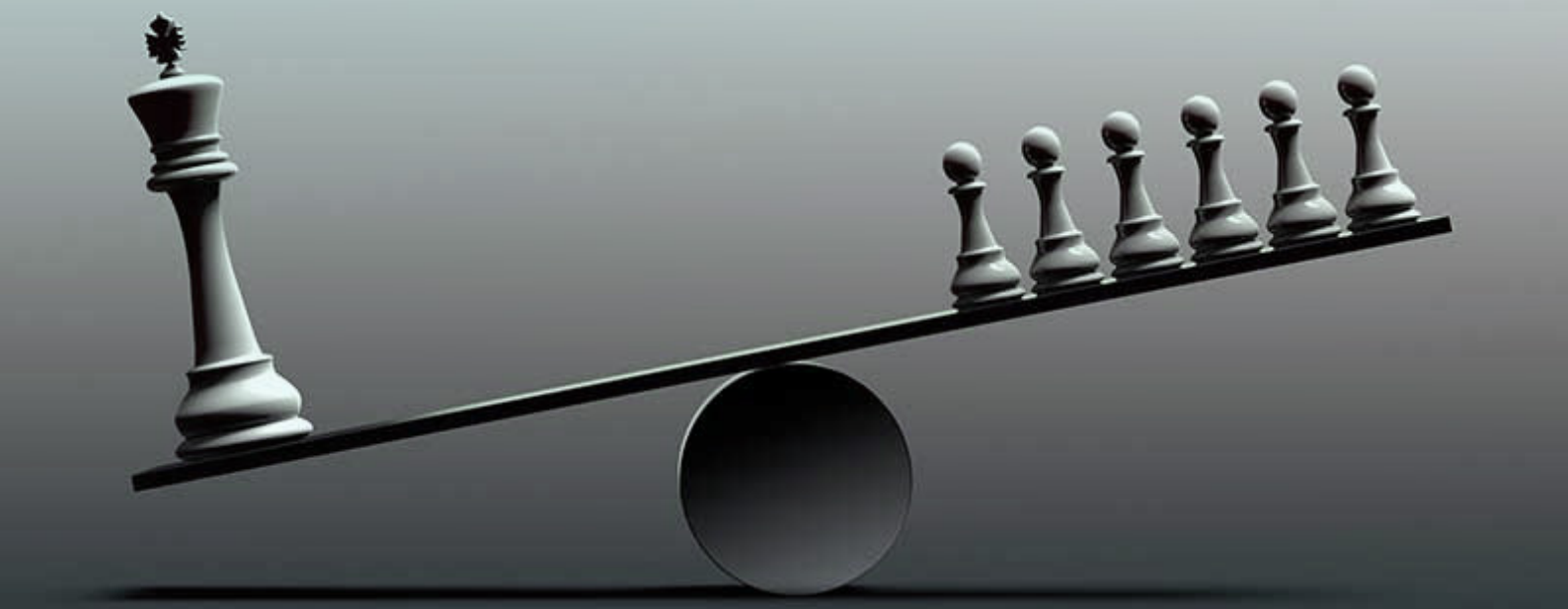
UNIVERSITY of York

Beyond the Average

Making Fairer Decisions for Public Health



EQUIPOL RESEARCH GROUP

wellcome trust

Preface

In an age of social division fuelled by rising inequality, and in the light of widespread commitments from governments to tackle these inequalities, the need to develop new tools to measure the equity impacts of health and social policy interventions has never been more urgent.

The University of York has a long history of pioneering innovative tools for measuring the effectiveness and efficiency of health interventions, which have subsequently achieved widespread application to decision making worldwide. It is now accelerating the development of equity tools.

This not only requires new methods for measuring different impacts of interventions for different population groups, but also the development of a robust and transparent ethical framework for deciding which equity measures to use.

With the support of the Wellcome Trust, the University's Equity in Health Policy (EQUIPOL) group has begun work on this fundamental reorientation of health policy research, forging new partnerships across disciplines, including biostatistics, economics, epidemiology, population-level informatics, simulation modelling and ethics that put the reduction of health inequalities centre stage.

While institutional inertia explains in part the persistence of decades-old decision making processes in organisations such as the NHS and NICE, the increasing availability of information-rich data coupled with powerful computing and simulation software, opens the door to a more integrated approach to policies that might reduce stubborn health inequalities.

If widely adopted, the new methods highlighted in this briefing paper could be as much a game changer as the University of York's earlier work on cost-effectiveness, providing powerful metrics to help health organisations around the world make better decisions with fairer outcomes.

Nick Timmins

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Introduction

Throughout the twentieth century, health care underwent major transformations in effectiveness and efficiency, extending and improving lives worldwide. These transformations, driven by scientific advances in the understanding and treatment of disease, were accelerated by two radical movements in the use of medical data.

First, researchers began systematically to analyse data from clinical trials to identify the most effective medical interventions, creating *evidence-based* treatment guidelines. Second, *cost-effectiveness* analysis combined this information with data on the costs of treatments to identify the most efficient ways of spending limited health budgets, maximising the benefits for the population as a whole. These methodological advances helped drive improvements in safety, effectiveness and efficiency, but they focused on the average benefits of interventions and so ignored variations in benefits between different population subgroups.

A third movement with a new purpose is now underway: to ensure that the benefits of health interventions are shared fairly, so that in addition to being effective and efficient, they are also equitable. This new movement relies on new methods of *distributional cost-effectiveness* analysis that can analyse the impacts of policies and interventions on equity. These methods can be applied to a wide range of interventions, from drug treatments to social policies, enabling decision makers to finally see who wins and who loses as a result of their decisions.

However, to succeed, this new equity movement will need support from policy makers, funders, universities, and public health organisations. This briefing paper describes the work of the EQUIPOL research group in helping to develop practical and powerful tools that make the trade-offs between efficiency and equity explicit and provides recommendations for embedding these tools in public health decision making.

Part 1

Tools for tackling health inequality

Despite the efforts of successive governments to reduce health inequalities, someone in the most affluent 20% of neighbourhoods in England can expect to live for nearly 12 healthy years longer than someone in the most deprived 20%. As a result, the most socially disadvantaged fifth of the population has a collective shortfall of 135 million healthy years of life (11.9 healthy years per person times a population of 11.4 million people) compared to the most socially advantaged fifth.

EQUIPOL's research shows that there is substantial public support for reducing these gaps, but none of the standard economic tools used to inform the spending decisions of public services like the NHS can quantify the impacts of these decisions on health inequalities.

Instead, decisions rely on outdated methods that only consider the average. For example, cost-effectiveness analysis (CEA) prioritises interventions that have the biggest impact on the average health of the population. Although it is important to compare different interventions in terms of their average health benefits, not everyone will benefit equally from a given intervention and standard methods provide no information on who gains and who loses.

The consequence of using outdated methods is that interventions prioritised by organisations such as the NHS and NICE may fail to reduce health inequalities, or may even make them worse. To avoid this happening, EQUIPOL researchers have helped to develop new analytical tools that go beyond just measuring averages, exploiting the increasing availability of large, complex datasets and the computing power necessary to analyse them. These methods can identify who wins and who loses as a result of a specific policy or intervention, and can illustrate the trade-offs between cost-effectiveness and equity in the distribution of health benefits.

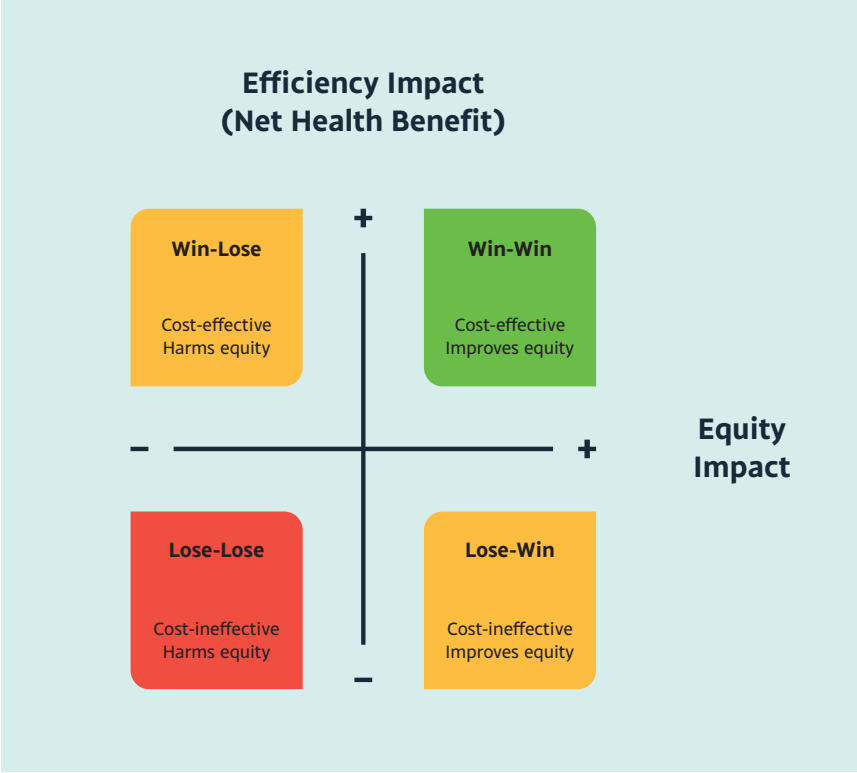


Fig 1: Equity-Efficiency Impact Plane

Adding an equity dimension in this way is transformative, as the 'Equity-Efficiency Impact Plane' illustrates (Figure 1). The vertical axis represents the standard economic measure of *efficiency* – the cost-effectiveness of an intervention across the whole of society. The higher an intervention scores on this axis, the more cost-effective it is and the higher priority it is given using standard methods.

Our approach adds the much-needed *equity* dimension, represented by the horizontal axis. The further to the right an intervention appears on this axis, the more it reduces health inequalities. This changes the picture dramatically, providing a richer perspective that enables decision makers to weigh equity impacts against efficiency for the first time.

By escaping the tyranny of the average, we place centre stage the question of who gains and who loses from an intervention. This approach can be used for any kind of intervention with important impacts on health – from new drugs and treatments to health care infrastructure investments and public health programmes to wider social policies on education, employment and tax-benefit reform.

Interventions will often fall either in the "win-win" quadrant of the equity impact plane, both improving health and reducing health inequality, or in the "lose-lose" quadrant, reducing health and increasing health inequality. Funding decisions in both these cases are relatively straightforward. Sometimes, however, interventions fall either in the "win-lose" or "lose-win" quadrants. In these cases, there are difficult trade-offs to be made between equity and efficiency.

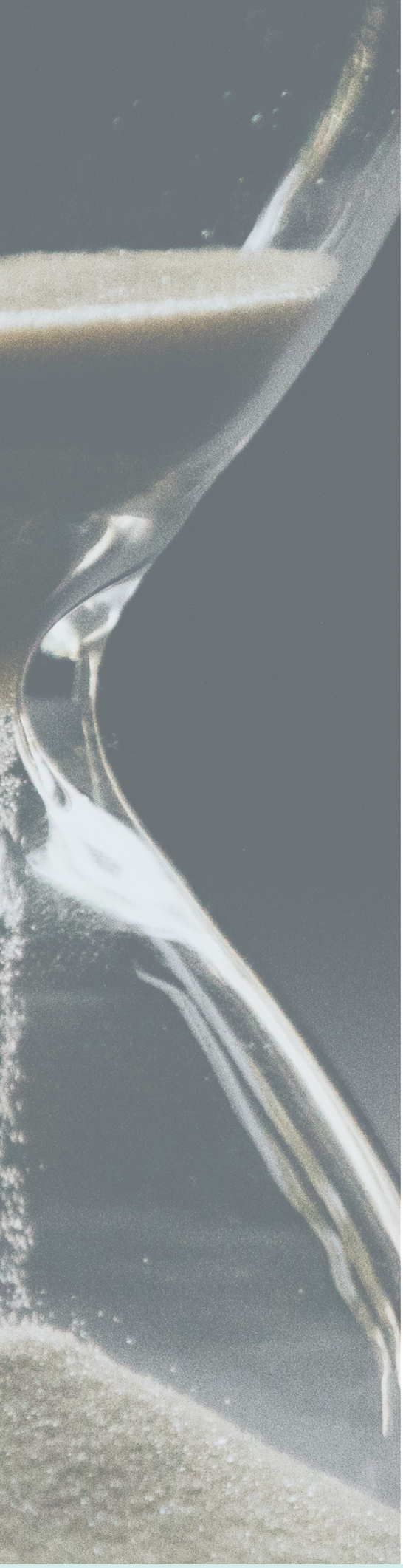
To help decision makers in balancing efficiency against equity, our approach analyses the implications of different judgements in a clear and systematic manner. This is done by quantifying how willing people are to forgo total health benefits across the population to reduce health inequality. This 'health inequality aversion' is expressed as a single number, with a value of zero denoting no concern with reducing health inequality and positive values indicating increasing levels of concern.

This approach exposes the social value judgements needed to prioritise one intervention over another, helping to establish benchmarks for how far, and in what contexts, decision makers, stakeholders and the general public are willing to make trade-offs between reducing health inequality and improving total health. As well as improving the transparency of decision making, this helps to align decisions more closely with the values of the general public. These public values are discussed in Part 2.

The application of the equity impact approach follows six simple steps:

1. **Identify equity-relevant subgroups in the population (e.g. socioeconomic groups)**
2. **Estimate the baseline (pre-intervention) distribution of health across the subgroups.**
3. **Estimate the distribution of the health effects and health opportunity costs of the intervention across the subgroups.**
4. **Compare post-intervention distributions using the health equity impact plane**
5. **Construct summary measures and evaluate trade-offs between inequality and efficiency**
6. **Conduct further analysis of uncertainty and alternative value judgements**

Importantly, this approach shows decision makers not only how the benefits of an intervention are distributed, but how their burdens are shared.



This approach – known as "distributional cost-effectiveness analysis" (DCEA) – can be time-consuming to implement, since it is data-intensive and requires specialised skills. We have therefore helped to develop and refine a quick and simple approach to DCEA that embodies the six steps in a web-based "health inequality impact calculator" with built-in data for England.

Quick and simple tool https://shiny.york.ac.uk/dceasimple/

This can be used when there are already pre-existing estimates of cost-effectiveness, but not yet a quantitative estimate of health inequality impact. Using this calculator, analysts are able to make a quick and simple estimate of the likely direction and magnitude of the health inequality impacts of an intervention.

As well as informing funding decisions, this can also improve "information triage" assessments about whether it is worth conducting more in-depth analysis of the health inequality impact – and whether that information might actually change a decision.

Helping decision makers

The ability to estimate health inequality impacts will help decision makers re-design proposed interventions before implementation, enabling them to tweak policy towards the "win-win" quadrant. It can also help decide whether an intervention is worth funding – sometimes shifting a "no" to a "yes" if an intervention clearly and substantially *reduces* health inequality, and sometimes shifting a "yes" to a "no" if an intervention clearly and substantially *increases* health inequality.

Reducing heath inequalities

By using these tools, NICE and other public bodies can start making decisions that reduce health inequality and avoid decisions that increase health inequality. No single funding decision by the NHS or any other government agency can eliminate the gap of nearly 12 healthy years between the most and least advantaged people in England. But cumulatively, over time, successive funding decisions can gradually bear down on the gap.

Part 2

Determining public support for reducing health inequality

82% **of the public said they were willing to trade-off some improvement in total health across society to reduce health inequalities**

Our research shows that most people are in favour of reducing health inequality, even if this comes at the cost of overall improvements in health. This research, which reveals the 'preference parameters' of the public, shows a public appetite for changing the way in which important decisions on health policy and inequality are made. Less than three percent of respondents in our online experiment supported the current approach of basing funding decisions on the average benefit of interventions. The vast majority – almost 82% – said they were willing to trade-off some improvement in total health across society in order to reduce health inequalities, valuing health gains to the poorest fifth of the population between six and seven times as highly as health gains to the richest fifth.

In our experiments, participants were presented with a succession of scenarios asking them to choose between two programmes, one that reduced health inequality and one that improved total health. Health inequality reductions were large in the first scenario, encouraging people to select this option, but became smaller with each successive scenario. The point at which the people 'switched' from favouring inequality reduction over total health improvement to being indifferent to the two programmes indicated their level of 'inequality aversion'.

People fell into five main categories with respect to their level of health inequality aversion:

Pro-Advantaged	Prefer to improve the health of the better-off
Health Maximiser	Prefer to increase total health across the whole population, irrespective of who benefits the most
Pro-Disadvantaged	Prefer to improve the health of the worse-off
Maximin	Only concerned with improving the health of the worst-off, and indifferent to the health of the better-off
Strict Egalitarian	Willing to reduce inequalities even if it means reducing the health of the worst-off

How could a decision maker use this information? Imagine they had to choose between two health policies, A and B, that affect the health of everyone in the UK and have the same cost. The table below shows the average health for the whole population – in terms of life expectancy – under these two policies. Which policy is best? With only this information available, Policy B appears to be the best, as it results in the highest level of average health.

Policy	Average Health
A	66.3
B	66.7

Whilst it is important to know the impact of policies on average population health, this does not tell us anything about the distribution of health benefits across different groups in the population, or the resulting impact on health inequality. This type of information is found in the table below, which shows health outcomes for three different groups within the population, in terms of average health for each group and the resulting health gap between the best and worst off. Given this additional information, is Policy B still the best option?

Policy	Health Levels			Average Health	Health Gap
	Group 1	Group 2	Group 3		
A	64	66	69	66.3	5
B	60	65	75	66.7	15

Additionally, suppose the groups represented different levels of income, with Group 1 being the poorest, and Group 3 the richest. In this case, and knowing the strong preference of the majority of the public for reducing inequalities, decision makers might prefer Policy A, as it results in the smallest health gap between groups, without sacrificing too much in terms of average health.

The first table reflects the approach taken by decision makers today. Standard cost-effectiveness analysis uses information on average health and costs alone. But these averages hide the underlying distribution of health. By focusing on averages alone, policies which unintentionally increase health inequalities might be chosen.

As described elsewhere in this report, we have developed methods to uncover the underlying distribution of health and provide policymakers with information on the consequences of their decisions. Adopting this approach makes decisions between policies more difficult, as a trade-off emerges between competing concerns of equity and efficiency. However, the equity-efficiency impact plane, described in the previous section, can help policy makers visualise this trade-off, and they can then use preference parameters to understand how far the public is willing to sacrifice efficiency in order to reduce health inequality.

Without these methods, opportunities to reduce health inequalities in line with public preferences will be missed.

Part 3

Simulating childhood policy impacts from cradle to grave

Investing in childhood can have important long-term impacts on improving health and wellbeing, reducing social inequalities, and reducing the public cost burdens that arise when children, adolescents and young people experience serious difficulties in life. Unfortunately, these long-term impacts of childhood policies have been almost impossible to estimate. Until now.

With the advent of big data and advances in simulation software, EQUIPOL researchers are designing a first-of-a-kind digital modelling tool – "LifeSim" – that will enable policy makers to predict the likely consequences of childhood interventions from cradle to grave using detailed data from the UK's world-leading birth cohort studies that follow the lives of successive generations of UK citizens.

Step-change in policy analysis

This emerging technology offers a potential step-change in childhood policy analysis across a range of sectors – including health, education, children's social care and tax-benefit reform – enabling a more coordinated approach to preventing inequality being passed from generation to generation.

LifeSim can provide summary measures of well-being that allow comparisons of value-for-money between different interventions in different policy sectors at different ages, in line with recent UK Treasury guidance on economic appraisal. It can also shed light on how and why long-term outcomes vary for different children in different circumstances.

LifeSim links together a diverse set of individual-level life outcomes of interest to policymakers - the current set of outcomes in our prototype are listed in the figure below. By using rich observational data it provides information on human capital development in childhood – including social skills, cognitive skills, and health (e.g. childhood obesity and teenage smoking) – and then extrapolates later life outcomes across economic, social, and health domains for the rest of the life course.

Current trial-based evaluation methods used to establish cause and effect are rarely able to quantify the longer term effects either of a single intervention or a package of diverse interventions. Our 'microsimulation' approach provides a robust way of evaluating childhood policies, taking recent trial data on short-term policy effects and extrapolating these effects into the future by combining historical data from cohort studies with data on the current demographic, social and economic context.

LifeSim will enable the coordination of interventions by central, regional and local agencies in a way that enhances their beneficial impact and minimises the risk of one policy undermining another. As with other methods and tools being developed by EQUIPOL, it puts the distributional impacts of policy on health inequality at the heart of decision making. With LifeSim, however, we are able to span impacts on education, income and other outcomes that go well beyond health.

Individual-level life outcomes

		Pre School Years	School Years	Working Years	Retirement
Parental Characteristics	Parental Income	●	●	●	●
	Parental Education	●	●	●	●
	Parental Mental Health	●	●	●	●
Skills	Conduct Problems	→	→	●	●
	Cognitive Skills	→	→	●	●
Social	Conduct disorder	→	→	●	●
	University degree			●	●
	Unemployment			→	→
	Poverty	→	→	→	→
	Prison			→	→
	Residential Care				→
Health	Unhealthy behaviour: smoking			→	→
	Mental illness: depression		→	→	→
	Physical illness: CHD			→	→
	Mortality	→	→	→	→
Economic	Earnings: work			→	→
	Earnings: interest			→	→
	Pension				→
	Savings			→	→
	Family wealth	→	→	→	→
	Taxes			→	→
	Benefits			→	→
Wellbeing	Consumption	→	→	→	→
	Health quality: in healthy life-years	→	→	→	→
	Wellbeing: in good life-years	→	→	→	→
Public Costs	Programme costs	→	●	●	●
	NHS healthcare costs	→	→	→	→
	Conduct disorder costs	→	●	●	●
	Prison costs			→	→
	Residential care costs				→

● Outcome determined in the previous life years, but still relevant

→ Outcome evolving

Sophisticated simulation software

The EQUIPOL model is powered by robust observational data drawn from the Millennium Cohort Study (MCS) which is following the lives of around 19,000 young people across the country born in 2000-02. The sophisticated simulation software we are developing enables us to model the interaction of a range of economic, social and health policy outcomes.

From this, we are able to capture how these evolve over time, revealing how disadvantages in the early years can combine over a lifetime to create a spiral of multiple disadvantage. As LifeSim allows us to map out the long-term outcomes for an entire general population cohort of children – not just a single group of trial participants – the model will serve as a platform for evaluating distributional impacts on social inequalities within the general population and opportunity costs falling on people not directly affected by the intervention.

A richer dimension

Unlike the current decision making tools, LifeSim also allows policy analysts to simulate individual-level outcomes for specific types of children, which is a much richer dimension than that provided by the existing decision making models which can only produce average outcome metrics.

The EQUIPOL team are now refining the LifeSim tool and stress testing it in a variety of policy applications through validation checks. We have already published a prototype version of LifeSim focusing on age 19 onwards, which we call LifeSim Adulthood, and are in process of developing a detailed model from age 0 to 17, called LifeSim Childhood, which we will then link together to model the whole lifecourse from cradle to grave. We are also about to develop a version focusing on adolescent mental health outcomes from age 11 to 17, called TeenSim. At each stage we validate and test our model predictions against long-term follow-up data from trials and quasi-experimental policy evaluation studies.

Transparency and efficiency

We will make all of our LifeSim code open source, to facilitate transparency and scientific scrutiny, and find efficient ways of helping other researchers and analysts to use LifeSim - for example by creating user-friendly "ready reckoner" tools that allow users to input a specific short-term childhood policy effect at a specific age and quickly estimate the long-term health and wellbeing impacts, public cost savings and other life outcomes in different policy domains.

The goal is to create a mature and easy-to-use suite of modelling tools that will enable a better informed and more joined up approach to childhood interventions.

Conclusion
Effectiveness, efficiency and equity

The EQUIPOL research collaboration is building on the University of York's legacy of methodological innovation, developing tools to support the design and delivery of effective, efficient and equitable health interventions. Our aim is to strengthen the evidence base to enable decision makers across government to adopt more joined up and effective approaches to eradicating health inequalities.

This short report – and the underpinning research funded by the Wellcome Trust – shows that the existing methods available to, and deployed by, agencies such as NICE are not fit for purpose. They need to be replaced.

Recommendation 1

All government agencies to ensure that major national expenditure decisions are routinely informed by analysis of their predicted impact on social inequality in health and wellbeing – starting immediately with health agencies such as the National Institute for Health and Care Excellence (NICE) and proceeding rapidly to education, welfare, justice and other areas of social policy.

Recommendation 2

HM Treasury, National and Local Government to accelerate the use of tools for modelling long-term impacts on social inequality in health and wellbeing – especially in the context of childhood policy which has life-long impacts that accumulate decades into the future.

Recommendation 3

UK Research and Innovation and the National Institute for Health Research to review UK research capacity for quantitative analysis of policy impacts on social inequality in health and wellbeing, with a view to strengthening research training, data collection, analysis and reporting.

www.york.ac.uk/healthsciences/research/health-policy/equipol/

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