

**Note on the status of this paper**

This paper setting out advice on public health research principles and goals was provided to UK Chief Medical Officers by the Strategic Coordination of the Health of the Public Research committee (SCHOPR) in July 2019. The Academy of Medical Sciences (AMS) have agreed to host the paper on their website as SCHOPR was formed in response to one of the recommendations in the Academy report, 'Health of the Public 2040'. This paper, including the research principles and goals, is a SCHOPR output and not an Academy output.

**Background**

In September 2018, the UK Chief Medical Officers (CMOs) requested that SCHOPR produce a set of public health research principles and goals to drive improvements in the UK's offer on health of the public research.

SCHOPR is a group of major health research funders; the National Institute of Health Research, UK Research and Innovation (Economic and Social Research Council, Medical Research Council, Engineering and Physical Science Research Council), Wellcome Trust, NHS Health Scotland (Scottish Government) and Health and Care Research Wales (Welsh Government). The group has an independent chair, Professor Dame Anne Johnson, and is currently a sub board of the Office of the Strategic Coordination of Health Research (OSCHR).

Following consultation with Government departments, devolved administrations, research councils, research charities and other interested groups, SCHOPR provided a paper to the CMOs in July 2019 setting out research goals and principles. In October 2019 the CMOs agreed the paper could be published in full.

The following is the paper provided to the CMOs.

## **Letter from the Independent Chair, on behalf of SCHOPR members, to the UK Chief Medical Officers; July 2019**

### **HEALTH OF THE PUBLIC RESEARCH PRINCIPLES AND GOALS**

#### **Introduction and background**

1. You asked me to work with the committee for Strategic Coordination of the Health of the Public Research (SCHOPR) and stakeholders to develop a set of ambitious principles and quantifiable goals for UK health of the public research. The overall purpose is to increase the impact of the UK's offer on health of the public research, so we are better able to respond to the public health challenges we face, now and in the future. We need health of the public research to be more ambitious, draw on a wider range of disciplines and better connect with public health practice.

2. To inform the principles and goals, SCHOPR invited contributions from a wide range of stakeholders. This included government departments, local government, research councils, research charities, academics and organisations representing public health and related professionals. We asked for bold new research ideas, including on the drivers of health, and how we could better support novel and transdisciplinary health of the public research.

3. We received over 30 responses from across the UK. Many were collated contributions from across several organisations. We were pleased with the range of organisations responding and the level of thought shown in the responses. Many included a high volume of detailed suggestions. A list of responding organisations is at annex A. Additionally, we have visited several local authorities to get a first-hand understanding of the public health challenges, evidence gaps faced in different areas and to test the ideas we are forming with a wider community.

#### **Research principles**

4. The goals that we have identified are underpinned by a set of principles intended to foster conditions for a flourishing health of the public research environment. A full list is provided in annex B. Collectively they are designed to raise ambition, widen perspectives and improve understanding of evidence. They include encouraging and rewarding innovation and ambitious thinking, bringing in the views of the public, and fostering transdisciplinary working and knowledge exchange. They are based on the view that complex, interrelated life experiences determine physical and mental health and wellbeing across the life course, with many preventable diseases closely associated with a number of common 'upstream' influences, such as the built and natural environment (including housing and air quality); employment, education, welfare, transport, health and social care, and communication systems; and the policies of local and central government and of commercial enterprises.

5. Given this challenging picture it is our view that a major priority for health of the public research for the next decade is to address the complex biological, environmental, social and behavioural determinants of physical and mental health, focusing particularly on prediction, prevention, and precision public health to improve health outcomes, extend healthy life expectancy and reduce health inequalities. This in turn requires working together across the range of disciplines and environments that influence health and behaviour, sharing methodological expertise.

6. One of the most important principles is that research on the health of the public where appropriate should be co-produced with local authorities, devolved administrations and the public. This is to ensure that questions addressed are relevant, provide actionable evidence, and are better connected with practice. Involving policymakers, practitioners and others who deliver initiatives which can improve the health of the public, such as schools, planners, lawyers, engineers and architects, is key. We are keen to encourage a shift in culture to one of a co-produced evidence-base between practitioners, researchers and the public, similar to what is being achieved in the NHS. This will generate the type of evidence required for those who need to translate it into practice for population health gain.

7. There is a further requirement for government departments, including those from devolved administrations, to work together to support a 'Health in All Policies' approach. There is also a need to share and translate knowledge and learning across the four UK nations, with opportunities for cross-country comparative work.

### **Research goals**

8. We have distilled the suggestions for research questions we received and identified priorities which, in our view, are the best ways to encourage new ways of working in the field of health of the public research and which are focused on intervention. Our goals are grouped across four themes:

- (1) The environment
  - Environmental determinants of health
  - People and place
- (2) Life course
  - Early life and educational settings
  - Healthy working lives
- (3) Systems
  - Food systems
  - Health and care systems
  - Legal and fiscal levers
- (4) Innovation
  - Technology

These focus on areas we identify as the major evidence gaps in research to improve the future health of the public. There are clear links between each of the goals – they are interdependent and not mutually exclusive.

9. The rationale for each goal is set out in annex C. These goals will signal the work that SCHOPR will prioritise in its role of strategic coordination with funders of health of the public research. They broadly align with other strategies, such as the UK's Industrial Strategy and the NHS Long Term Plan.

### **Infrastructure**

10. To support our research principles and achieve each of the goals we need to ensure we have the right structures, resources, mechanisms and incentives in place. We have summarised key aspects of infrastructure investment required in annex D. These will need refinement as we take our work forward.

## **Our vision**

11. Using these principles and goals we hope to build on existing strengths to create a world-leading health of the public research capacity in the UK. It will be based on greater recognition of the value of health of the public research and increased resourcing, underpinned by a culture of co-production, both across academic disciplines and stakeholders. Ultimately this will lead to a public health system founded on high quality research.

12. There are a range of ongoing activities which support our principles and goals. Among others, this includes the UK Prevention Research Partnership, the NIHR School of Public Health Research and the Wellcome Trust 'Our Planet, Our Health' initiative. We will ensure we continue to progress and work alongside these activities to build a vibrant health of the public research offer in the UK.

## **Next steps**

13. We welcome comments on these proposed principles and goals. With your agreement we would like to publish our conclusions to signal where new ways of working are required and where priorities lie.

14. With respondents' consent, we also plan to publish the contributions we received to our consultation as they contain a wealth of ideas which others might wish to pursue.

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## Respondents

- Alzheimer's Research UK
- Association of Directors of Public Health (ADPH)
- Asthma UK
- Bradford Institute for Health Research (BIHR)
- British Society of Gastroenterology (BSG)
- Centre for Diet and Activity Research (CEDAR)
- David Kidney, UK Public Health Register (UKPHR)
- Diabetes UK
- Faculty of Public Health (FPH)
- Food Foundation
- Food Standards Agency (FSA)
- Health and Safety Executive (HSE)
- Health Data Research UK (HDRUK)
- Local Government Association (LGA)
- Office for National Statistics (ONS)
- Professor Bruce Hollingsworth, Lancaster University on behalf of the Health Economists' Study Group (HESG)
- Professor Dame Hazel Genn, University College London
- Professor Harry Campbell, University of Edinburgh
- Professor Johnathan Shepherd, Cardiff University
- Professor Martin White, University of Cambridge
- Public Health England (PHE)
- Royal Academy of Engineering
- Royal College of General Practitioners (RCGP)
- Royal College of Paediatrics and Child Health (RCPH)
- Scottish Government
- Society for Social Medicine and Population Health (SSM)
- Soil Association
- The British Academy
- The Health Foundation
- The Royal Society
- UK Research and Innovation (UKRI)
- Wellcome Trust
- Welsh Government

## Research principles

These principles are proposed to guide investment in, and development of, health of the public research to provide evidence for action and to respond to the public health challenges faced by the UK in the 21<sup>st</sup> century.

| <b>INCREASING THE IMPACT OF THE UK'S OFFER ON HEALTH OF THE PUBLIC RESEARCH</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p><b>Overarching principles</b></p> <ol style="list-style-type: none"> <li>1. Undertake research to identify the most cost-effective methods to prevent ill-health, increase healthy life expectancies and reduce health inequalities</li> <li>2. Embrace a long-term and sustainable approach to better balance human advancement with the environment, in line with the principles of planetary health</li> <li>3. Intervene across a range of environments on both the upstream drivers of physical and mental health, alongside what can be achieved by the health and social care system</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Raise ambition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Focus on research that has the potential to drive large-scale positive change</p> <p>Encourage and reward innovation and ambitious thinking</p> <p>Support a 'Health in All Policies' approach to bring health of the public centre stage</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p><b>Co-production of research</b></p> <p>Develop new models of joint working to co-produce research with those who will use and benefit from the evidence, including:</p> <ul style="list-style-type: none"> <li>• local authorities and devolved administrations</li> <li>• the public</li> <li>• practitioners</li> <li>• policymakers</li> <li>• the third sector</li> </ul> |
| <b>Widen perspective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>Encourage transdisciplinary working, training and knowledge exchange to bring non-traditional disciplines into health of the public research</p> <p>Develop and optimise new methodological approaches and technologies</p> <p>Advocate a systems-based approach to understanding and tackling complex public health challenges</p>                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Improve understanding</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Encourage synthesis of existing and new evidence of what works and what doesn't, and ensure this feeds into policy and practice</p> <p>Ensure that research findings are timely and communicated to the public and practitioners through novel, modern and relevant means based on evidence from behavioural science</p> <p>Evaluate interventions to identify what works, where and why, assess costs, benefits and timeframes for impacts, and use implementation science approaches to ensure transferability across demographic groups and geographical areas</p> <p>Promote a culture of learning and sharing with other countries to support international efforts to improve global health security and planetary health</p> |                                                                                                                                                                                                                                                                                                                                                                                   |

## Health of the Public Research Goals

| <b>ENVIRONMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <p><b>A) ENVIRONMENTAL DETERMINANTS OF HEALTH</b></p> <p><b>Goal: Create and maintain built and natural environments for better health</b><br/>           Transdisciplinary research into the environmental determinants of health to develop cost-effective interventions to improve and protect the health of the public through the design and maintenance of built and natural environments, consistent with the principles of planetary health.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>What's needed to achieve the goal:</b></p> <ul style="list-style-type: none"> <li>• A transdisciplinary community of researchers, with leadership from disciplines beyond the traditional health field, such as planners, engineers, architects and environmental scientists.</li> <li>• Partnerships between researchers and local government to identify, implement and evaluate interventions in their local environment.</li> <li>• Strong ties with national government so that evidence feeds into the future design of policy and practice, e.g. through working closely with the Department for Environment, Food and Rural Affairs (UK government), the Department of the Economy, Skills &amp; Natural Resources (Welsh Government), the Department of Agriculture, Environment and Rural Affairs (Northern Irish Executive), the Scottish Government Economy Directorates, and the Environment Agency.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p><b>What success would look like if evidence was implemented:</b></p> <ul style="list-style-type: none"> <li>• Planning, development and maintenance of built and natural environments in the UK consistently integrates evidence-based actions to improve the health of the public.</li> <li>• Improved short- and long-term outcomes demonstrated in key measures such as: air quality, quantity of healthy low-carbon, sustainable buildings, uptake of active transport, access to green spaces (etc.)</li> <li>• Greater equity in access to high-quality, sustainable built and natural environments.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p><b>Context</b></p> <ul style="list-style-type: none"> <li>• 23% of deaths globally are estimated to be due to modifiable environmental factors.<sup>1</sup></li> <li>• Air pollution is the top environmental risk to human health in the UK, and the fourth greatest threat to public health after cancer, heart disease and obesity.<sup>2</sup></li> <li>• The UK Climate Change Risk Assessment 2017 (CCRA2) identified flooding, coastal erosion, water availability and health impacts of heat, cold, pathogens and air pollution as potential health consequences of climate change. The Adaptation Sub-Committee of the UK Committee on Climate Change has highlighted the need for key adaptations in the built and other environments to reduce health risks, particularly in cities and towns.<sup>3</sup></li> </ul> <p>There is growing appreciation of the interdependencies between the health of human populations and natural systems as enshrined in the principles of planetary health. Rapid anthropogenic environmental change on both local and global scales, from habitat and biodiversity loss to climate change, is likely to have severe consequences for physical and mental health. For example, those suffering from asthma or other respiratory conditions are at increased risk during low air quality incidents, whilst changing UK climate could threaten vulnerable populations through extreme events, enable the establishment and spread of new infectious diseases, and impact water security and food production. Complex systems science approaches are required to understand the contribution of changing environmental conditions and exposures to mental health, chronic disease, multiple long-term conditions, and life expectancy.</p> |

Well-designed built and natural environments can improve physical and mental health and wellbeing. For example, through the provision of clean air, green and blue spaces, well-ventilated and insulated buildings, active transport and healthy food supply. Government, local authorities, devolved administrations and the NHS have a major role in creating and maintaining natural and built environments for better health but require the evidence for the most cost-effective design and implementation strategies.

Significant health co-benefits for a range of diseases arise from interventions which promote decarbonisation and UK-wide environmental sustainability, in the energy, transport and building sectors and in ensuring high-quality local environments are accessible to all. This is an area where research investment and leadership from disciplines beyond the traditional health field, such as planners, engineers, architects and environmental scientists, is required. This will require investment to incentivise transdisciplinary working. We need to ensure that consideration of planetary health principles, and an evidence base for effective action, become an integral part of the design, development and maintenance of our built and natural environments.

**Links to:**

Reports: 25 Year Environment Plan (Defra, 2018); Clean Air Strategy 2019 (Defra, 2019); Healthy High Streets: good place-making in an urban setting (PHE, 2018); The Clean Growth Strategy: Leading the way to a low carbon future (HM Government, 2017); UN Sustainable Development Goals; UK Climate Change Risk Assessment 2017 (HM Government, 2017); UK Climate Projections 2018

Programmes: UK Climate Resilience (Met Office/NERC); Our Planet, Our Health (Wellcome Trust)

**References**

1. Prüss-Üstün, A., Wolf, J., Corvalán, C., Bos, R. and Neira, M., 2016. Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks. World Health Organization. Available at: [https://www.who.int/quantifying\\_ehimpacts/publications/preventing-disease/en/](https://www.who.int/quantifying_ehimpacts/publications/preventing-disease/en/)
2. Department for the Environment Food and Rural Affairs, 2019. Clean Air Strategy 2019. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/770715/clean-air-strategy-2019.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf)
3. HM Government, 2017. UK Climate Change Risk Assessment 2017. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/584281/uk-climate-change-risk-assess-2017.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf)

## ENVIRONMENT

### B) PEOPLE AND PLACE

#### **Goal: A place-based approach to reduce health inequalities**

A strong body of actionable transdisciplinary evidence to create and deliver targeted national and local health of the public solutions to meet the needs and improve health outcomes of excluded and vulnerable populations (including the elderly) within their communities. Research questions and interventions should be co-produced with the public and practitioners, independently evaluated and with findings translatable to different geographical locations.

#### **What's needed to achieve the goal:**

- Novel funding mechanisms to enable co-production of place-based interventions with the public, local authorities and equivalent devolved systems and public health practitioners, including posts that are jointly funded by universities and local government.
- Interventions should draw on the best science from a range of disciplines to optimise intervention design.
- Research undertaken in the context of relevant service, local government and third sector settings across the UK.
- Programmes of implementation science to translate evidence at scale to different geographical locations.

#### **What success would look like if evidence was implemented:**

- Strengthened culture of and mechanisms for co-production of research within local communities and translation of evidence-based actions across the UK.
- The health gap between the most and least deprived areas of the UK is reduced. Example impact measures include: reduced inequities in healthy life expectancy, reduced smoking rates, reduced admissions for substance and alcohol abuse, reduced TB incidence, reductions in homelessness, reductions in street violence (etc.)
- Improved health outcomes for excluded and vulnerable populations, including the ageing population.

#### **Context**

- People in the most deprived areas of England develop multiple long-term conditions 10 years earlier than those in the least deprived areas.<sup>1</sup>
- Women from the most deprived communities are 12 times more likely to smoke during pregnancy than women from more affluent areas.<sup>2</sup>
- In a sample of 274 coastal communities across England and Wales, 20% of the population were aged 65 years or over (compared with 16% nationally) and were relatively more deprived than those elsewhere.<sup>3</sup>

The gap in health between the rich and the poor remains a considerable challenge, particularly for the most excluded and vulnerable populations. This includes vulnerable children and young people (including those outside educational settings), those who have suffered adverse childhood experiences, are frail and elderly, live with multiple long-term conditions, are homeless and/or sleeping rough, live within secure environments such as offender institutes, or belong to disadvantaged BAME communities.

Health inequalities are often driven by geographical location, physical environment, socio-economic background and limited employment opportunity. This creates the conditions to entrench poor physical and mental ill-health across generations and locations. Vulnerable groups are often clustered in specific places, such as inner cities, rural areas, coastal areas and places in economic decline. There is also some evidence that the prevalence of multiple long-term

conditions is different in rural and urban populations, although the direction and drivers of this are unclear. This means a place-based approach to reducing health inequalities is critical.

Solutions to improve and protect public health need to be suitable for the local communities in which people live. Local authorities and devolved administrations are responsible for many of the local services which can improve the public's health, have evidence of the problems of their specific area, and hold many of the levers required for wider environmental change. However, they often lack or are unable to generate evidence around the impact of interventions and therefore the most effective ways to allocate resources. This requires a significant shift of culture and infrastructure investment to foster closer working between researchers, local authorities and devolved administrations, practitioners, the third sector and the public, to define relevant evidence gaps, co-produce research and develop cost-effective interventions.

Research should take advantage of comparisons between different systems in different UK countries. Implementation science approaches should be used to translate this knowledge to different geographical regions across the four nations.

**Links to:**

Reports: Civil Society Strategy: building a future that works for everyone (DCMS, 2018); Health and Wellbeing in Rural Areas (LGA/PHE, 2017); Industrial Strategy: Building a Britain fit for the future - Ageing Society Grand Challenge (HM Government, 2017); Integrated Communities Action Plan (MHCLG, 2019); Multimorbidity: a priority for global health research (AMS, 2018); The NHS Long Term Plan (NHS, 2019)

Programmes: Better Care Fund; Health and Social Care transformation fund; Place Based Social Action (PBSA); UKRI funding priorities (1.7)

Tools: Place Standard (Scottish Government, 2019)

**References**

1. The Health Foundation, 2018. Understanding the health care needs of people with multiple health conditions. Available at: <https://www.health.org.uk/publications/understanding-the-health-care-needs-of-people-with-multiple-health-conditions>
2. NHS, 2019. The NHS Long Term Plan. Available at: <https://www.longtermplan.nhs.uk/>
3. Depledge, M., Lovell, R., Wheeler, B., Morrissey, K., White, M. and Fleming, L., 2017. 'Future of the sea: health and wellbeing of coastal communities' commissioned as part of the UK government's Foresight Future of the Sea project. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/639432/Health\\_and\\_Wellbeing\\_Final.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/639432/Health_and_Wellbeing_Final.pdf)

## LIFE COURSE

### A) EARLY LIFE AND EDUCATIONAL SETTINGS

#### **Goal: Set children and young people on the right path for good health**

Transdisciplinary research into the association between early life, education, educational environments, and health to inform policy and practice and to develop cost-effective interventions within early life programmes and educational settings, co-produced with young people and practice partners, to establish healthy learning environments and behaviours, and improve physical and mental health and educational outcomes.

#### **What's needed to achieve the goal:**

- Partnerships between researchers and relevant practice partners, such as nurseries, schools and universities, educationalists, the NHS and local authorities to develop interventions within early life and educational settings, co-produced with young people.
- Engagement with novel disciplines including behavioural scientists, neuroscientists, developmental biologists, architects (etc.)
- Strong ties with national government and with educationalists and their professional bodies so that evidence feeds into the future design of policy and practice, e.g. through working closely with the Department for Education (UK government), Department of Education and Public Services (Welsh Government), the Department of Education (Northern Ireland Executive), and the Scottish Government Education, Communities and Justice Directorates.

#### **What success would look like if evidence was implemented:**

- Better pre-natal and early life health, to reduce developmental inequalities and ensure children enter school on an equal footing.
- Improvements in health and wellbeing of children and young people; for example, through reduced childhood obesity, lower levels of smoking and substance abuse, improved mental and sexual health.
- Reduced inequalities in educational attainment, opportunity and health outcomes across the life course.

#### **Context**

- 56.6% of children in England who are eligible for free school meals were 'school ready' (i.e. they had achieved a good level of development) at the end of reception in 2017/18, compared with 71.5% of all children.<sup>1</sup>
- Regular consumption of energy-dense nutrient-poor food has been linked with poorer behaviour in class and lower educational outcomes.<sup>2</sup>
- Poor educational attainment has been linked with increased rates of death and illness in adults for a wide range of health conditions.<sup>2</sup>
- 50% of mental health problems are established by age 14, such that schools may have an important role in the prevention of mental health problems.<sup>3</sup>
- Young adults aged 16–24 today are more likely than previous generations of young adults to experience mental health issues and the numbers of students reporting mental ill health is increasing.<sup>4</sup>

Poor educational attainment is closely associated with poor health outcomes and is a key determinant of health inequalities. We need to better understand how educational settings can be enhanced to improve long-term employment prospects, socio-economic and health outcomes. Working closely with practitioners, we can use systems-based approaches and apply insights from behavioural science to develop interventions in early life, school and higher education or training settings to establish life-long healthy behaviours and improve physical and mental health outcomes.

It is important that children enter the educational system on an equal footing, with the developmental skills and capabilities needed to get the most out of their education. We need to determine the best methods to support parents and carers during the first 1000 days (from the beginning of pregnancy to two years) which are recognised as critical for a child's development. Within schools and nurseries, there are multiple opportunities for improving physical and mental health outcomes; these include: the physical environment, such as indoor air quality and green buildings; the culture, such as building exercise into the day, facilitating healthy diets and supporting mental health; approaches to learning, for example by integrating insights from behavioural neuroscience with those from educational research to optimise learning; and the curriculum, such as relationship and sex education, and the content of science curricula in relation to health. Schools can further engage with families and communities to optimise positive health behaviours and reduce adverse impacts of alcohol, sexual risk-taking, drug use, violence and antisocial behaviour in young people. Post-16, we need to develop effective ways to continue to support young people's physical and mental health and wellbeing as they experience the lifestyle changes, opportunities, challenges and pressures that come with entering the workplace, undertaking apprenticeships and training, or pursuing higher education.

All these potential interventions require a stronger evidence base of 'what works', implementation science, and a culture of transdisciplinary strategic coordination of research in partnership with practitioners and policymakers.

#### **Links to:**

Reports: Childhood Obesity: A Plan for Action (DHSC, 2016-18); DfE Strategy 2015-2020: world-class education and care (DfE, 2016); Harnessing Educational Research (The British Academy/The Royal Society, 2018); Policy statement: relationships education, relationships and sex education, and personal, social, health and economic education - amendment to the Children and Social Work Bill (DfE, 2017); Wellbeing of Future Generations (Wales) Act 2015: The Essentials (Welsh Government, 2015)

Programmes: Healthy lifestyles funding for schools (DfE, 2017); Healthy Lifestyles Programme (HeLP), Office for Education Research [proposed by The British Academy and The Royal Society]; Scottish Attainment Challenge: Attainment Scotland Fund, Care Experienced Children and Young People Fund and Pupil Equity Funding (Scottish Government, 2015-2019)

#### **References**

1. Public Health England, 2019. Public Health Outcomes Framework. Available at: <https://fingertips.phe.org.uk/profile/public-health-outcomes-framework>
2. White, J., 2018. Children's social circumstances and educational outcomes. NHS Health Scotland. Available at: <http://www.healthscotland.scot/media/2049/childrens-social-circumstances-and-educational-outcomes-briefing-paper.pdf>
3. Mental Health Foundation, 2015. Fundamental Facts About Mental Health. Available at: <https://www.mentalhealth.org.uk/publications/fundamental-facts-about-mental-health-2015>
4. Connell-Smith, A. and Hubble, S., 2017. Mental health services for post 16 students in England. House of Commons Library. Available at: <https://researchbriefings.files.parliament.uk/documents/CBP-8163/CBP-8163.pdf>

## LIFE COURSE

### B) HEALTHY WORKING LIVES

#### **Goal: Respond to changes in how we work and what it means for health**

Forward looking research that explores the relationship between work environments, patterns and practices (including worklessness) and health of the public, and how this is likely to evolve in the context of the digital revolution and changing demography. It should drive evidence on optimum workplace design, employment and income structures within the workplace and inform forward-looking government policy, practice and industry measures to maintain and improve the physical and mental health, adaptability and resilience of the working age population.

#### **What's needed to achieve the goal:**

- Partnerships between researchers, employers and trade unions, economists and others to generate evidence of how best to optimise workplace environments and employment practices for health. This should include consideration of the minimum wage, Universal Credit, fiscal policies, and impact on health.
- Strong ties with national and local government so that evidence feeds into the design of forward-looking policy and practice, e.g. through working closely with the Department for Work and Pensions (UK government), the Department of the Economy, Skills & Natural Resources (Welsh Government), the Department for the Economy (Northern Ireland Executive), the Scottish Government Economy Directorates, and the Health and Safety Executive.

#### **What success would look like if evidence was implemented:**

- Healthy working environments and practices to promote good physical and mental health, wellbeing, adaptability and resilience of the working population as they progress through to retirement.
- Better health outcomes and support for those who are unemployed, underemployed or with low job security.
- Reduced levels of work-related ill-health, sickness absence, presenteeism and absenteeism.

#### **Context**

- Worklessness and sickness absence costs the wider economy around £100 billion a year.<sup>1</sup>
- 1.4 million workers suffered work-related ill-health in 2017/18.<sup>2</sup>
- Almost 3 in 10 workers are now over 50, compared to around 2 in 10 in 1997.<sup>3</sup>

Work is a major determinant of health. The working environments that we spend large amounts of time in, and the nature and quantity of the work we do, are all closely related to our physical and mental health and wellbeing. Poverty and low standards of living, resulting from unemployment, underemployment and low pay, are recognised drivers of poor physical and mental health, including multiple long-term conditions. Our health in turn affects our ability to participate in the workplace and sustain employment. Modern-day working environments are changing rapidly. At the same time, increases in the retirement age and longer lifespans lead to longer working lives.

There have been huge changes in recent decades in how, when and where we work, including increased flexible and home working, low-pay shift work and short-term or zero-hour contracts, and unpaid caring. Reduction in heavy industry and the digital revolution have changed the way we work, leading to increased sedentary behaviour and screen exposure, alongside changes in the skills required and methods of communication. Advances in machine-learning and AI are likely to drive increased automation of jobs and it is uncertain how this will impact the workforce.

It is important that we understand the impact of changing patterns of work on health, particularly for those in disadvantaged groups, and identify ways to optimise work environments and culture to diminish inequalities in work-related illness, reduce work-related stress, promote good physical and mental health, and achieve healthy ageing. This may lead to economic benefits for individuals and communities and increased national economic stability, in turn improving health outcomes.

**Links to:**

Reports: Fair Work Action Plan (Scottish Government, 2019); Good Work: The Taylor Review of Modern Working Practices (Taylor, 2017); Health matters: health and work (PHE, 2019); Improving Lives: The Future of Work, Health and Disability (DWP/DHSC, 2017); Industrial Strategy: Building a Britain fit for the future (HM Government, 2017); Thriving at Work: The Independent Review of Mental Health and Employers (Stevenson/Farmer, 2017)

Programmes: NHS Health at Work

**References**

1. Public Health England, 2019. Health matters: health and work. Available at: <https://www.gov.uk/government/publications/health-matters-health-and-work/health-matters-health-and-work>
2. Health and Safety Executive, 2018. Health and safety at work: Summary statistics for Great Britain 2018. Available at: <http://www.hse.gov.uk/statistics/overall/hssh1718.pdf>
3. Taylor, M., Marsh, G., Nicol, D. and Broadbent, P., 2017. Good Work: The Taylor Review of Modern Working Practices. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/627671/good-work-taylor-review-modern-working-practices-rg.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627671/good-work-taylor-review-modern-working-practices-rg.pdf)

## SYSTEMS

### A) FOOD SYSTEMS

#### **Goal: Reshape food systems to improve health**

Systems-based research capacity to inform agricultural and food industry policy and practice and to identify and fill evidence gaps for cost-effective interventions across the food system to support healthier, more sustainable and environmentally-friendly diets, and diminish inequalities in nutrition related health outcomes.

#### **What's needed to achieve the goal:**

- A wider range of disciplines involved in food systems research programmes led by disciplines beyond the traditional health field, including agricultural and plant sciences, human biology and genetics, environmental science, behavioural science and economics.
- Coordinated activity by research funders to incentivise systems research.
- Strong ties with national government so that evidence feeds into the future design of policy and practice, e.g. through working closely with the Department for Environment, Food and Rural Affairs (UK government), the Department of the Economy, Skills & Natural Resources (Welsh Government), the Department of Agriculture, Environment and Rural Affairs (Northern Irish Executive), the Scottish Government Economy Directorates, and the Food Standards Agency.

#### **What success would look like if evidence was implemented:**

- Recognised UK skill and capability in systems science.
- An increase in healthier, more sustainable and environmentally-friendly diets.
- Reduced inequalities in access to and consumption of healthier affordable diets.
- A reduction in obesity and diet-related diseases (including heart disease and cancers) across the UK, and reduced carbon footprint across the food system.

#### **Context**

- Obesity is estimated to affect more than 1 in 4 adults in the UK.<sup>1</sup>
- It is estimated that 1.3 million people over the age of 65 living in the UK are suffering from, or are at risk of, malnutrition.<sup>2</sup>
- A diet in line with the Eatwell Guide is better balanced, healthier, and has a 32% lower environmental impact than the current average UK diet.<sup>3</sup>

The UK food system is complex and impacts on the health of the population in many ways. A systems perspective allows us to consider the synergistic or opposing effects of interventions at different levels of a system and to consider both the intended and unintended consequences of health interventions.

This includes consideration of all the processes and infrastructure required to feed a population, from growing crops and rearing livestock, to transport and marketing, to consumption and disposal. This requires a broad programme of work to investigate the biological, behavioural, commercial, fiscal, physical, agricultural and social factors that shape food choice, eating patterns and their impact on health. In turn, this will identify the effective interventions required to support healthier, sustainable diets across the population and life course, lower inequalities, and reduce the environmental impact of the food industry. This will require the engagement of the full range of disciplines and sectors that contribute to food systems and their regulation.

#### **Links to:**

Reports: 25 Year Environment Plan (Defra, 2018); OECD Obesity Update 2017; The Eatwell Guide: a More Sustainable Diet (The Carbon Trust, 2016); The future for food, farming and the environment: policy statement (Defra, 2018); UN Sustainable Development Goals

Programmes: Childhood Obesity Trailblazer Programme; NHS Diabetes Prevention Programme; Soil Association Out to Lunch campaign

**References**

1. OECD, 2017. Obesity Update 2017. Available at: <http://www.oecd.org/health/health-systems/Obesity-Update-2017.pdf>
2. The Food Foundation, 2017. UK and Global Malnutrition: The New Normal. Available at: [https://foodfoundation.org.uk/wp-content/uploads/2017/07/1-Briefing-Malnutrition\\_v4.pdf](https://foodfoundation.org.uk/wp-content/uploads/2017/07/1-Briefing-Malnutrition_v4.pdf)
3. The Carbon Trust, 2016. The Eatwell Guide: a More Sustainable Diet. Available at: <https://www.carbontrust.com/media/672635/phe-sustainable-diets.pdf>

## SYSTEMS

### B) HEALTH AND CARE SYSTEMS

#### **Goal: Understand the role of the health and social care system in prevention**

Develop a strong evidence base and promote a culture of understanding of what works in health and social care systems for prevention of ill-health, at both the individual and population level. This would enable systems-level change that is informed by implementation science and which complements the work of local authorities and devolved administrations.

#### **What's needed to achieve the goal:**

- A programme of implementation science for systems change across health and social care to prevent ill-health.
- Closer working between the NHS, health practitioners and local authorities to develop preventive interventions at individual, local and national level.

#### **What success would look like if evidence was implemented:**

- Prevention is an integral, well-recognised and better resourced part of the UK health and social care system.
- Evidence across care system of increased uptake, staff competence, and investment in cost-effective personalised prevention services (smoking, alcohol, diet, rehabilitation, stroke and CVD prevention etc.)
- The NHS and local authorities or devolved administrations work together to prevent ill-health in local communities and optimise integration of health and social care for public benefit.
- Evidence of reduced risk of disability from complications of long-term and multiple health conditions (e.g. diabetes, COPD, arthritis etc.)
- Measurable improvements in population health, including longer healthy life expectancies.

#### **Context**

- In the UK, we spend 60% of public funding for healthcare on cure and rehabilitation, and only 5% on prevention. This is equivalent to spending £97 billion a year on treating diseases, and only £8 billion on preventing them.<sup>1</sup>
- Multiple long-term conditions are associated with worse quality of life and lower disability-free life expectancies for patients and increased costs for healthcare systems.<sup>2</sup>
- Investments in prevention have the potential for significant long-term social return – an estimated £14 of social benefit for every £1 spent.<sup>1</sup>

Both health and social care systems have a key role to play in preventing ill-health, but currently remain focussed on managing sickness, not health. The NHS Long Term Plan has signalled the importance of prevention and integrated care systems, but the evidence on how best to achieve cost-effective systems-wide prevention across the NHS and improve the population's health is lacking. We need to understand the existing role and future potential of the NHS and social care system to prevent mental and physical ill-health, particularly in response to our ageing population. We further need strategies and interventions to prevent or slow down disease trajectories as well as reduce the negative impact of one or more chronic conditions on people's lives. This includes a greater focus how to effectively implement existing evidence at scale and achieve measurable improvement in the health of the population. Evidence should be used to determine the best ways to (1) work across the NHS and public health services to improve prevention services and protect people's health, and (2) drive population-level health improvement.

Alongside a national programme of precision public health to effectively target interventions to meet the needs of specific populations lie key opportunities for personalised and predictive prevention to address modifiable risks to physical and mental health (such as smoking, diet,

environmental stressors etc.) in individuals embedded in clinical practice at scale. We need better evidence to both guide and evaluate the population impacts of new approaches to prevention and integrated care proposed for the NHS. This includes overcoming barriers to changing professional practice, up-skilling the workforce, and enabling NHS investment.

**Links to:**

Reports: Health and Wellbeing 2026: Delivering Together (Northern Ireland Executive, 2016); Industrial Strategy: Building a Britain fit for the future (HM Government, 2017); Personalised Health and Care 2020: Patient, Carers and Service User Vision (National Information Board, 2017); Prevention before cure: Prioritising population health (BMA, 2019); Prevention before cure: Securing the long-term sustainability of the NHS (BMA, 2018); Prevention is better than cure: Our vision to help you live well for longer (DHSC, 2018); The NHS Long Term Plan (NHS, 2019)

Programmes: Applied Research Collaborations; Better Care Fund; Health Data Research UK

**References**

1. Department of Health and Social Care, 2018. Prevention is better than cure: Our vision to help you live well for longer. Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/753688/Prevention\\_is\\_better\\_than\\_cure\\_5-11.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/753688/Prevention_is_better_than_cure_5-11.pdf)
2. Academy of Medical Sciences, 2018. Multimorbidity: a priority for global health research. Available at: <https://acmedsci.ac.uk/file-download/99630838>

## SYSTEMS

### C) LEGAL AND FISCAL LEVERS

#### **Goal: Better use of legal and fiscal levers to improve population health**

Investment in research to investigate and measure the health impact and economic costs and benefits of legal and fiscal measures at national, local and individual level, to inform future policy and practice.

#### **What's needed to achieve the goal:**

- A national community of transdisciplinary researchers, involving lawyers, economists, behavioural scientists, political scientists and public health specialists, working with practitioners and the public.
- A well-developed research programme of the cost-effectiveness of fiscal and legal interventions relative to other approaches (e.g. sugar taxation, air quality, food labelling, building design etc.) on health behaviours and environments.

#### **What success would look like if evidence was implemented:**

- Increased socio-legal capability in health of the public research.
- A greater understanding of how and when to use legal and fiscal measures to improve population health, evidenced through increased join-up with law, economics, behavioural science and other disciplines.
- Evidence of positive health impact of introduced legal and fiscal levels, e.g. through individual and organisational-level behavioural change, compliance with statutory responsibility, and improved health outcomes.

#### **Context**

- Effective policies often use a range of interventions, including regulatory and fiscal measures; for example:
  - Seat belts are estimated to have saved tens of thousands of lives in Britain, since they became mandatory to wear in the front seats of cars in 1983.<sup>1</sup>
  - The number of smokers in Britain fell by 1.9 million in the 10 years after the smoking in public places ban was introduced in 2007.<sup>2</sup>
  - The Scottish Government have supported social prescribing in socio-economically deprived communities through funding the Community Link Worker Programme from 2017.<sup>3</sup>

Law and fiscal policy are important levers which influence health behaviour and outcomes at the national, local and individual level. National examples include legislation on air quality, the built environment and taxation in relation to unhealthy products, most recently the Soft Drinks Industry Levy. Local examples include decision-making around funding of and entitlements to services, such as social prescribing.

The law also shields the vulnerable from factors affecting health. The emerging field of health justice addresses many of these issues but there is little capacity or investment in socio-legal research in the UK. There is an opportunity to lead the world in facilitating transdisciplinary health justice research that (1) integrates socio-legal and public health perspectives, (2) is informed by behavioural science, both behavioural change and behavioural economics, and (3) deploys innovative and transferable evaluation methods that could support rapid translation and policy implementation.

Achieving this requires leadership and transdisciplinary working with the legal profession, economists and behavioural scientists to better understand the role of legal and fiscal interventions as well as the ethics of their use, in improving the health of the public.

We need to use systems-based approaches, informed by insights from behavioural science, to build evidence around what works and what doesn't (within the four UK countries and internationally) in terms of driving environmental and behavioural change to improve population health, how and when it is appropriate to implement effective legal and fiscal measures, and how we support these to increase their impact.

**Links to:**

Reports: Health Taxes to Save Lives: Employing Effective Excise Taxes on Tobacco, Alcohol, and Sugary Beverages (The Task Force on Fiscal Policy for Health, 2019); Behaviour Change - Science and Technology Committee report (House of Lords, 2011); Soft Drinks Industry Levy (HMRC, 2016); The NHS Long Term Plan (NHS, 2019)

Programmes: Health of the Public Transdisciplinary Research Fellowships

**References**

1. The Royal Society for the Prevention of Accidents, 2018. Road Safety Factsheet. Available at: <https://www.rospa.com/rospaweb/docs/advice-services/road-safety/vehicles/seatbelt-advice.pdf>
2. Statistical Information Team at Cancer Research UK, 2017. Press release: British smokers down by 1.9 million since the ban. Available at: <https://www.cancerresearchuk.org/about-us/cancer-news/press-release/2017-07-01-british-smokers-down-by-19million-since-the-ban>
3. Scottish Government, 2017. Scottish Government 's Community Link Worker Programme: Briefing 30th May 2017. Available at: <https://vhscotland.org.uk/wp-content/uploads/2017/06/Scottish-Government-Briefing-on-Community-Link-Workers-30-May-2017.pdf>

## INNOVATION

### TECHNOLOGY

#### **Goal: Deploy new technologies for health protection and health improvement**

Transdisciplinary research to develop and evaluate novel digital and non-digital technologies for health protection, health improvement and health communication, and deploy these where needed across the health and social care system.

#### **What's needed to achieve the goal:**

- An integrated research and practice capacity in the use of novel technologies for health protection and health improvement.
- Upskilling of the health practitioner workforce in the application and evaluation of new technologies and increased engagement of computer scientists, engineers, and remote diagnostics and technology industries in health of the public research.
- A programme of research co-produced with the public investigating the effectiveness of communication technologies and social media for improving health and a better understanding of whether such media have adverse outcomes for physical and mental health.

#### **What success would look like if evidence was implemented:**

- A skilled health and social care workforce that can use novel technologies, integrate multiple big health data sources and embraces relevant novel expertise to protect and improve public health.
- A health, public health and social care system that has rapid and robust methods for evaluation and implementation of new technologies and can deploy them for more rapid surveillance and precision public health.
- Effective methods of health communication supported by digital technologies, including the use of social media and apps.

#### **Context**

- The UK has the chance to lead the world in health technologies – we have world-class healthtech companies and academic institutes and, in the NHS, the world's largest health service organisation.<sup>1</sup>
- We have world-leading resources in big data for health, biomeasures and health services informatics including Health Data Research UK (HDRUK), population cohorts and surveys, UK Biobank, and national and international resources for surveillance of infectious diseases and biological hazards through Public Health England (PHE) and devolved organisations.

New digital and non-digital technologies, such as big data, AI, machine-learning and remote diagnostics, have the potential to transform public health and health services. Examples include digital surveillance methods for infectious disease outbreaks (e.g. using social media, internet searches and electronic healthcare records), satellite-based remote sensing to monitor the environment, personalised healthcare apps for health improvement, and novel diagnostics.

Big data from electronic records allows development of personalised prevention treatment and algorithms through machine learning, alongside the ability to assess effectiveness of interventions to improve health of the public within and outside healthcare services. New technologies also have the potential to support people to remain active and independent as they age, and to reduce the burden associated with living with one or more long-term conditions. These technologies are currently under-used and under-evaluated in public health interventions; effective implementation across health and social care systems requires upskilling of the workforce, rapid and robust methods for evaluation and implementation, and an understanding of the ethics and governance around personal data use.

We further need to be developing up-to-date and effective methods for communicating health improvement messages to the public and evaluating their impact on health behaviour and outcomes. This requires better working with communication experts and behavioural scientists and should explore the use of new internet-based and digital technologies, including social media, public engagement, and citizen science.

**Links to:**

Reports: Contained and controlled: the UK's 20-year vision for antimicrobial resistance (DHSC, 2019); Health and Social Care Workforce Strategy 2026 (Northern Ireland Executive, 2018); Industrial Strategy: Building a Britain fit for the future – Artificial Intelligence and Data Grand Challenge (HM Government, 2017); Informed Health and Care: A Digital Health and Social Care Strategy for Wales (Welsh Government, 2015); Personalised Health and Care 2020: Patient, Carers and Service User Vision (National Information Board, 2017); The future of healthcare: our vision for digital, data and technology in health and care (DHSC, 2018); The Topol Review: Preparing the healthcare workforce to deliver the digital future (NHS Health Education England, 2018)

**References**

1. Department of Health and Social Care, 2018. The future of healthcare: our vision for digital, data and technology in health and care. Available at: <https://www.gov.uk/government/publications/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care>

## Infrastructure

The table below sets out some of the proposed structures, resources, mechanisms and incentives which would support us in meeting our research principles and achieving our goals. These are not exhaustive and further development will be required, including identifying incentives to encourage a new approach to health of the public research.

| What                                                                                                                                                                                                        | How                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Facilitate and invest in better use and linkage of health, administrative, social, and environmental data, including longitudinal cohorts, while ensuring appropriate safeguards are in place</b></p> | <ul style="list-style-type: none"> <li>• Health and social care data at local and national level linked with wider health determinants and outcomes, including administrative, social, educational, and environmental datasets.</li> <li>• Population-level longitudinal datasets to infer cause-and-effect mechanisms of health. We should utilise existing birth cohorts and consider new longitudinal studies to address evidence gaps.</li> <li>• Cross-sectional datasets, such as serial population surveys, to assess the impact of population-level interventions.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>Exploit advances in technology, genomics and data science to improve research methods and design</b></p>                                                                                              | <ul style="list-style-type: none"> <li>• Big data, mathematical modelling, machine-learning and other cutting-edge techniques to (1) develop and optimise new approaches for personalised prevention, clinical practice, and precision public health, (2) develop digital approaches for evaluating the impact of public health interventions, and (3) develop digital approaches for the surveillance of infectious diseases and biological hazards.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Develop novel approaches and best practice for co-production of research in non-traditional settings</b></p>                                                                                          | <ul style="list-style-type: none"> <li>• Incentivise collaboration between universities and local authorities, i.e. through the creation of joint research posts and research funding schemes.</li> <li>• Stimulate co-production of research with the public, including through the creation of citizen science initiatives.</li> <li>• Develop effective ways to work and foster leadership in research with a range of practice partners, such as public health practitioners, local authorities, teachers, urban planners, engineers, lawyers, economists and the third sector.</li> <li>• Create infrastructure to support research within non-traditional settings, such as schools and workplaces.</li> <li>• Develop methods to integrate health of the public research with new health and social care service organisation, including social prescribing, and remote diagnostics and delivery.</li> <li>• Develop robust evaluation methods for natural experiments, including comparative studies between the four UK nations.</li> <li>• Provide clear governance structures and ethical guidance for working in novel setting (including with industry), and ensure compliance with regulations.</li> </ul> |
| <p><b>Develop new transdisciplinary and sustainable career pathways</b></p>                                                                                                                                 | <ul style="list-style-type: none"> <li>• Promote collaborations between traditional and non-traditional public health research disciplines, such as behavioural, social, political, environmental and data sciences, law and economics.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>for the health of the public research workforce</b></p>          | <ul style="list-style-type: none"> <li>• Identify incentives for non-traditional disciplines to lead on health of the public research, e.g. through working with professional bodies and academies to develop new funding schemes and recognised career pathways.</li> <li>• Facilitate networking and knowledge exchange opportunities between traditional and non-traditional public health research disciplines.</li> <li>• Create training and development opportunities to introduce public health concepts to those who are new to this field, and to expand the skills and knowledge base of existing public health researchers.</li> <li>• Support transdisciplinary public health training and fellowship programmes to bring new researchers into this field.</li> </ul> |
| <p><b>Build long term sustainability into funding arrangements</b></p> | <ul style="list-style-type: none"> <li>• Incentivise, promote and value transdisciplinary and applied team science; for example, through potential changes in the Research Excellence Framework.</li> <li>• Stimulate funding pathways for joint research projects and transdisciplinary research programmes.</li> <li>• Stimulate funding pathways to support long-term and large-scale longitudinal studies.</li> <li>• Develop joint research bids between traditional and non-traditional public health funders which incentivise new disciplines to lead in this area.</li> </ul>                                                                                                                                                                                             |