveys and can be used to derive a composite measure of health-related quality of life (e.g. in the calculation of QALE). One of the main advantages of SF-12 over other self-reported measures is that it incorporates both physical and mental health indicators in a common framework, and indeed you can produce separate physical and mental health scores using the SF-12 questions. Thus, it covers two important areas of interest in a way that is also coherent with QALE. Unfortunately, SF-12 is not routinely collected in a large sample of Scottish respondents. The only widely-collected self-reported health measure included in the core set of questions asked across Scottish national surveys is based on a 5-point Likert scale from 'Very good general health' to 'Very bad general health'.

In terms of our list of requirements, both SF-12 and self-reported health score very similarly to QALE and the only major differences between the two are the fact that the SF-12 can be used to separately assess physical and mental health, while the self-reported health measure has much wider coverage in Scotland. The biggest drawbacks of these measures are that they are slightly less current and that using them at relatively low levels of geography (e.g. below Local Authority) would likely require additional data collection, or modelling.

Receipt of benefits due to inability to work through ill health

This measure equates to the proportion of the population who are in receipt of some form of government benefits due to a health-related inability to work. The measure is age-sex-standardised to allow for comparability between areas that may have different population structures. Both the English and Scottish Indices of Multiple Deprivation include this measure as part of their health domain. This measure is included as it directly reflects the impact of ill health in working age people on the economy. It is also available at lower levels of geography – e.g. down to Middle Super Output Area/Datazone. Its biggest drawback, in the context of our list of requirements is that it is not too current, with data currently available reflecting the situation a few years previously.

Hospital admissions for Non-Communicable Diseases

This measure captures all hospital admissions where the primary diagnosis is a Non-Communicable Disease (NCDs) as defined by the relevant ICD-10 code recorded in the hospital statistics. NCDs are obviously a particular focus for SIPHER (and Public Health more broadly) and this measure specifically captures their impact on health. One of the key advantages of this measure is that it can be derived directly from hospital statistics, which are available within a few months and therefore it is more current, and so responsive to recent changes, than many other measures. It can also be readily calculated by population subgroup and for low levels of geography.

Emergency admissions to hospital for any cause

The final measure captures emergency (i.e. unplanned) admissions to hospital for any cause. Emergency admissions reflect not only poor health, but in many cases also represent a failure or inability to engage with healthcare services at an earlier stage where doing so could have prevented the potentially more serious emergency admission. This measure is a component of the Scottish, but not the English, Index of Multiple Deprivation and as with NCD admissions it can be calculated from hospital statistics and therefore shares the same strengths and weaknesses.

Summary

Taken together these indicators form a broad 'basket' of health measures, which collectively cover all of our requirements and should be able to capture the full impacts of public policy on health.

Technical details

QALE

In order to calculate QALE we require two data sources: self-reported health-related quality of life for a representative population sample, and all-cause mortality data. The former of these is available from a number of sources, including the Health Survey for England and Understanding Society, while the latter can be obtained directly from the Office for National Statistics and National Records of Scotland. The standard approach to estimating QALE from these sources has been described previously be Love-Koh et al. [8]. Using this data it is relatively straightforward to estimates QALE for any population subgroup that can be defined in the data.

However, although the Health Survey for England includes health-related quality of life, measured using the EQ-5D, there is no equivalent measure included in large-scale Scottish surveys such as the Scottish Health Survey. We therefore propose an adapted approach. Using the Health Survey for England, we will fit a model to estimates health-related quality of life using the 5-point Likert scale question on self-rated health and a range of sociodemographic covariates (age, sex, socioeconomic position etc.) and potentially health-related data which are included in both the Health Survey for England and the Scottish Health Survey. We will then use this model to predict the health-related quality of life for each individual in the Scottish Health Survey and calculate QALE on that basis.

In order to help future-proof this approach, we will develop dedicated R functions which can perform the necessary calculations from the survey data, which local Public Health analysists should be able to access themselves.

SF-12 Mental and Physical Health/Self-reported health

These questions are included in a wide range of surveys, including Understanding Society (SF-12), the Health Survey for England (self-reported health) and in the Scottish core questions asked across multiple Scottish surveys, including the Scottish Health Survey.

Receipt of benefits due to inability to work through ill health

This data is included at low levels of geography (Lower Super Output Areas in England, Data Zones in Scotland) in the health domain of both the English and Scottish Indices of Multiple Deprivation. We are exploring the possibility of obtaining data more regularly directly from DWP, but our fallback will be to use the IMD scores, which are updated approximately every 3 years.

Hospital admissions for Non-Communicable Diseases & Emergency admissions to hospital for any cause

Both of these measures can be calculated directly from Hospital Episode Statistics, which should be accessible at local level, to public health analysts.

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Working together to tackle health inequalities and improve the health of the public.

The conditions in which we are born, grow, live, work, and age are key drivers of health and health inequalities. Preventing illness related to these 'social determinants of health' requires well-coordinated policies across many sectors, such as the economy, welfare, housing, education, and employment.

SIPHER's innovative systems science approach offers a powerful framework to explore the complex real-world relationships and interdependencies of diverse policies that shape our public health and wellbeing.

A major research investment by UKPRP, the SIPHER Consortium is a collaboration of policy and academic experts working with practice partner organisations to create evidence-based products that deliver improved public health policy.

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