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Future of Health

Findings from a survey of stakeholders on the future of health and healthcare in England

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Preface

RAND Europe was commissioned by the National Institute for Health Research (NIHR) to gather and synthesise stakeholder views on the future of health and healthcare in England in 20 to 30 years' time. The aim of the work is to gain an understanding of a wide range of stakeholders' views on the differences and trends affecting the future of health and healthcare as well as of the key drivers of change, in order to inform strategic discussions about the future priorities of the NIHR – and the health and social care research communities more widely. This work is based on an online survey of a range of stakeholders in health and social care in the United Kingdom (UK), including policy experts, academics, professional bodies, advocacy organisations and patient representatives.

The report's primary intended audience is the health and social care research community in England. However, it is hoped that the findings will be of relevance to all stakeholders in the future of health and social care in England as well as in the UK more widely. The report can be read alongside the full dataset of survey responses for which permission to share was given, which has been published online at: http://nihr.ac.uk/news-and-events/documents/quotes.xls

RAND Europe is a not-for-profit policy research organisation which aims to improve policy and decision making through research and analysis. For more information on this report or on RAND Europe more widely, please contact Dr Jon Freeman:

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Abbreviations

AHSN	Academic Health Science Network
AI	Artificial Intelligence
AMR	Anti-microbial Resistance
CLAHRC	NIHR Collaboration for Leadership in Applied Health Research and Care
CRN	Clinical Research Network
EHR	Electronic Health Record
HRA	Health Research Authority
NICE	National Institute for Health and Care Excellence
NIHR	National Institute for Health Research
PPI	Patient and Public Involvement
RCT	Randomised Controlled Trial
UK	United Kingdom

Summary

The health challenges of the coming decades may look significantly different to those faced today. Demographic changes, technological advances, and socioeconomic and environmental developments, to name a few, are expected to shape – and in some cases transform – the future health and social care landscape.

This report presents findings from a survey conducted by RAND Europe at the request of the NIHR to gather and synthesise stakeholder views on the future of health and healthcare in England in 20 to 30 years' time. The aim of the research was to generate an evidenced-based picture of what future needs in England may be and how they might differ from today, in order to inform strategic discussions about the future priorities of the NIHR and the health and social care research communities more broadly.

Response

The survey provided a rich and varied dataset based on responses from 299 stakeholders in total. Over half (153/299) answered in their capacity as a 'professional representative' of their organisation and 146 in their capacity as a 'private individual'. A wide range of fields were represented, including, but not limited to, public health, social care, primary care, cancer, genomics, mental health, geriatrics, child health, patient advocacy and health policy. The respondent group also included a number of professional and private stakeholder categories, such as clinicians, policy experts, academics and patient and public representatives.

Findings

A summary of the key themes which emerged from survey responses is presented below in Table 1. Respondent views on the future differences and trends shaping the future health landscape were thematically grouped into three overarching areas: population health, health systems and performance, and perceived priorities for supporting research and impact. Themes cover stakeholders' expectations of the trends and changes likely to shape the future health and healthcare landscape in England, as well as their views on associated priorities for research and the research infrastructure in responding to this predicted future.

Table 1. Summarised trends and research focus areas raised in survey responses

CHAPTER 3	CHAPTER 4
Key trends	*Key areas for future research investment*
Population health	*Population health*
- The challenge of an ageing population - Lifestyle and environmental drivers of disease: public health and prevention - The challenge of increasing health inequalities - Trends in mental health - Global challenges and changing patterns of disease.	- Addressing the challenge of an ageing population and associated multi-morbidities - Improving strategies for public health and prevention - Understanding and tackling health inequalities and their determinants - Exploring the causes and effects of mental ill health - Improving maternal and child health for a life-course approach - Responding to the threat of anti-microbial resistance and infectious disease - Evidence gaps in specific disease areas.
Health systems and performance	*Health systems and performance*
- Transformations in the organisation and delivery of health and social care - Focus on interventions for public health and prevention - Advances in technology and medical science - Access to and availability of new kinds of patient and public data.	- Understanding and implementing effective health and social care - Ensuring the safe, effective and equitable implementation of advances in technology and medical science.

CHAPTER 5	
Perceived priorities for supporting health research and impact	
- Developing new processes and structures for research governance and administration - Embedding research in the NHS.	- Driving new approaches to research - Facilitating patient and public involvement in research.

Respondent views on the future differences and trends shaping the future health landscape emphasised a range of themes relating both to population health and to health systems and performance. Particularly pertinent examples that emerged included: an ageing population, living longer but not necessarily in better health; rising health inequalities and the increasing influence of unhealthy lifestyle choices; increases in the burden of mental health, especially for children and older people; and the future threat of changing patterns of infectious and respiratory disease, in part due to anti-microbial resistance (AMR) and air pollution.

Transformations in health and social care were anticipated to interact with these trends in a number of ways. Changes in models of care to tackle the health challenges associated with an ageing population and increasingly complex physical and mental illness included shifts towards more holistic, integrated models of care and prevention, supported by more multi-disciplinary working amongst health and social care professionals. Advances and expansion in the use of technology, such as artificial intelligence (AI) and digital apps, were expected to facilitate the roll-out of self-management approaches for patients, but concerns were expressed that due to differential access across groups, such approaches risked exacerbating inequalities in health. Advances in genomics and personalised medicine were seen as holding transformative potential for prevention, diagnostics and treatment; however, respondent views varied on the degree to which personalised approaches could be widely implemented in the NHS in the near future. Access to and availability of data was another key area of predicted change, as researcher and clinician access to vast population-level datasets ('big data') and linked service datasets could inform approaches to prevention, diagnostics and treatment with previously inaccessible insights into public behaviours, service use and health status. However, barriers to maximising these benefits included currently unresolved ethical and data quality issues.

Priorities for research raised by respondents resonate with the key predicted challenges for health and social care and highlight the need for enhanced understanding of the drivers and effects of trends affecting health and care, as well as of effective interventions and strategies to tackle and mitigate these challenges. Key areas deemed to warrant further research included managing and understanding multi-morbidity, addressing social determinants of health inequalities, understanding the causes and effects of mental illness, and responding to the threat of infectious disease pandemics. Respondents also highlighted the importance of research into improving approaches to care and support for older people, women and children, informal carers and those at the end of life, and into improving the equitable and effective uptake and spread of health innovations in the NHS, including advances in technology, genomics and research more broadly.

Finally, in order to provide a supportive environment for health research and impact, respondents saw a key role for health funders and coordinating bodies in overseeing and investing in programmes which underpin quality research nationally. Key priorities included: ensuring the responsiveness of research governance and ethics reviews to a changing research landscape, in particular in terms of access to linked datasets; continuing to build on research capacity building and facilitating proven approaches to research translation into order to embed the use and conduct of research in the NHS; facilitating the use of appropriate methodologies and the latest technologies in the design and conduct of health research; and continuing to strengthen representative patient and public engagement in health research at all stages.

Conclusions

By providing overarching insights into the synthesised views and perceived priorities of a wide range of multi-disciplinary health and social care stakeholders, this research offers a unique contribution to the existing literature on the future of health in England and in the UK more widely. The study findings validate a number of prominent health research priorities currently visible in England, such as AMR, the burden of dementia and age-related multi-morbidity, digital health and genomics. Interest in and prioritisation of these and other themes, such as mental health, health inequalities and transforming

health service models, cut across disciplinary boundaries. However, it is clear that there is divergence in views among stakeholders on the relative importance of these areas of focus, and on the best approach to managing their emergence in the coming decades. Tensions were visible, for example, between desires for future investment and emphasis on expensive, cutting-edge treatments and technologies in specialist care on one hand, and the perceived necessity of shifting emphasis away from the biomedical model to low-cost prevention, public health and community-based solutions on the other. It will be important for the health research community, its funders and its coordinating bodies to leverage this diversity of views in strategic discussions going forward to ensure that it benefits from the challenge and innovation offered by the dissenting, varied and minority viewpoints that exist.

1. Introduction

1.1. Background and context

The health challenges we will face in 20 years' time may look significantly different to those we face today. Demographic changes, technological advances and socioeconomic and environmental developments, to name a few, are expected to shape – and in some cases transform – the future health and social care landscape. While some future trends, for example an ageing population at risk of complex multi-morbidities, are putting increasing pressure on health and social care systems and driving cost upwards (NHS England, 2017, 2014), others, such as continued advancement in treatments, diagnostics and technologies, could facilitate improved approaches to tackling health challenges and even transform paradigms of what healthcare can and should be (NHS England, 2017, 2014).

Improving population health and increasing the quality of health and social care services depends on continued advances in basic, translational and applied science from multiple disciplines. In addition to the transformations required in services, the broad field of health and social care research will also need to proactively respond to maximise potential benefits and minimise the risk of negative or inequitable outcomes.

From a research perspective, this opens up new challenges in terms of: (i) developing new products, technologies and treatments; (ii) better understanding trends and context, including epidemiology and social sciences; and (iii) testing better methods of delivery to maximise the effectiveness and cost-effectiveness of health and social care delivery (Department of Health, 2017).

1.2. Aims of the study

The aim of this research was to generate an evidenced-based view of what future health and healthcare needs in England may be, and how they will differ from today's needs. The findings are intended to inform the future priorities of the health and social care research communities, including the NIHR, providing a rational view of the future that is informed by a diverse range of stakeholder views and perspectives. The study aims to reflect both pervasive views and unique insights on key trends, shifts and drivers that will affect health and healthcare in the future, whether these are economic, social, technological, environmental or other drivers.

1.3. Report structure

In the subsequent sections of this report we seek to fulfil the aims stated above. Chapter 2 presents the methodological approach to gathering and analysing the survey data. Chapter 3 provides an overview of survey respondents' views on future differences and trends in health and healthcare in England over the next 20 to 30 years, as well as the related drivers. Chapter 4 presents the views of surveyed stakeholders on priority areas for future research to meet the needs of the health and social care systems in England in the coming decades. Chapter 5 focuses on the aspects of the health research infrastructure which support the delivery and impact of quality research and presents stakeholder views on the future role and challenges faced in terms of these cross-cutting areas. Finally, in the Discussion we offer a synthesis of the evidence presented in the report, briefly situate our findings in the existing literature on health futures and provide reflections on implications for the health and social care stakeholder community in a broad sense.

2. Methods

To capture a rational and comprehensive view of the future, a survey questionnaire was developed and distributed to a diverse range of experts working in health and social care across the UK.

2.1. Survey design and distribution

The survey was designed to capture views on the likely health challenges in England in 20 to 30 years' time, and how they will differ from today's challenges. The online questionnaire included five open-text questions:

1. In relation to your area of interest (discipline or geography), what differences do you foresee in the state of health and provision of healthcare in England in 20–30 years' time? In your answer, please consider if/how these changes might affect some populations (within England) differently to others, i.e. socioeconomic, ethnic groups and/or geographic groups.
2. What do you think will be the key drivers of the changes you have described?
3. In your view, what will be the major trends in health and healthcare in England over the next 20–30 years? (Going beyond your immediate area and expertise).
4. Are there any commonly discussed issues related to the future of health and healthcare in England which you believe to be overstated? If so, why do you believe them to be overstated?
5. Are there any issues that are underrepresented in the debates around the future of health and healthcare in England? If so, please describe them and explain why you think they merit greater attention.

The survey questions were deliberately broad and open, to capture nascent thinking and allow a wide range of stakeholders to contribute. Respondents were not required to answer every question. All responses had a 2,500 character limit (not including spaces); however, this word limit was not applied to the small number of responses (n=14) which were submitted by e-mail. The questions were developed by the NIHR in collaboration with the RAND research team. The full text of the survey tool is provided in Appendix 1.

A link to the online survey tool was distributed via email to an initial list of 486 experts that was developed jointly by the NIHR and RAND Europe based on their professional networks and knowledge of the field. It included experts from health, social care and science, as well as patient and public representatives. Those contacted were encouraged to further distribute the survey link to colleagues within and beyond their organisations, and as such it is not possible to establish the total number of invitees, nor the response rate. The survey was open for 12 weeks (until 16 June 2017).

All respondents were asked their permission firstly for their participation in the survey to be publicly acknowledged and secondly for their responses to be published verbatim and their quotations attributed to them by name.

2.2. Data analysis and reporting

The analysis followed a grounded theory approach (Glaser and Strauss, 1967) in order to capture unexpected and emergent themes and ideas. It comprised three elements: coding, thematic analysis and reporting. In the coding phase, one researcher (JC) developed an analytical framework based on the initial themes emerging from the data, which was refined through discussion with the wider team and the NIHR. This encapsulated three categories of factors: (i) the scope, effectiveness and accessibility of health services in England; (ii) issues relating to individual behaviours that shape health outcomes, such as diet, physical activity, smoking and alcohol consumption; and (iii) contextual drivers that shape behaviours and services, including socioeconomic inequality and climate change. Coding was undertaken by three researchers (JC, CdA and LG) and additional themes (or 'codes') were added iteratively. Survey responses were coded in Microsoft Excel.

The coded responses were synthesised and written up by the same three researchers, drawing out the most common themes as well as reflecting on discordance and agreement within themes. Lone voices and outliers were also considered to ensure inclusion of potentially disruptive or countervailing views. We did not seek to quantify the responses as the respondents sampled were not intended to be representative. As far as possible, the extent to which themes and views were shared among the respondents, or those from particular fields, has been described. Where appropriate, quotes from respondents are presented to illustrate key themes. Where consent was given, quotations have been attributed by name and primary affiliation. Where consent for attribution was refused but permission was given for quotations to be used, quotations have been included anonymously. The full dataset of survey responses for which permission to share was given has been published alongside this report and is a useful resource for those seeking to engage with a particular issue in more depth.[1]

2.3. Response

The survey received contributions from 299 stakeholders. Over half (153/299) answered in their capacity as a 'professional representative' of their organisation and 146 in their capacity as a 'private individual'. Twenty-seven responses within the former group were known to be collated institutional responses, which were prepared collaboratively by various contributors within an organisation or group. A wide range of fields were represented, including, but not limited to, public health, social care, primary care, cancer, genomics, mental health, geriatrics, child health, patient advocacy and health policy. Among these, a number of professional and private stakeholder categories were present, including clinicians, policy experts, academics and patient and public representatives. Figure 1 below provides a high-level illustration of the stakeholder profiles according to respondents' self-reported organisation of primary affiliation. Where

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[1] The dataset can be found on NIHR's website at: http://nihr.ac.uk/news-and-events/documents/quotes.xls

respondents reported more than one primary affiliation, only the first of those listed has been counted. A list of the names and affiliations of respondents who permitted the acknowledgement of their contribution is presented in Appendix 2.
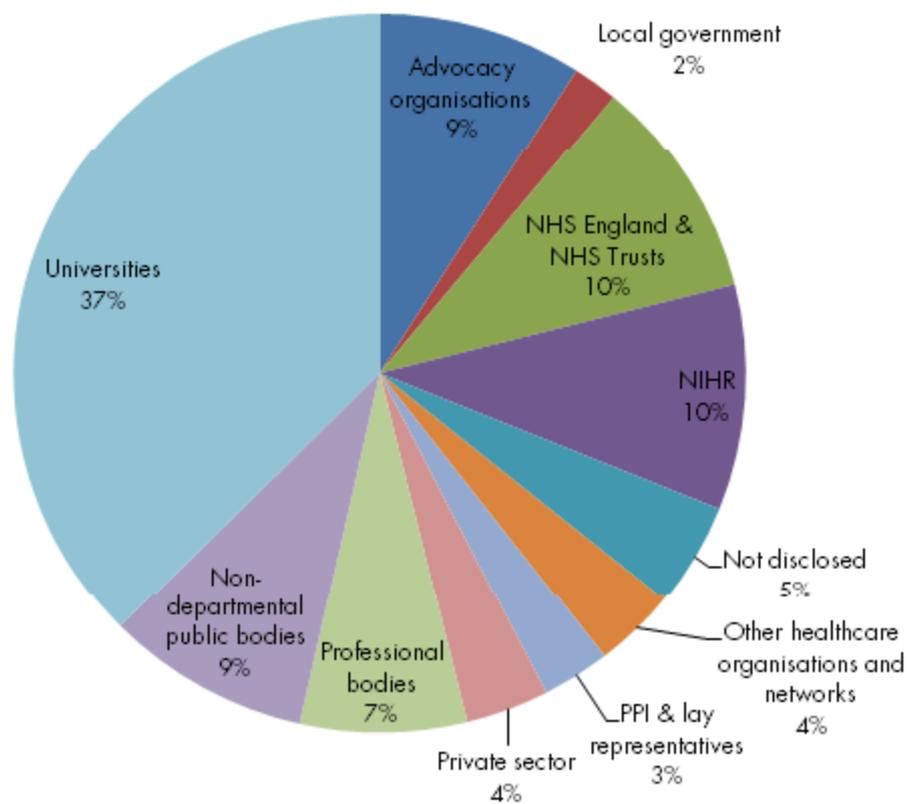
Figure 1. Overview of stakeholder categories

3. Views on the future health and healthcare landscape

This chapter presents an overview of survey respondents' views on future trends in health, healthcare and social care in England over the next 20 to 30 years, as well as the related drivers. A wide range of topics were discussed by respondents and Table 2 below provides an indication of the prominence of selected key themes in respondents' contributions.

Table 2. Prominence of selected key themes in discussions of future trends

Theme (in descending order of frequency)	Number of respondents who discussed theme*
Changing models of health and social care	155
Public health and prevention	149
Challenges related to an ageing population	147
Advances in health technologies	106
Genomics and personalised medicine	96
Healthcare workforce and education	85
Mental health	72
Health inequalities (socioeconomic)	54
Antimicrobial resistance and infectious disease	51
Access to and management of patient data	47
Patient and Public Involvement and patient voice	45
Care at home and self-management	41
Health inequalities (ethnic)	34
Maternal and child health	31

* The numbers provided indicate the total number of individual respondents who discussed the corresponding theme in their responses to survey questions one and three (relating to predictions of future trends and differences in the health and healthcare landscape).

The chapter is structured around two overarching sections. The first, 'Population health', covers topics and trends related to the health and wellbeing of the population, or specific subgroups thereof. The second, entitled 'Health systems and performance', addresses structural factors which affect the planning,

delivery and organisation of healthcare, social care and public health interventions. Figure 2 presents a high-level overview of the main topics covered.
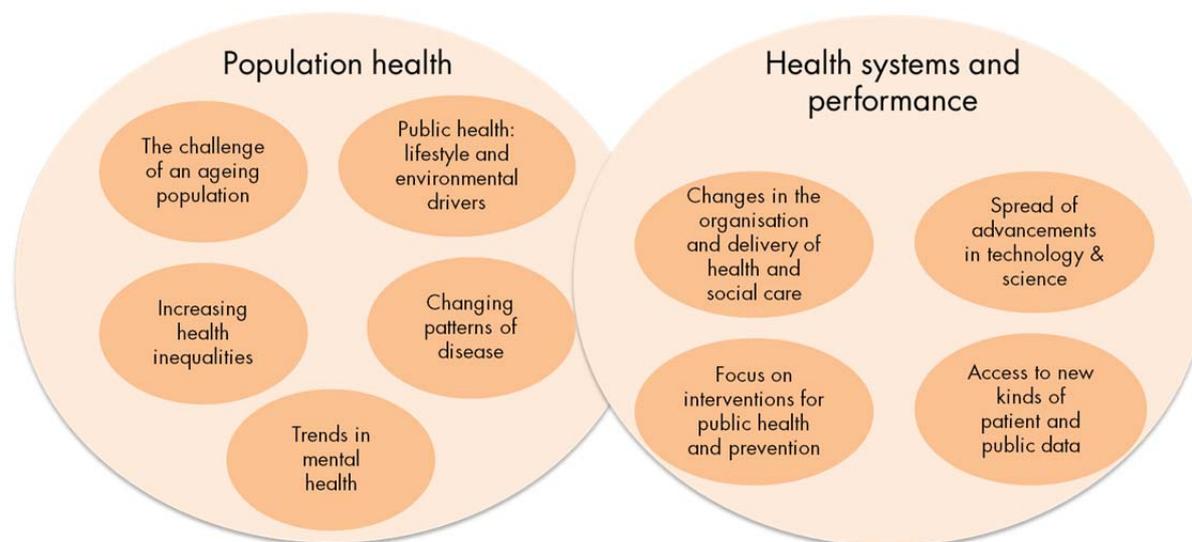
Figure 2. Overview of key themes related to the future health and healthcare landscape

3.1. Population health

With regard to future trends and differences in population health in England, the wide-ranging views given by respondents are grouped into five overarching themes, which form the structure of the following section. These are: i) the challenge of an ageing population; ii) lifestyle and environmental drivers of disease; iii) health inequalities; iv) mental health; and v) changing patterns of disease.

3.1.1. The challenge of an ageing population

A large number of survey respondents, representing diverse sectors and disciplines, underscored the importance of the ageing population and the associated burden of complex multi-morbidity, including neurodegenerative diseases (e.g. dementia), frailty and mental health issues, as a driver of future health and social care priorities.[2]

> *There will be a requirement to meet the ever greater needs of an increased ageing population, the costs of healthcare, and expectations of this, in addition to reducing the occurrence of neurodegeneration, social isolation and poverty.* (Liverpool Health Partners)

Stakeholders drew attention to the fact that improvements in treatments and condition management would mean many more people living longer, but not necessarily in good health. Respondents felt that current research and policy placed too much focus on increasing life expectancy at the expense of healthy ageing and quality of life:

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[2] The impacts of these trends on healthcare delivery are discussed in more detail in Section 3.2.1.

> *We will get older but at the present time I don't see it likely that our older people will be healthier, in fact looking at today's working age population, the stress they are under and the high prevalence of overweight, obesity and physical activity, I fear health in older age will get worse before it gets better.* (Sarah Weld, South Gloucestershire Council)

Another consequence of multi-morbidity raised by respondents was the issue of polypharmacy. One respondent, a researcher studying preventive primary care, suggested that polypharmacy could be driving poor health and the occurrence of multi-morbidity at a younger age. As a consequence, a number of respondents noted that healthy ageing would need to be promoted with an emphasis on quality of life, so that people can live independent, healthy lives with as few healthcare needs as possible for as long as possible.

> *Not enough effort is put into patients' wishes, respecting that quality of life can sometimes be more important than reduced mortality risk. Particularly important with complex multimorbidity, and the resulting polypharmacy.* (Steven Kiddle, King's College London)

In addition to the widely noted challenges described above, individual respondents also highlighted specific areas of increasing concern related to the health of the ageing population. These were: increasing problems with podiatry and demands for limb salvage; increasing issues with joint mobility, involving advanced degeneration of both hard and soft tissue around the joint and requiring novel and holistic solutions (James H Naismith, Research Complex at Harwell); geriatric trauma from falls; increases in conditions causing debilitating sight loss and age-related degeneration (Peng T Khaw, NIHR Moorfields Biomedical Research Centre); increases in bone marrow failure and the resulting need for chronic blood transfusion; increasing retirement age and potential health consequences; and the need for greater discussion around the costs and limited benefits of many chronic disease medications, which may be better diverted to social care.

Despite the general consensus amongst stakeholders on the challenges posed by an ageing population, a minority of stakeholders, ranging from mental health researchers to experts in child health policy, felt that the future challenge of dementia may be overstated in current debates. It was suggested by one respondent that frailty was a more pressing issue which was overlooked, and by another respondent that investing in prevention was likely to mitigate the predicted burden of dementia in 20 to 30 years' time. In addition, one stakeholder predicted that the most worrisome projections regarding the burden of age-related illness may be avoidable with a comprehensive preventive and public health approach:

> *Ageing population with multi-morbidities and dementia ... it might be what we are seeing now, but if we get the preventative and public health interventions in now we might be able to avoid this in 20 years' time.* (Jean O'Hara, NHS England)

3.1.2. Lifestyle and environmental drivers of disease: public health and prevention

While a wide range of respondents predicted an increase in lifestyle-related conditions such as obesity, diabetes, cancer and dementia, stakeholders diverged on the degree to which this issue would worsen in the coming decades. Respondents representing NHS England, as well as public health, mental health and oncology research, felt that addressing lifestyle and environmental factors such as inactivity, poor diet, alcoholism, smoking and air pollution, which cause and exacerbate illness, would be key to tackling these conditions. The physical and mental health complications associated with increased prevalence of lifestyle-related conditions were expected to create unsustainable demands on health and social care services,

negatively affect mental health and lead to widening gaps in life expectancy, as well as healthy life expectancy, between socioeconomic groups.

In contrast, some respondents felt that certain issues, such as obesity and smoking, are overstated. They were hopeful about the potential for education and new drug-based treatments to lessen the burden of obesity and for government-led policies and e-cigarettes to mitigate risks related to tobacco smoking. However, this was not universally agreed upon, and others, mostly in the field of public health, were concerned about the inconclusive evidence around long-term health impacts of e-cigarettes.

Others predicted that the next 20 to 30 years would see life expectancy continue to increase, with less mortality associated with chronic disease, due to improved diet, medico-scientific advances and rising wealth.

A life-course approach to prevention: maternal and child health

Stakeholders expected child and maternal health to worsen in the coming decades, and underscored the need to focus on the health of these populations and take a life-course approach to prevention risk.

Some stakeholders argued that a life-course approach to prevention and public health, should take the place of one focused on responding to adult risk factors. It was stressed that investing in the health and wellbeing of children, young people and mothers could help to mitigate disease risk later in life, and thus provide a more effective and cost-effective solution to costly adult interventions.

> *We seem to be stuck in responsive mode in the adult risk factor paradigm, with a focus on optimising and developing sometimes expensive treatments and services for sick adults, at the expense of adopting a life course prevention and optimisation paradigm.* (David Taylor-Robinson, University of Liverpool)

Childhood obesity and the nutritional status of children were particular areas of concern, as both were expected to deteriorate due to a lack of public health regulation of the production and marketing of unhealthy commodities. The risk of increasing mental ill health in children and young people was also underscored by a number of respondents. It was suggested that greater collaboration across disciplines such as health, education and the environment could help to promote health literacy and health awareness at an early age in order to promote early-years prevention.

In terms of maternal health, respondents, mostly with expertise in the area of women's health, also noted that the next decade would see a significant change in the health profile of pregnant women, including increased maternal age, higher prevalence of obesity and associated complications, increased use of assistive reproductive technologies, reduced nutritional status and poor mental health. It was predicted that these health challenges would have negative impacts on both maternal and child health, and put pressure on maternity services by driving increases in complicated pregnancies and births and an associated rise in Caesarean deliveries.

It was felt by some stakeholders that maternal health and associated complications continue to be severely underrepresented in public discussions and funding programmes. Respondents predicted that focusing on maternal health would increasingly be recognised as important and, like child health, offered an opportunity for more long-term solutions to health and social care challenges.

Approaches to behaviour change for public health

Respondents representing diverse sectors and disciplines questioned the effectiveness of individual-level interventions targeting behaviour change for health, such as education and information provision, and believed this approach to be overstated in research and policy discussions. Instead, they felt that population-wide approaches underpinned by national legislative or fiscal incentives were required to address unhealthy behaviours such as poor diet, alcohol and illegal drug consumption and inappropriate use of antibiotics and health services:

> *The limitations of approaches based on education and information alone have been clearly demonstrated, as have the substantial potential benefits of population-wide approaches to disease prevention and health protection underpinned in many cases by national or local government action.* (Peter Whincup, Population Health Research Institute, St George's, University of London)

These respondents felt that individual-level approaches failed to recognise the role of upstream social determinants in driving public health outcomes and instead often increased health inequalities by favouring the health literate and those with the means to access healthcare innovations. The University of Leeds School of Medicine described how they considered this approach to be overstated in research and policy debates:

> *The likely effectiveness and cost-effectiveness of individually-targeted approaches to changing people's behaviour, derived from academic psychology… downplays the role of social determinants … Individual patients may also find themselves 'at risk' of multiple conditions. Even if this activity were of demonstrated value, which is often not the case, the implications for the provision of services to this growing proportion of the population are profound and need much more careful consideration than they have been given to date.* (University of Leeds School of Medicine)

In contrast, other respondents from charities, professional associations, the NHS and the NIHR emphasised the need for individuals to take greater responsibility for managing their health. It was felt that personal responsibility for health was an underrepresented issue that deserved greater attention in current debates, particularly in terms of how different groups could be empowered and educated to take that responsibility. One expert in health informatics also suggested that although behavioural change is difficult to achieve using traditional means, advances in behavioural science would facilitate this in the future.

The growing health impacts of air pollution

Several respondents raised the issue of increasing levels of air pollution, particularly in urban environments, leading to an increase in pollution-related diseases such as poor respiratory health and immune conditions (e.g. allergies and autoimmune diseases). The negative impact of pollution on children in particular was emphasised by the Royal College of Paediatrics and Child Health. One respondent with a background in dermatology felt that the health effects of air pollution were currently overlooked and received insufficient levels of research funding. It was suggested that the negative impacts of pollution could be addressed in a number of ways, for instance through the use of more energy-efficient and less polluting forms of transport, such as electric cars, or greater reliance on nuclear and renewable energy.

3.1.3. The challenge of increasing health inequalities

A large number of respondents expressed the view that the coming decades would see a continuing increase in health inequalities. Respondents placed particular emphasis on inequalities in access to healthcare, health innovations and outcomes experienced by members of black and minority ethnic groups and socioeconomically disadvantaged groups. Respondents also underscored the geographic patterns of health inequalities, with the north of England, for example, continuing to have a greater disease burden than the south and southeast.

Social and economic drivers of health inequalities

In relation to the drivers of future health inequalities, respondents highlighted several factors contributing to poorer health outcomes in socioeconomically disadvantaged groups, including lifestyle factors (e.g. poor diet), substandard housing (especially for older people), low health literacy, inadequate access to services and privatisation of healthcare.

> *A growing body of research in recent years has shown that the overall rate of health improvement has masked slow and sometimes non-existent improvements in health for more disadvantaged people.* (Daniel Permain, People's Health Trust)

In line with current trends, the detrimental impacts of tobacco smoking and alcohol were expected to continue to predominantly affect more disadvantaged socioeconomic groups and ethnic minorities.

A greater focus on tackling health inequalities was considered essential to address the future strain on health systems and prevent worsening population health outcomes:

> *Increasing inequalities due to income, gender, geographical location and other socially constructed features result in a disparity in health access and outcomes. It has already been shown that inequalities lead to an excess of preventable deaths and destabilise health systems, potentially leading to poor outcomes for all groups and not just those who are at first glance disadvantaged.* (Science and Technology Facilities Council)

Stakeholders, including a representative of Care & Repair England, also highlighted a growing problem of substandard housing (in terms of quality and suitability) for older people, which was predicted to worsen as social inequalities widen:

> *As low income householders retire and become low income pensioners we are likely to see declines in housing standards for lower socio-economic groups as they become less able to maintain and adapt their homes.* (Sue Adams, Care & Repair England)

Respondents from academia and teaching hospitals stressed that addressing health inequalities would require a life-course approach, encouraging and enabling individuals to look after their health from an early age. Indeed, a large number of respondents noted that in the next 20 to 30 years increased poverty would be a key driver of worsening child health, with resultant negative effects on adult health. It was predicted that this trend would also be reflected in mortality rates; two respondents predicted that child mortality rates may in fact increase, and that this might be due to increases in the numbers of socioeconomically disadvantaged children and decreases in the most advantaged groups.

Ethnic determinants of health inequality

Diverse respondents also felt that the interaction of ethnicity with health inequalities would demand greater attention in the coming years. In addition to the effects of socioeconomic disadvantage often experienced by members of minority ethnic groups, key challenges highlighted as facing some minority ethnic groups included the need to account for different patterns of disease (compared with majority ethnic groups) in research and care provision, low levels of health literacy, and access to appropriate and tailored treatments where necessary.

3.1.4. Trends in mental health

A large proportion of survey respondents, across a wide range of sectors and disciplines, highlighted that the next 20 to 30 years would see increasing numbers of people experiencing mental health disorders, particularly depression and anxiety. However, other respondents expressed alternative views on the future of mental health, predicting reduced stigma, improved mental health literacy, and increased acceptance and awareness of the challenges of mental health in society, which would lead to parity of esteem with physical health and consequent improvements in services. Indeed, respondents from Bristol NHS Foundation Trust and the Association of Directors of Public Health noted a possibility that the apparent increase in the prevalence of mental ill health was simply an effect of increasing acceptance and awareness of mental health issues, leading to more people seeking help and diagnosis.

The following sections discuss specific mental health challenges that respondents expected would be faced by children, young people and older populations. The health service impacts of trends in mental health are discussed in Section 3.2.1.

Mental health challenges for children and young people

Some respondents suggested that an increasing prevalence of mental ill health would disproportionately affect younger people, in particular those from more socially disadvantaged backgrounds. Contributing factors identified by respondents included stress, housing insecurity, high student debt, unemployment and stigma. If left unresolved, it was suggested that this would have negative wider social impacts (e.g. in terms of unemployment, crime and domestic abuse) due to childhood psychiatric disorders continuing on into adulthood. Some respondents also felt that deleterious effects of excessive screen-time on physical and mental health and the normalisation of digital means of communicating rather than face-to-face interaction was an overlooked health issue:

> *The increasingly pervasive use of mobile and other electronic devices has the potential to impact negatively on mental health and the quality of social interactions.* (Linsay Gray, University of Glasgow)

As with physical health, it was noted by some that mental health prevention strategies should give greater emphasis to early intervention by focusing on wellbeing in schools. Education around emotional intelligence, respectful communication and safe relationships to reduce partner and sexual violence were considered priority areas. Conversely, one respondent felt the focus on early intervention to be overstated, as it detracts attention from the need to provide ongoing care after the early phases of illness.

Mental health challenges for older people

Several respondents, including three with expertise in the field of mental health, highlighted the growing burden of mental health disorders amongst older people, partly driven by increased longevity, as well as

increasing loneliness and social isolation. Respondents drew attention to the challenge of social isolation as a result of the tendency for older people to live alone or in rural areas, as well as societal fragmentation (e.g. due to changing family structures or migration). It was suggested that there should be a focus on better social and community-based support to help address this issue.

3.1.5. Global challenges and changing patterns of disease

The next 20 to 30 years were widely predicted to see changing patterns of chronic and infectious diseases as a result of environmental drivers such as climate change, air pollution and food and water insecurity:

> *As global climate change influences our environment, it is perceivable that disease pathogens may move to new host areas and change disease distributions. This is likely to be exacerbated by an increasingly mobile population with worldwide travel already commonplace…the potential impact of new and emerging conditions on UK healthcare should not be overlooked.* (Association of Medical Research Charities)

Some predicted that these challenges could also exacerbate health inequalities due to changes in the cost or availability of basic needs such as food, water, energy and transport.

In addition, a significant proportion of respondents, including those with backgrounds in cancer research, public health and pharmaceuticals, expected that a re-emergence of infectious disease as a major public health threat in the next 20 to 30 years would be driven by AMR. Respondents suggested that AMR would lead to more frequent national and international disease pandemics, resulting in increased morbidity and mortality, which would disproportionately affect socioeconomically disadvantaged groups and regions, both nationally and internationally.

Despite the widely shared view that AMR was a serious threat to health, three respondents working as in public health felt that the threat was overstated, particularly considering the extensive research and other resources being dedicated to the issue. Indeed, the Faculty of Pharmaceutical Medicine stated:

> *Currently, we also see a re-awakening of the development of anti-microbial therapies including a step-change in vaccine development, greater knowledge of the application of adjuvants, and enhanced selection of targets. These changes in drug development could forestall the predicted major crises in infectious diseases.* (Faculty of Pharmaceutical Medicine)

3.2. Health systems and performance

With regard to health systems and performance, the diversity of trends and issues raised by respondents can be grouped into four key themes, which are addressed in turn below. These are: i) the organisation and delivery of health and social care; ii) interventions for public health and prevention; iii) advances in technology and medical science; and iv) changes in access to and availability of data.

3.2.1. Transformations in the organisation and delivery of health and social care

Expected future changes to the delivery and organisation of healthcare services, as well as their interaction with social care and wider community services, were a prominent theme among survey responses from the full range of fields and disciplines. These changes were expected to be driven, both out of necessity and proactive innovation, by a number of contextual factors. These related to: resources (human and financial), advances in technology and medical science, changing population health, demographic and

socioeconomic profiles, epidemiological trends, and strengthening patient voice and expectation. Primary predicted changes to models of care in England highlighted by respondents could be grouped into six themes, which are explored in the following section. These are: (i) integrated and patient-centred care; (ii) care in the community and self-management; (iii) an expanding role for private healthcare providers; iv) mental health provision; (v) interventions for public health and prevention; and (vi) education of the healthcare workforce.

Enabling holistic care: linking up and integrating services

A wide range of respondents expected health, social care and other community health services to become further integrated in order to deliver holistic and joined-up provision. This was expected to take place alongside an enhanced emphasis on patient-centred care and patient involvement in order to deliver more effective and appropriate health services for patients with complex care needs.

The integration of health and social care services

A wide range of respondents across diverse backgrounds underlined the importance of predicted improvements to the provision of holistic, patient-centred healthcare as a result of both horizontal integration (with social care, public health and community services) and vertical integration (between acute and primary care). These changes in service models were considered particularly important for responding to the needs of patients with multi-morbidities, chronic disease and other complex, resource-intensive care requirements that cut across specialties and services, especially in the context of an ageing population that is predicted to live longer but often in poor health. However, there was also divergence in views on the prospects for future advances in this area.

The importance of the integration of health services with social care was an especially prominent theme, reflecting the high inter-dependency between the two systems. In order to adapt to the changing needs of an older and increasingly multi-morbid population, there needs to be a shift in emphasis away from acute hospital care to chronic disease management in the community, and this would require greater integration of health and social care. It was predicted that the traditional healthcare model of single-disease specialties would not be suitable for providing the holistic care required for management of multiple chronic diseases, where patients may, for example, be in touch with different parts of the health and social care services for each condition.

> *Holistic care and greater integration of health and social care will become the features of the new healthcare system to deal with these changing needs of the older population. Chronic health conditions with a variety of multi-morbidities are most effectively treated as a multi-disciplinary team, which treats the person rather than the disease.* (Alzheimer's Research UK)

Despite the widespread support for joined-up approaches, some respondents were more sceptical of prospects for integrated care, due to countervailing organisational and sociocultural trends as well as a perceived lack of underpinning evidence. Another respondent predicted that meaningful integration of health and social care would never take place due to a fundamental devaluing of care work in society:

> *The continued gendering and de-valuing of the labours of care means that health and social care will not be integrated.* (Mary Madden, University of Leeds)

Finally, one response on behalf of the Academic Health Science Network (AHSN) network contended that the importance of integrating health and social care was overstated and current initiatives suffered from a lack of underpinning evidence:

> *There is an over emphasis on the benefits of integrated care in the absence of clear evidence that pooled funding brings better health outcomes.* (Oxford AHSN on behalf of the AHSN Network)

Developing a patient-centred model

A number of respondents also predicted (or hoped) that health and social care services of the future would become more person- and patient-centred, designed to respond to patient needs in personalised ways and facilitate shared decision making between patients and clinicians. By enabling streamlined multi-disciplinary working between services according to patient needs, the meaningful integration of health and other supportive services was one potential facilitator of a patient-centred approach. It was felt that patient-centred approaches could be particularly important as care pathways became more complex and greater flexibility in management was needed. In addition, the Royal College of Physicians saw a role for shared decision making in counteracting current trends of overtreatment, which can harm patients and strain health system resources.

Expanding services in the community and self-management

The expansion of health services offered locally in the community, rather than in specialist centres further from home, as well an increasing role for patient self-management of health conditions, were seen by a large number of respondents as key to future changing models of health and social care.

Healthcare provision in the community

While a number of respondents emphasised trends towards the centralisation of healthcare in specialist hospitals and centres of excellence, driven by advances in specialist treatment and technology and cost-efficiencies, others suggested that while hospitals would always be a critical part of the healthcare landscape and the delivery of specialist, critical care, emphasis would move away from hospitals towards treatment in the community.

> *The increasing demands on the health service whilst working within limited means will mean that there will need to be better economic models of care - This will likely include a shift to a growing focus on care outside of the hospital settings (community care, mental health support, social care and primary care).* (Liverpool Health Partners)

One respondent felt that this would lead to a divergence in primary and secondary care, as primary care responds to the needs of older people and those with chronic conditions:

> *Primary and secondary care will diverge, with treatment of acute illnesses taking place in high-tech hospital settings further from home, while primary care will be strongly focussed on long-term management of chronic conditions.* (Peter Whincup, St George's, University of London)

These respondents considered greater investment in out-of-hospital care to be essential to a sustainable and cost-effective health and social care system in the long term:

> *We will struggle to deliver services in the current system, because too much emphasis on hospital care. The result is that demand will outstrip supply, and without some fixes this will get worse.* (Matthew Hotopf, King's College London)

Moreover, several respondents, including some from social care research, felt that social care is often overlooked when considering the future of healthcare, and that working with communities should be given more prominence. They emphasised that many health challenges, such as social isolation, are not specifically about health but may increase use of health and social care services.

However, two respondents with backgrounds in intensive care and acute medicine felt that the evidence base for this shift was overstated, suggesting that it was not yet clear whether bringing care out of hospitals was possible, desired by patients or less costly. In addition, other respondents highlighted that current resource shortages in social care would need to be resolved to make enhanced care in the community possible:

> *Hospitals will become big critical care units as most patients with less severe patients can go home…The big unknown is social care. The impact on healthcare in either community or hospital will be dominated by patients with care needs. Healthcare practitioners in both environments will spend more of their time caring for chronic disease in people whose main problem is limited function.* (Rupert Pearse, Queen Mary University of London)

Patient self-management and care at home

Respondents also expected the coming decades to see an increased movement towards care at home and self-management of illness as a means to reduce costs, minimise the burden on health systems and empower patients. This shift would apply particularly to patients with complex co-morbidities, mental ill health, dementia and frailty, and would largely be facilitated by advances in supportive technologies (see Section 3.2.2). Growing self-management would require patients to assume greater responsibility for their health and wellbeing, facilitated by awareness of the lifestyle drivers of sickness and mortality. In addition, two public health professionals felt that shifting to self-care would facilitate integration between health and social care by allowing people to receive care in their homes.

However, the appropriateness of a self-management approach for potentially vulnerable or less health literate groups, such as older or less educated people, was questioned by some respondents:

> *There is a need for society to have a debate on the role of the citizen in taking control of their own health; there will be cohorts of the population who will not wish to, or feel unable to, take control and responsibility for their own healthcare. How such cohorts will be managed if digital citizens become a reality needs serious consideration.* (Guy's & St Thomas' NHS Foundation Trust)

In terms of delivering care at home, one stakeholder argued that housing older people in smaller, specialist accommodation was overemphasised in current policy and did not reflect the desire of most older people to remain at home with adaptations and support. To allow patients to live at home safely, respondents suggested service improvements and initiatives such as community peer support for older people, and an increased role for technology:

> *There will have to be a rethink of how specialist care is provided. More and more people are retiring to rural areas and we have to think about how to provide care for the elderly across a greater geographical area - technology will have to help with this.* (Elizabeth Robertson, Diabetes UK, Diabetes Clinical Studies Group)

However, while some respondents associated greater self-care with patient empowerment, others expressed concerns about inequalities in patients' ability to benefit from self-care, potentially disadvantaging vulnerable groups. This would likely be exacerbated by a perceived current tendency to encourage but not sufficiently support self-management, which one respondent felt was likely to continue.

The role of family carers

Respondents suggested that against the backdrop of growing demand for health and social care services, the availability of informal and family carers would decrease in the coming decades due to family migration patterns and increasing single-person or childless households. This predicted trend, combined with a growing reliance on carers to deliver care at home, would create strain on personal finances and assets and drive changes in family and carer roles and responsibilities, particularly with regard to managing end-of-life care. In expectation of this, given current shortfalls in social care, one respondent predicted that a system-level response would be needed to finance care for older people:

> *My prediction is that in thirty years, children will be legally required to pay for their parent's care, if the parent cannot. Families need to be warned so they can start to prepare financially now. The alternative is cheap care that increases mortality, or euthanasia.* (June Andrews, Sedaca Ltd, University of Stirling)

However, one respondent from local government was less concerned about a shortage of informal carers, and expected that AI and other technology would be capable of taking their place to some degree in the coming decades:

> *The challenge of not enough carers - this depends on the development of artificial intelligence, but I would not be surprised to see the use of robotic caring technology in thirty years' time, at least for simple tasks of everyday living, which might go some way to offset against the shortage of trained human carers.* (David Pitches, Dudley Metropolitan Borough Council)

An expanding role for private healthcare providers

A wide range of respondents suggested the role of private providers in delivering healthcare in the NHS would become more pronounced over the coming decades, driven by the inability of the NHS to meet patient demand, and raised concerns that this would lead to a more fragmented, stratified health service. They foresaw the development of a multiple-provider system, which would be more fragmented and work against the push for integrated services due to increased administrative, communication and institutional barriers. One respondent felt that the value of privatisation as a solution to funding gaps in the NHS and in providing potentially more efficient care was overstated, and lacking in evidence.

Some respondents expected that employers would increasingly offer private healthcare benefits to their employees:

> *As the NHS struggles to meet demand, more and more large organisations will offer private health care to employees and this will increasingly be seen as an important in-job benefit. I am concerned that this will, in turn, reduce capacity within the NHS ever further, as consultants work more and more in private health care and less for the NHS.* (Ann-Marie Towers, PSSRU at the University of Kent)

A number of respondents expressed concerns that increasing investment in private sector providers would undermine the 'safety net' of NHS services and that a tiered health system would emerge which would limit access to healthcare based on ability to pay.

In contrast, one academic respondent felt that opening up the NHS to competition would bring benefits and reduce ineffective treatment programmes.

Challenges and potential for mental health services

As noted in section 3.1.4, many respondents predicted an increasing prevalence of mental ill health in the coming decades, which was expected to result in an increased demand for mental health services. Perceived underfunding and inadequacy of current mental health services, often due to stigma as well as a lack of parity between mental and physical health, was expected to affect their ability to cope with this future surge in demand. Moreover, mental health issues were expected to be a critical determinant of health and social care expenditure, particularly since unrecognised and untreated mental health issues would drive up costs.

Respondents highlighted how integration across all services, including health, social care, community care and education, was considered essential for effective mental healthcare. As one mental health expert explained:

> *Greater common mental disorder in children and young people especially girls is likely to continue unabated unless resources are focussed on multi agency approaches to public mental health and away from developing acute services. More resources should be diverted towards integrating services not just across the health and social care sectors, but also within schools and educators.* (Kathryn Abel, NIHR CRN)

The crucial and established role of self-management and peer-support for mental health was also acknowledged and emphasised as an area for future investment. Additionally, respondents called for health services to reduce variation in provision across mental and physical health and ensure that people with mental illness receive the same quality of physical healthcare as those without a mental health problem, as well as appropriate interventions and support to address the much higher rates of risky behaviours associated with poor mental health.

However, as previously noted, respondents expressed contrasting views in relation to the future of mental health and mental health services, predicting that reduced stigma, improved mental health literacy, and increased acceptance and awareness of the challenges of mental health in society would lead to parity of esteem with physical health and consequent improvements in services.

> *Over the next 20–30 years, we envisage that mental health is likely to gain more traction with the research community and greater awareness and understanding from the general public. Research funding is likely to increase and re-balance previous inequalities and this may lead to enhanced stratification relating to diagnostics and treatment options.* (Association of Medical Research Charities)

Adapting the structure and education of the healthcare workforce

Significant restructuring of the healthcare workforce was predicted by a number of respondents, in particular with regard to the shifting of duties and expansion of the roles of less qualified healthcare professionals. These changes were driven by a range of factors, primarily related to changing models of care and patterns of patient need described above, and anticipated workforce shortages against a backdrop of increasing patient demand. These issues, as well as workforce skills and education, are discussed below.

Shortages in the health and social care workforce

Shortages in health and social care workforce supply were expected to become more acute for a variety of reasons, such as Brexit and restrictive immigration rules, as well as diminishing interest in the field due to perceived poor pay and working conditions faced by the medical profession. Stakeholders emphasised the need to improve the mental health of NHS employees and recognise the knock-on effect staff wellbeing has on care quality. Respondents from NIHR CLAHRC Northwest London and an NHS Trust also highlighted the importance of creating an empowering, motivating working environment, which is open and adaptable to change, in order to attract individuals into the NHS.

Difficulties in recruiting to primary care and resulting workforce shortages were widely mentioned, with geographic variation in recruitment and lack of interest among new graduates in becoming practice partners of particular concern. Two respondents with backgrounds in public health and medical education suggested that greater investment in academic clinical roles may help to alleviate the problem and offer more attractive prospects for young trainees:

> *[…] urgent need to boost recruitment of academic GPs (there are 200/ 60, 000 in the UK). This will make a massive difference to giving the profession a strong voice by developing leaders within the discipline instead of blue collar coal face work. Those who practice will become better teachers and trainers and inspire others from students to their peers and will themselves benefit from time to reflect, be part of a high quality working team and thereby are more likely to remain committed and serve patients well.* (Sonia Saxena, Imperial College London)

Workforce shortages and challenges with recruitment in midwifery, pathology, emergency medicine and clinical radiology were also specifically highlighted.

Changing clinical and healthcare roles

It was anticipated that changes to how care is organised would lead to corresponding changes in the roles of healthcare professionals, as well as creating a need for new kinds of roles. Respondents noted that the increasing emphasis on treating people in the community for as long as possible and reducing time spent in hospital will mean that capacity needs to be built in primary care and social care, including training health professionals other than doctors. Respondents expected cross-disciplinary team work to increase, both between different disciplines (e.g. to manage patients with multi-morbidities) and between multiple agencies (e.g. as part of the integration of health and social care). It was anticipated that this would occur in response to increasing demand for care, changing population health needs, the rise of personalisation of care requiring multi-disciplinary expertise, and increased use of technology.

Respondents predicted an increasing blurring of professional boundaries between clinicians and other healthcare professionals, driven by an increasing shifting of duties to less qualified healthcare professionals, facilitated by supportive protocols and tools.

> *The structure of the clinical workforce will change, with fewer senior doctors and more medical assistants and nurse practitioners trained and willing to follow protocols. We are already seeing this in, for example, nurse-run pre-op clinics.* (Jeremy Wyatt, University of Southampton & Wessex Institute of Health Research)

This shift in duties would be facilitated by technological advances and analytics, which would help to provide protocols and guidance for less qualified professionals:

far less of health budgets will go to high paid consultants as most diagnosis will be the result of data analytics and the model of many years of training to become an expert will dissolve. (Jenny Edwards, Mental Health Foundation)

The increased role of 'distance medicine', where specialists support and guide patient care remotely and via other healthcare professionals, was expected to reshape the requirements and nature of care provision, leading to more routinised, standardised care:

Fewer clinical staff will have autonomy, leading to more consistent and predictable care. Clinical staff will be selected not for outstanding academic skills but an ability to build rapport with patients, then find and apply the tested NHS solution, rather than inventing a personalised but undocumented novel care pathway for every clinical problem, as now. Our conventional approach carries risks and prevents other staff and the patient from contributing to care. (Jeremy Wyatt, University of Southampton & Wessex Institute of Health Research).

However, while this was thought to be appropriate in some areas of provision, others raised concerns that the diminishing role of doctors could impact on the quality of care.

The shift to providing and managing more patients in the community was also expected to expand the role of primary care. As with hospital care, respondents foresaw that increasing demand would be met by expanded roles for nurses and allied health professionals. To support this, respondents said that roles traditionally based in hospitals would need to reach out to primary care services, although again some respondents believed that technology may increasingly replace the need for highly specialised expertise.

Primary care will expand with more healthcare delivered in the community. In this context, the role of clinical pharmacologists needs to expand to support patients and doctors in individualising their treatments and to advise on appropriate dosage regimens and the potential side-effects (adverse reactions) and interactions of an inevitably expanding range of biologic and targeted therapies. (Lee Page, British Pharmacological Society)

One respondent also outlined how the centralisation of specialist services, such as vascular surgery, would demand corresponding adaptations to the clinical skills of clinicians who operate on the 'periphery':

As services centralise to maintain/improve quality then some peripheral services will disappear and non-specialist clinicians in those areas will need to be trained. The approach to the education of these clinicians needs to be established as this will also affect many of the NHS plans such as more patients cared for in the community. (Matt Bown, University of Leicester)

Adapting clinical education and training to the new healthcare landscape

The shifts described above in the structure and organisation of the healthcare workforce were expected to require significant corresponding changes in the training of healthcare professionals in order to ensure patient safety and quality of care. In addition to specialised training to support the adoption by these new roles of advanced duties such as prescribing rights, a key area identified for development was the need for increased technological literacy to maximise the benefit of technological advances and ensure that quality standards were maintained.

All healthcare professionals will be required to be digitally literate/competent, and will generally need to have a different set of skills to meet demand…Increasing gap between technological advances and knowledge acquisition and the ability of services to consistently deliver potential benefits at local level. (Mandy Sainty, Royal College of Occupational Therapists)

In addition, to support the shift to expanded care in the community, respondents noted that the training of local clinicians would need to be enhanced to manage more complex patients, especially in relation to the management of multi-morbidity and polypharmacy. Finally, another respondent called for training of all healthcare and allied professionals in the assessment of health at a population level, in order to facilitate a greater emphasis on public health and prevention.

3.2.2. Focus on interventions for public health and prevention

The next 20 to 30 years were expected to see a shift from treatment to a greater focus on health promotion, according to a large share of respondents from across disciplines. It was strongly felt that this change in focus was needed to address the current strain on health systems, as well as to reduce growing health inequalities. As noted in section 3.1.2, the most commonly noted priorities in this area included interventions to promote healthy ageing, facilitate behaviour change and enable people to make 'good choices' to prevent and reduce the burden of chronic disease, with emphasis on adopting a life-course approach to understand and affect wellbeing from childhood to old age.

Many respondents felt that there was currently not enough emphasis on effective prevention interventions and many stakeholders were concerned that simple, low-cost strategies were often overlooked in favour of more high-profile and sophisticated medical interventions:

> *There needs to be greater discussion around the increasing importance of prevention in public health and its potential impact upon the future sustainability of the NHS. There is always the danger that too much focus and discussion on increasingly sophisticated (and often expensive) technological advances such, as genomic or regenerative medicine etc., crowd out simple and effective preventative solutions such as eating well, taking moderate exercise and drinking and smoking less.* (Health Research Authority)

3.2.3. Technological and medico-scientific advancements

Technological and medico-scientific advancements were perceived to be pivotal drivers shaping the future organisation and delivery of care, diagnostics and preventive interventions, as well as the patient-doctor relationship more broadly. In particular, advances in and greater use of AI, wearable technologies, digital apps and genomics-based medicine were widely highlighted by respondents as important trends. The following section explores stakeholders' views on the nature and predicted impact of advances in technology and science on health and healthcare in England in the coming decades, as well as potential impacts of healthcare innovations on health inequalities.

The nature and impacts of advances in health technology

In the next 20 to 30 years, a wide range of respondents expected a major increase in use of technology for the prevention, diagnosis, management and treatment of physical and mental illness. However, there was some divergence in respondents' views, as some considered such expectations to be overstated due to a lack of evidence of effectiveness, the irreplaceability of human interaction, questions over actual cost-benefits and the capacity of the NHS to translate certain innovations into practice.

Respondents expected new technologies to provide opportunities for cost-savings and flexible care, through enabling more patients to self-manage at home, as well as opportunities for health promotion and disease prevention, by enabling patient self-monitoring. In addition, technologies were expected to deliver

more streamlined, consistent and cost-effective healthcare to a greater number of people, thereby reducing costs and burdens on health systems.

> *Technology will enable patients to monitor their own health and administer their own treatments. In addition, frail and elderly patients will be monitored remotely in their own homes by healthcare staff to allow early identification of deterioration in a condition and/or acute illness. It is likely to be commonplace for patients to use wearable technology or technology integrated into living environments that make diagnoses and solicit intervention as required. Robotics will be available to offer patients significant support with personal care.* (Kruti Shrotri, Medical Schools Council and Association of UK University Hospitals)

Although the expectation of an increasing reliance on e-health and remote monitoring technologies was widely shared, as noted above this was not welcomed among all respondents. Concerns expressed focused largely on the potential for increasing use of technology in healthcare to 'de-humanise' medicine, create dependence and drive up demand by increasing health-related anxieties among healthy patients. Other challenges mentioned included the adoption and spread of new technologies, its actual cost-effectiveness, privacy concerns, and the false perception by some of technology as a panacea.

In particular, four areas of technological advancement emerged from the data: AI, wearable devices, digital apps and robotics. Stakeholders' specific views on these technologies are presented below. Other technologies mentioned included more powerful imaging techniques and increased use of fusion imaging, which were expected to better enable precision diagnoses and precise, minimal-intervention surgery; capsule or nano-technology; and customised implants created with new-generation 3D printers.

Key types of health technology

Artificial intelligence

A number of respondents, with a mixed range of expertise, predicted that healthcare, including diagnostics and therapeutic decision-making, would increasingly be delivered by AI-based technologies. This, it was hoped, would streamline the diagnostic process, leading to faster, more accurate and thus better outcomes for patients. Some respondents also saw AI and increasingly powerful digital algorithms replacing clinician-patient contact for the treatment of most minor health issues, thereby significantly re-shaping the organisation of the NHS and its workforce. Indeed, according to one stakeholder:

> *The major change in healthcare will be brought about by AI, which will oversee almost all diagnostics and therapeutic decision-making by 2050 (leaving a role for medics which is much closer to nursing).* (Jon Nicholl, University of Sheffield)

One stakeholder predicted that AI that would eventually be capable of processing human emotion, opening up the opportunity for even more complex patient interactions. Other predicted uses for AI across the health system included the use of autonomous vehicles or drones to transport patients within the ambulance service and the potential for more user-friendly diagnostic technologies to reduce attendance at hospitals for diagnostic purposes.

Wearable devices

Wearable devices were another form of AI that was expected to have a particularly significant impact in the near future. Many stakeholders from across disciplines expected wearable devices, which offer the

potential to continuously monitor an individual's health status, calories consumed or physical activity, could be transformative and cost-saving to prognostics, diagnostics and patient self-management and monitoring. According to one academic stakeholder, advances in wearable technologies could allow small implanted devices to work in real time, store patient history, continuously monitor a patient and automatically release medication.

Digital apps and mobile technology

The use of digital apps on personal devices, such as smartphones and tablets, to support both physical and mental health was expected by some stakeholders to become more important, and to significantly transform traditional notions of the patient-doctor relationship. For example, e-health apps were expected to merge wearables with other types of AI, including the Internet of Things, allowing for rapid and integrated delivery of advice, diagnosis and treatment, without clinician supervision. One current example given was the 'Babylon' app, which provides real time patient consultation based on reported symptoms which are checked against a database of diseases.

Robotics

Respondents mentioned a variety of other technologies which were likely to increasingly contribute to patient care in the coming decades. These included an increased role for medical robotics and automated surgery, allowing less invasive and more precise interventions for surgery, ventilation, physiotherapy and intensive care. However, as with the specific technologies mentioned above, one stakeholder from NICE felt that there was still a limited evidence base for improved outcomes from costly surgical robotics (Hannah Patrick, NICE Centre for Health Technology Evaluation).

The following sections explore stakeholders' views on the nature and predicted impact of the emergence and expansion of the four most prominent technologies on health and healthcare in England in the coming decades.

Impact of technology on patient interactions with care

The increasing use of e-health and other personal technologies was expected by a number of stakeholders to lead to more patient-centred and self-managed healthcare. Although a small number of respondents raised concerns about the practical and mental benefits of this, the majority perceived it as a step toward the 'democratisation of health' – if properly implemented (Harry Hemingway, University College London).

By enabling patients to monitor their own health and administer their own treatments, a small number of stakeholders thought that new technologies could broadly empower people to self-manage conditions at home and take greater individual responsibility for their health and wellbeing. For example, robotics could offer patients significant support with personal care, possibly allowing older people to live independently in their homes for longer. As the Science and Technology Facilities Council explained:

> *Technologies such as the Internet of Things will empower the individuals to take greater control and responsibility of their own health, help older people living independently in their homes for longer and delay the time when they will enter into the statutory care system.* (Science and Technology Facilities Council)

The replacement of clinician roles with AI was also discussed by respondents, implying a wholesale reorganisation and potentially downsizing of the healthcare workforce. A number of respondents

predicted that this shift, combined with the use of e-health and telehealth virtual consultations, would affect primary care in particular:

> *There will be fewer visits to GPs and hospitals and more virtual consultations. In the technological arena, artificial intelligence is going to change the role of the GP, I suspect this will be eliminated.* (James H. Naismith, Research Complex at Harwell)

However, other respondents, including the Royal College of Paediatrics and Child Health, did not expect reductions in the health workforce as a result of technology, arguing that the NHS workforce has expanded rather than decreased in recent decades despite major technological advancements.

Some respondents expected that greater uptake of wearables and health apps would lead to a general shift away from treatment of illness to promotion of wellness, health management and public health. However, some stakeholders believed the predicted impact of such digital tools to be overstated and unlikely to come about, citing a lack of supporting evidence and patients' reluctance to renounce to face-to-face consultations. Indeed, while some stakeholders supported the suggestion that technology such as wearable devices could reduce the demand on primary care services, a small number of other respondents suggested that the constant flow of health information, coupled with users' poor health literacy, could cause anxiety and ultimately drive up demand.

In addition, a large number of respondents saw technology as a potential mechanism to strengthen patient voice, but felt that it would also lead to increased patient expectations of care, in large part driven by information access and empowerment as described above. Several stakeholders argued that with improved health literacy, patients would expect to have greater involvement in decision making, supported by rapid access to information and digital tools to support such decision making. As one respondent noted:

> *The involvement of the public in all areas of health and healthcare becomes the 'norm'.* (Martin Burton, Cochrane UK)

However, respondent opinion varied and a number felt that the healthcare benefits promised by advances in technology have been overstated, particularly at the expense of prevention, and in most cases are not backed by sufficient evidence. In addition to concerns around driving an increase in numbers of 'worried well', some stakeholders expressed concerns that expanding reliance on technology would negatively impact on patient wellbeing in other ways. For example, concern was raised that robotics would lead to the depersonalisation and de-humanisation of medicine, though respondents gave mixed opinions on the likelihood of face-to-face interaction being replaced to any meaningful extent. One cardiologist advocated a more balanced approach, using technology to reinforce the human face of healthcare rather than to replace face-to-face interaction:

> *Very few people are actively defending the human elements of healthcare whilst increasing technology to create efficiencies that sustain human interactions.* (Ameet Bakhai, Amore Health Limited)

One academic stakeholder felt that current policy debates overlooked the potential political dimensions of reliance on digital algorithms, which may misrepresent and influence the degree to which a patient can take autonomous decisions with regard to their health:

> *…the mature age of algorithms will often posit the individual patient at the centre, controlling their own care. While this may be objectively true in some cases, it may also be the case that the individual patient becomes ever*

> *less powerful in the face of the global capital, and opaque instruments which may be informing this 'control'.* (Harry Hemingway, University College London)

Indeed, there was concern among a number of respondents about the increasing focus on technology as a solution to health and healthcare problems rather than as a supportive aspect of a combined, holistic strategy:

> *At present we seem stuck in the rut of technology as the solution as opposed to the enabler.* (Derek Bell, Imperial College London)

It was felt that technologies may not necessarily address the cause of disease and should be used to aid and enhance health and healthcare, rather than replace it. Moreover, the focus on costly technologies over other methods has the potential to widen inequalities in health and healthcare outcomes unless active steps are taken to ensure access for specific population groups, such as older people or the less educated, and this could counterintuitively drive up costs.

Stakeholders from academic, clinical and policy backgrounds expressed concern that an increasingly technologically sophisticated society may expect healthcare to be delivered using high-quality technology solutions and provide efficiency at all times. This could lead to a growing sense of patient 'entitlement' and transfer of accountability for their health to medical professionals. In addition, increasing amounts of health information without adequate health literacy would risk creating confusion about health choices, leaving some vulnerable to being misguided by unreliable information found online. Indeed, one lay representative predicted that patients may become 'immobilised due to apparent conflicts of information' (Amanda Roberts, British Association of Dermatologists). Some stakeholders suggested that this confusion could manifest in public inability to take preventive measures and meaningful responsibility for their own health, increasing their reliance on acute services and leading to increased expectations that one's 'health problems are for 'someone else to address'' (John Cordwell).

Barriers and challenges to the adoption and spread of technology

A number of respondents questioned the NHS's readiness to efficiently adopt and embed new technologies. This was perceived to be largely a result of cultural barriers within the NHS which rendered some professionals resistant to innovations, as well as a lack of skills, knowledge and incentives to adopt. One respondent argued that until these barriers are overcome and the NHS moves beyond acting as a 'technology buyer', it will struggle to 'drive technological innovation in healthcare in the direction needed, for example toward new technologies that reduce costs' (Marco Viceconti, Insigneo Institute). Related to this, stakeholders underlined a need for medical training and education to maximise the benefits of these new innovations and to increase their adoption where appropriate:

> *The current medical training also needs to be updated to reflect the changes above and to encourage adoption of new technologies, as well as ensuring appropriate levels of training for current technologies.* (Sheuli Porkess, Association of British Pharmaceutical Industry)

The nature and impacts of advances in medical science

A wide range of respondents highlighted the transformative potential of key advancements in medical science on treatments and diagnostics in the coming decades. Most prominent among these were advancements in genomics research and personalised medicine, but other areas where advancements were

predicted included stem cell technology in neonatal therapies, artificial donor organs and blood, and the discovery and implementation of effective biological treatments for some psychiatric or neuropsychiatric disorders.

However, while the potential benefits offered by these advancements were widely appreciated, respondents also highlighted that the use of these treatments and diagnostics would likely entail a considerable cost burden for the NHS. For example, several stakeholders felt that the benefits of many new drugs were overstated, as they are often costly and only provide minimal extra benefits compared to existing treatments. One respondent highlighted the benefits of drug re-purposing, which they felt was underrepresented in debates, even though it is time-saving for research, cost-effective for implementation and often more patient friendly in terms of safety and adverse events.

Indeed, there was a sense among some respondents, particularly those in public health and primary care, that too much emphasis was often placed on new and expensive treatments that deliver little in the way of actual patient benefit. This concern related closely to wider concerns expressed that policy and research investments favoured biomedical approaches to health at the expense of measures to promote population wellbeing, prevention and public health:

> *It can be argued that there is an over-emphasis of attention and resources given to biomedical research and advances that have profound impact for individuals. However, the greatest disease burden and the greatest inequalities [are] caused by the major killers which we know are susceptible to action at a population level. The knowledge base about how we prevent and mitigate these diseases and bring about the necessary population level changes needs to be funded and used in policy-making.* (Helen Walters, NIHR Evaluation and Trials Coordinating Centre)

One university professional also noted that a coherent and combined emphasis on public health, prevention, behaviour change and biomedical solutions will be important to achieve the best health outcomes:

> *It will be important to move away from the perceived tension between personalised medicine and public health - these are not competitive but complementary. We need both.* (Liz Prendergast, University of Liverpool)

Genomics and personalised medicine

A large proportion of respondents, from a range of fields, believed that genomics and personalised medicine (also known as stratified or precision medicine) would grow in importance in medical practice and pharmaceuticals. These views were balanced by concerns raised by a number of stakeholders about cost-effectiveness and ethical issues that these new approaches would raise.

Genomics and personalised medicine are emerging areas of medicine which, in general terms, allow treatments to be tailored to the specific healthcare needs of the individual. It was expected that the incorporation and development of novel biomarkers of high diagnostic, prognostic and predictive value would allow precise selection of new therapies and stratification of patients. Particular disease areas were highlighted that might benefit from these advances, including cancer, degenerative diseases (e.g. Alzheimer's), rare diseases, ethnicity-specific diseases (e.g. Mediterranean anaemia) and mental health.

One stakeholder described how recent advances in techniques such as whole genome sequencing, genome editing and regenerative medicine were opening up new possibilities in terms of diagnosis and treatment:

Indications are that this trend will continue, if not accelerate. It will be increasingly possible to make precise diagnoses at the molecular level, and this will lead to the development of increasingly targeted therapies. (Alastair Kent, Genetic Alliance UK)

A number of stakeholders predicted that these scientific advancements would transform approaches to healthcare, allowing increased responsiveness to individual needs and more effective, targeted (therefore cost-saving) therapies. Some stakeholders saw a future where all patients could have their genomes sequenced, changing the face of preventive medicine. One stakeholder working on genomics research described how genome sequencing 'would initially be offered to families with likely genetic risk (e.g. cancer families), but later offered prospectively to all (in a staged manner)' (Peter Searle, University of Birmingham).

However, stakeholder views varied considerably on the likely benefits of developments in the field in 20 to 30 years' time. A large number of stakeholders, with expertise ranging from public health to genetics, did not expect a transformation of treatment as a result of advancements in genomics:

I doubt that there will be a significant advancement in genetics based medicine. Most treatments will remain the same as today, but it will be far easier to do early prevention and intervention. (Roberto Sans, Plymouth Hospitals NHS Trust)

More sceptical respondents struggled to see a basis for future groundbreaking developments in current research. One stakeholder in the field of biomechanics suggested that while 'it is unquestionable that molecular approaches have [changed] the face of biological research in the last 50 years,' there was still little evidence that personalised medicine would become widely used (Marco Viceconti, University of Sheffield). Indeed, a multi-disciplinary group of stakeholders felt that the prohibitive cost to the NHS of providing personalised medicine to a large section of the population would mean that its roll-out would be unaffordable or potentially occur at the expense of public health and prevention.

Finally, another key area of concern across disciplines was research and medical ethics in relation to genomics-based medicine. In addition to potential inequalities in access discussed below, a small number of respondents suggested that further development in genomics and personalised medicine, especially in prenatal and reproductive medicine, would need strong and clear ethical guidance in order to prevent a growth in interest in eugenics.

Finally, another concern raised was that further improvements in pharmaceuticals would lead to the identification of new marginal conditions, driving a general 'medicalisation of illness' (Richard Hobbs, NIHR School for Primary Care Research).

Healthcare innovation as a driver of inequality

As noted above, differential access to novel treatments and self-management was highlighted by a number of respondents from public health and technology backgrounds as a potential driver of inequality:

If citizens are required to, and seek to, engage more with their healthcare decisions (both in terms of digital health and in terms of genomic medicine) this has the potential to further exacerbate social inequalities, and marginalise groups that are already struggling to access services. (Health Research Authority)

Academics and lay representatives raised concerns that if new, expensive treatments such as genomics-based medicine were not made publicly available, their high cost risked becoming a barrier to their use by

those unable to afford it, thus creating stratified access. It was felt that this might particularly be problematic if novel or personalised treatments and technology were tailored to majority ethnic groups or for larger disease populations:

> *There will be growing tensions between the concepts of personalisation of healthcare and rationing of use as greater numbers of high cost treatments become available for segments of larger disease populations or for rare diseases.* (Paul M Matthews, Imperial College London)

Due to the typically lower levels of health literacy among certain groups (e.g. socioeconomically disadvantaged groups or vulnerable migrants), some respondents also raised concerns about the potential for increased reliance on self-management and remote technology to exacerbate existing health inequalities, commenting that it would need to be carefully implemented to cater effectively to the whole population:

> *Technological change continues and its impact upon individuals, populations and health inequalities is unknown. The inequality of access to technology may exacerbate health inequalities with individuals benefiting from increased quantification of their health and behaviours.* (Faculty of Public Health)

Some respondents reported that a lack of health literacy could affect patients' ability to understand and respond to the huge advances in knowledge that genomics, personalised medicine and digital technology could make available, potentially leading to counter-productive effects.

Inequalities in technological literacy were also highlighted as a potential barrier to the self-management of health, which could in turn drive inequalities in health outcomes.

3.2.4. Access to and availability of new kinds of patient and public data

A wide range of stakeholders suggested that changes in healthcare professionals' and researchers' access to different types of health data would have significant impacts on health research, prevention, and the planning and provision of healthcare. In the coming decades, respondents expected patient and public health data to support decision making both on a macro scale (e.g. service planning and public health strategies) and a micro scale (e.g. identifying the optimal treatment options for a patient by collecting and analysing data in real time). Prospects for data linkage and sharing across services (including related technical and institutional limitations) and challenges to implementing data-driven practices in healthcare, including ethical challenges around data quality and privacy, were also raised and are explored in the sections below.

Data for healthcare and research

The provision of healthcare was expected to become more data driven and connected over the coming decades, leading to radical change. Despite varying levels of optimism among respondents, it was generally expected that technology would increase opportunities for patients and their data to be enrolled in registries, databases, and trials, through unified interconnecting systems. This would bring complementary benefits for both healthcare and research. Stakeholders predicted that data-driven predictive analytics could be used to gather intelligence about specific individuals or geographic areas to optimally target individual- or population-level interventions. In this way, respondents expected increased use of 'big data' for epidemiological analysis, to investigate long-term outcomes and generate insights into population health patterns, trends and risks. Anticipated benefits to individuals include more personalised care, for instance with molecular data being used to inform diagnosis and treatment. Respondents highlighted the potential for this increasing use of data to reduce variation and improve quality and efficiency of healthcare.

However, a minority of stakeholders believed the potential of big data in healthcare to be overstated, citing a need for more evidence on which to base practice. As with digital technologies and genomics, it was felt that there is currently too much focus on big data as a solution, at the expense of simple and cost-effective measures (e.g. promoting healthy behaviours).

Data sharing and linkage across services

A number of respondents expected integrated patient Electronic Health Records (EHRs) to be enhanced for improved clinical care, with more linkage between health, lifestyle and environmental data:

> *Healthcare will build increasingly on multiple sources of data derived from inside and outside the NHS to inform risk prediction, diagnosis, prognosis and treatment.* (Philippa Brice, PHG Foundation)

However, stakeholders underscored current gaps in data infrastructure in England in particular, which prevent population-level life-course approaches to tackling health challenges and indicate a need for significant progress:

> *There is a mismatch between policy rhetoric on improving child health across the life course and what happens in practice and in funding decisions at national and local level…The data linkage systems that are needed to underpin population level systems change across the life course are absent in England, in contrast to Wales and Scotland that are moving towards Nordic levels [of] sophistication.* (Faculty of Public Health)

In their response, a group of researchers said that challenges to sharing and accessing data went beyond technical issues and demanded structural adjustments:

> *Digital health is often badged as 'patient-centred care' but most digital health innovations have been implemented piecemeal into traditional health systems with little modification of the system to support the innovation. This often results in frustrating fragmentation of care for the patient.* (Claudia Estcourt, Anne Johnson, Rachel McKendry, Pam Sonnenberg, Jo Gibbs and Soazig Clifton, University College London, i-sense)

Indeed, several stakeholders, including a representative of EMBL-European Bioinformatics Institute, underscored the structural and supportive adaptations that would be needed to fully implement a data-driven NHS, including private sector engagement to manage and analyse complex datasets.

One respondent from the NIHR Clinical Research Network (CRN) Public Health National Specialty Group cited a successful local learning hub model which provided the local collaborative structures necessary for inter-service data sharing. The Connected Health Cities model was established in Bradford to 'harness the growing richness of routine health, social and education data' (Jane West, NIHR CRN Public Health National Specialty Group), and links the city's primary care, secondary care, education and other local authority data to provide evidence to inform population healthcare (Connected Health Cities, 2017).

Challenges in implementing data-driven practices in healthcare

Several respondents highlighted potential barriers to embedding the use of complex datasets and systematic data sharing into clinical practice and fully leveraging its digital infrastructure. Stakeholder concerns primarily centred around ethical and data quality issues. Some respondents highlighted the growing public concern around data privacy and security arising from the greater integration of technologies into the health and care professional relationship. The ethical challenge of balancing patient privacy and data confidentiality on one hand, with the need for open information sharing for clinical care and research on the other, was expected to challenge current ethics and regulatory frameworks. It was feared that if not properly addressed, these issues could impact on the uptake of digital technologies, and therefore patient involvement will be crucial to help deal with these challenges:

> *We also need to be better informed about public views on the nature of the trust relationship that they have with their health and care professionals and the impact that new developments in technology and use of data might have on that relationship. At the moment trust levels are high but could be quickly damaged in the event of unauthorised releases of confidential data or misuse of technology.* (British Computer Society)

Finally, a range of stakeholders also acknowledged that success would depend on the quality and depth of the data collected. This would have implications for the NHS's current approaches to data collection, including those provided by patients, the regulatory framework in which data are collected and the development of AI. Indeed, one stakeholder described health data currently collected as often 'too crude or inaccurate to be of much use' (anon.)

4. Perceived priority areas for health research

Reflecting the themes and issues discussed in the preceding chapter, this chapter presents the views of surveyed stakeholders on key areas for future research investment to meet the health and healthcare needs of England in the future. Figure 3 below presents an overview of the key topics covered. Like Chapter 3, it is structured around two overarching sections: 'Population health' and 'Health systems and performance'.
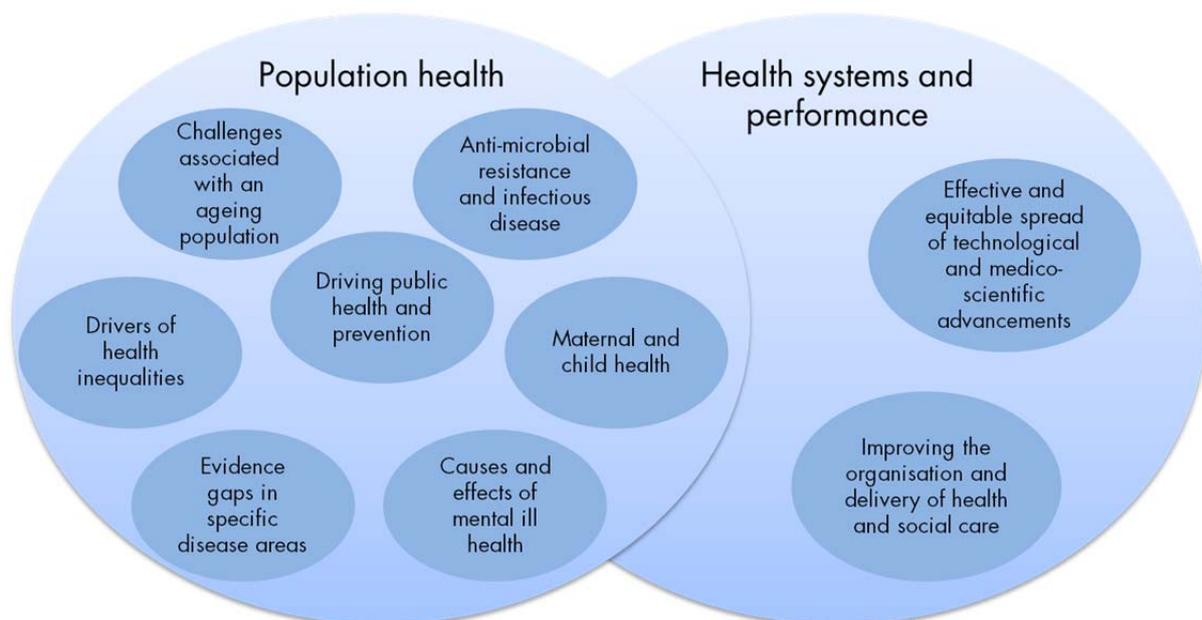
Figure 3. Overview of themes related to priority areas for health and healthcare research

4.1. Population health

This section addresses the need for research into the health and wellbeing of the population and specific subgroups. Broad areas identified by respondents as priorities for future research to address were: i) the challenge of an ageing population; ii) public health and prevention; iii) health inequalities and the social determinants of health; iv) exploring the causes and effects of mental ill health; v) maternal and child health; vi) managing the threat of anti-microbial resistance (AMR) and infectious disease; and vii) evidence gaps in specific disease areas.

4.1.1. Addressing challenges associated with an ageing population

In terms of research priorities raised by respondents in order to help to manage the future challenge of an ageing population, areas of focus were tackling complex multi-morbidity, and musculoskeletal conditions and dementia. These are explored in turn below.

Tackling complex multi-morbidity

A number of survey respondents, including public health and mental health researchers and health policy officials, called for a stronger evidence base to improve both the understanding and management of multi-morbidity and associated polypharmacy, and frailty, as well as strategies for promoting healthy ageing and quality of life:

> *Directing research at syndromes which are common in later-life and which have previously failed to attract funding because of the 'Cinderella' nature of many services supporting older patients with frailty. Obvious examples are around continence, falls, cognitive impairment and iatrogenic disease. These will continue to be prominent contributors to morbidity at the end of life and between them will contribute to ongoing demand for frequent high-intensity health-service support towards the end of life unless their natural course can be modified by evidence-based interventions.* (Adam Gordon, Member of the British Geriatrics Society)

Several stakeholders felt that further research was warranted on conceptual models of multi-morbidity and frailty (how they should be described and understood), as well as how to change the healthcare system to meet the needs of people affected. Arthritis Research UK in particular called for more collaborative research into multi-morbidity, emphasising musculoskeletal conditions, which are often present and make living with multi-morbidity more difficult. Other stakeholders also highlighted the need for diverse, multi-disciplinary research approaches to comprehensively address the complexity of the challenge:

> *Ever increasing and aging population with multiple complex conditions which will need a combination of not only blue skies research, but systems design, translational, quality improvement, audit and implementation research which enhances the quality of patient care, experience and outcomes.* (Royal College of Physicians)

In relation to polypharmacy in particular, several stakeholders stressed the need to develop evidence around how polypharmacy affects health, particularly in older patients, as well as novel methodologies to predict, prevent and better manage adverse drug events, which were expected to increase beyond the significant existing burden.

Evidence gaps for addressing dementia and musculoskeletal conditions

Several stakeholders also called for more investment into dementia research, given the predicted scale of the challenge for health services and the health and wellbeing of older people (see Section 3.1.1). Specific areas believed to require greater investment included pharmacological treatments; the underlying risk factors, biology and disease mechanisms that cause it; prevention strategies through lifestyle management; and the development of more effective approaches to condition management. Alzheimer's Research UK suggested that the current lack of evidence may lead to unforeseen challenges in the future, as, for example, if poor cardiovascular health and diabetes are risk factors, the recent increases in obesity may result in higher future prevalence of dementia than predicted.

A number of respondents highlighted musculoskeletal disorders as an under-investigated area which would become more pressing in the years to come. Arthritis Research UK specifically highlighted the

management of chronic pain, particularly as experienced by people with arthritis and other musculoskeletal conditions, as an area of severe unmet need. Research was called for to understand mechanisms, develop effective treatments and empower and enable effective approaches to ongoing self-management.

4.1.2. Improving strategies for public health and prevention

A number of stakeholders from a range of disciplines called for more research into evidence-based public health interventions to facilitate a more holistic understanding of health and wellbeing beyond the biomedical paradigm:

> *Research and funding need to move beyond the biomedical paradigm towards a broader perspective on health and wellbeing, to reflect the complex nature of major public health issues.* (Natalie Lovell, The Health Foundation)

Priorities for research in this area included developing evidence around efficient and effective population-level interventions to bring about behaviour change, greater awareness of risk through population-based cohort studies, understanding the negative effects of air pollution on population health as well as potential benefits of reductions in pollution, and focusing on research that explores complex public health systems.

> *We don't yet know the correct balancing of behaviour change strategies between a focus on individuals or on populations, let alone being able to construct a narrative that might have widespread influence.* (Bernie Hannigan, Public Health England)

One respondent stressed the need for more input from non-health sectors in future public health research in order to achieve this, including education, transport and housing. It was felt that this evidence would provide an economic incentive for governments and policymakers to do more to legislate for change that will drive positive public health outcomes.

4.1.3. Understanding and tackling the drivers of health inequalities

Respondents called for more research into the wider determinants of health, including those driving health inequalities between different population groups (primarily the socioeconomically disadvantaged and ethnic minorities) and geographies. It was felt that a better understanding of differential access to healthcare and inequitable impacts of new and existing technology, as well as how to mitigate these inequalities when developing and implementing innovations, was particularly necessary.

Respondents in the areas of public health, mental health, eye health and others felt that tackling the socioeconomic determinants of health inequality continues to be underrepresented in research and policy priorities.

> *Despite the well-known evidence for the primary effect of income, housing, family background etc. on health, an influence that survives generational transfer, science continues to chase new, complex and expensive solutions.* (David Richards, University of Exeter and European Academy of Nursing Science)

Additionally, respondents highlighted the need for research to ensure that members of minority ethnic groups with patterns of disease or subtypes of disease that are different to those observed in majority ethnic groups benefit equally from novel technologies, diagnostics and treatments.

4.1.4. Exploring the causes and effects of mental ill health

A number of respondents, including but not limited to mental health researchers, felt that mental health was currently underfunded and underrepresented in policy and research debates, and called for more research into mental ill health. Stakeholders stressed the need to develop a better understanding of, as well as treatments for, common mental disorders.

> *Recently, mental health has been more widely publicised, but this awareness is not being translated into increased research funding, improved patient care or better treatments.* (Alex Hulme, Academy of Medical Sciences)

Respondents also highlighted the need for greater research efforts dedicated to understanding the links between physical and mental health, as well as the social determinants of health and mental health in children and teenagers. These are discussed in turn below.

Determinants of mental ill health

Respondents from the NIHR and elsewhere argued that a greater understanding of the causes of mental ill health, as well as its prevention, would improve services' capacity to cope with increasing demand. Stakeholders called for research into the early determinants of mental disorders, including around effective public mental health policy at secondary school level, and how different systems and policies can affect wellbeing. Several respondents felt that the economic and social causes of mental health (such as poverty) and the potential for effective community- and peer-led responses were under-acknowledged, often in favour of more biomedical models of care. As one mental health researcher said:

> *Yet because of the focus on biomedical models, the psycho and social have been hugely neglected, particularly in research terms. It is critical that, in moving forward, research funding is rebalanced… The focus on biomedical models has resulted in an insufficient acknowledgement of other underlying individual and social determinants of poor mental health, including ethnicity, poverty, lack of equal access to work, education and society. If these issues are ignored, the research is unlikely to translate to the real world experiences of people with mental illness. Innovative work on these issues happens within communities but those voices are rarely acknowledged in the academic literature.* (Steve Gillard, St George's, University of London)

Links between physical and mental health

A number of respondents with backgrounds in primary care and psychiatry underlined a specific need for more research into the link between physical and psychological illness. They argued that not only would this shed light on an issue which was currently under-acknowledged in policy and research debates, it would also enable us to understand the psychological impact of living with chronic conditions, and facilitate the secondary prevention of physical morbidity in people with mental disorders. One research stakeholder stated:

> *Although there is increasing and welcome discussion of the importance of mental health the recognition of the inter-relatedness of mental and physical health still receives less attention than might be appropriate.* (Stuart Logan, University of Exeter Medical School)

However, while an understanding of physical manifestations of mental ill health were important, a holistic perspective, which also incorporated social outcomes, was needed. Indeed, one mental health researcher noted a bias in outcome measures of recovery for mental health towards physical disability, which resulted in inadequate understanding of the importance of individual and social recovery.

Mental health in children and adolescents

A number of respondents, including several in mental health research, underlined that research into the mental health of children and young people in particular was underfunded and required greater attention. It was suggested that there should be a greater focus on developing and evaluating early interventions to reduce the later burden on adult services, including education to improve mental health literacy. This could include, for example, giving support and training to equip children to take control of their mental health and reduce stigma.

However, concerns were also raised that despite the importance of attention on early intervention, an emphasis on early intervention had diverted resources from those in the early phases of illness. Further research was needed to address and improve these approaches.

4.1.5. Improving maternal and child health for a life-course approach

It was generally agreed that research and services addressing children and young people's health, including early intervention strategies, were underrepresented and underfunded within current research programmes. Stakeholders from the Royal College of Paediatrics and Child Health and the UCL Great Ormond Street Institute of Child Health felt this was reflected in the current diversion of resources from child health to support the increasing burden of adult health.

Research to better understand the risk factors leading to adverse health outcomes among children and young people (e.g. obesity and the impact of stress on mental health) was felt to be a priority for improving both child and adult health. One stakeholder with expertise in geriatric medicine felt that understanding the life-course and early-life determinants of later-life frailty in particular should be considered a priority, in order to create opportunities for interventions to modify, delay or reverse the onset of frailty, with potential benefits at individual and population levels. Stakeholders from the UCL Great Ormond Street Institute of Child Health also stressed that environment and health would need to be considered together if improved outcomes for children are to be achieved, and a respondent from the Royal College of Midwives stressed the need to better promote breastfeeding by reducing the stigma of public breastfeeding and combining it with a mother's return to paid work. In addition, in their response the Royal College of Paediatrics and Child Health put forward the impact of transgender experiences of healthcare services as an important overlooked issue in policy and research, in particular in relation to age limits on referral for transgender young people and potential treatment as a mental health issue rather than one of identity.

Respondents also underlined the need for more research attention on maternal health. Stakeholders in the area of women's health stressed the need to invest in the development and testing of drugs for use in pregnancy, as underinvestment in this area contributes disproportionately to morbidity and mortality trends. Stakeholders also highlighted that researching the lifelong impacts of events in utero and intrapartum could provide new scope for disease prevention.

4.1.6. Responding to the threat of anti-microbial resistance and infectious disease

To combat AMR, respondents called for more research into novel treatments, as well as a stronger evidence base on managing disease outbreaks and configuring appropriate systems and services to support

responses. One NIHR respondent felt that despite increasing recognition of the issue, AMR is still an under-researched area that is under-acknowledged when thinking about future health needs.

Understanding drivers of infectious disease

As part of a global approach needed to tackle the predicted spread of infectious disease, respondents including experts in cancer research and bioethics called for research efforts to focus on low- and middle-income regions in order to, for example, build research and surveillance capacity in the countries where disease outbreaks most often occur. The need to research the impacts of the environment on health as well as greater collaboration between the environment and health sectors was also recognised, since human, animal and environmental factors interact in the spread of disease and contribute to drug resistance.

Exploring novel treatments

A number of survey respondents identified the need for research into new pharmaceutical treatments to combat AMR, including new, more effective antibiotics, as well as more novel approaches, such as vaccines.

> *There is a desperate need for new drugs and vaccines, but research has made little headway in this area to date.* (Nuffield Council on Bioethics)

Respondents felt that investing in the development of new vaccines would allow AMR to be managed proactively, and would also improve resilience to outbreaks of emerging and re-emerging infectious diseases with pandemic potential:

> *The MRC [UK Medical Research Council] has led commendable work to improve national resilience, linking NHS, academia, and industry through its Vaccine Network initiative. However, there is still considerable scope to strengthen research efforts in the development of new vaccines, drugs, and diagnostics against pathogens where these interventions do not currently exist. This will require global leadership with coordinated and collaborative action across the public and private sectors.* (Chris Lowry, British Society for Immunology)

Managing disease outbreaks and protecting populations

Respondents, representing NHS staff as well as policy officials, stressed the need for health systems to develop methods of early identification and rapid response to disease outbreaks, such as rapid preparedness units or networks for national and global early warning of diseases and emergencies. Other respondents, with backgrounds in policy as well as public health research, also identified the need to develop more effective methods of infection prevention and control, both in hospitals and in the community. It was argued that these could be used to detect pre-symptomatic carriers of infection and protect the most vulnerable patients.

One academic stakeholder also emphasised the need for systems research on how to configure services and collaborate with industry, in order to understand how social and institutional factors, including existing vulnerabilities and health inequalities, should shape any service planning and response.

4.1.7. Evidence gaps in specific disease areas

Individual respondents also drew attention to evidence gaps in a number of specific disease areas and fields of healthcare. These were: gastroenterology, oral healthcare, cancer, rare diseases and sudden cardiac death.

A respondent from the British Society of Gastroenterology highlighted how clinical research into gastrointestinal and liver diseases was underfunded compared with other areas of health, despite these being major causes of mortality and illness. Oral health was another underfunded field according to a number of respondents, including Birmingham Health Partners, despite the widespread prevalence of oral infectious and inflammatory diseases.

With regard to cancer research, a respondent from Breast Cancer Now called for greater intervention research in prevention and detection, and Cancer Research UK emphasised a need for a specific focus on cancers with poor survival rates, such as brain, lung, oesophageal and pancreatic cancers and other rarer cancers.

4.2. Health systems and performance

This section addresses the need for research into structural factors which affect the planning, delivery and organisation of healthcare and public health interventions. Topics raised by stakeholders were: i) health and social care organisation and delivery; ii) technological and medico-scientific advancement; and iii) public health and prevention.

4.2.1. Health and social care organisation and delivery

Respondents highlighted a range of research gaps related to the future organisation and delivery of health and social care, in relation to the provision of services for specific groups as well as delivering effective interventions within appropriate and efficient models of care. Key areas of research proposed were: i) evaluating and implementing new models of care; ii) health and social care services for older people; iii) the role of informal carers; iv) end-of-life care; v) patient shared decision making; and vi) healthcare workforce.

Evaluating and implementing effective models of care

A range of stakeholders, with backgrounds in arthritis research, primary care, health services and social care, emphasised the importance of robust evaluations of new models of care to provide an evidence base for future good practice, as well as implementation research to ensure effective translation of interventions into NHS practice.

Respondents highlighted the need for evidence around optimal models of primary care provision, social prescribing services, models of integrated care, self-care and critical care in order to establish what configurations deliver the best patient outcomes and experience and value for money:

> *A broad range of new models of care are being introduced across the country […] It is essential that all new models of care are robustly evaluated to provide an evidence base on those interventions which deliver the best outcomes and experience for people, alongside value for money.* (Arthritis Research UK)

A number of respondents specifically highlighted research gaps in the integration of health and other services, especially social care, in order to provide evidence of clinical effectiveness and cost-effectiveness, maximise benefits to patients and enable services to cope with the increasing burden of need. Research was also needed to help to address the operational, institutional, cultural and other complexities inherent in cross-boundary working:

> *Research advancements are required to understand how to improve care provision across boundaries that embrace system and operational complexity.* (Ganesh Sathyamoorthy, NIHR CLAHRC Northwest London)

One respondent from Public Health England also emphasised the need for a better understanding of potential service models of self-care and care at home and their scope, as well as evidence for commissioners on the effectiveness of technology-based models which are likely to be popular. Respondents identified a need to articulate what support is required for individuals to manage their health conditions and undertake prevention activities, as well as how these public health measures can be funded as current local authority arrangements may be inadequate.

With regard to the field of critical care, which cares for post-acute patients by interfacing with hospital and community care services, two respondents with specialism in the area drew attention to the need for research to improve provision. Both respondents particularly highlighted the need to explore post-critical care outcomes in order to understand the changing scope, (as a result of changing treatment options), of patient suitability for critical care interventions (Anna Batchelor, Faculty of Intensive Care Medicine and Critical Care Leadership Forum and Paul Dark, NIHR CRN Critical Care Specialty Group). Perioperative social care was also raised as an overlooked area which would benefit from multi-disciplinary research and collaboration between relevant fields, including partnerships of surgery, anaesthetics and pain, geriatrics, primary care, diabetes, respiratory, cardiology and psychiatry.

Additionally, research into improving implementation and managing transformation in complex healthcare settings was identified by stakeholders from acute medicine to geriatric medicine as a key priority in developing generalisable knowledge about successful implementation of new interventions or innovations. As one NIHR stakeholder noted:

> *We do not yet well know enough about the generalisable and scale-able determinants of implementation of evidence based interventions or service change.* (anon.)

Finally, respondents also highlighted the shortfalls in current evaluation approaches, whose experimental designs often assume ideal settings for the intervention, but fail to provide evidence on 'real-world' implementation and outcomes in typical NHS settings (see Section 5.3.1 for further discussion of this theme). In their response, the NIHR Collaboration for Leadership in Applied Health Research and Care (CLAHRC) South London noted potential opportunities for advancing implementation research to better understand local contextsacross the UK:

> *The increasing localisation of the planning and delivery of health care (e.g. Greater Manchester health and social care experiment) will provide opportunities for implementation research to investigate the divergence of policy, practice and funding across UK. This should result in better synergy between commissioning and research.* (NIHR CLAHRC South London)

Providing optimal healthcare for older people

In the context of predictions that the traditional healthcare model of single-disease specialties was not suitable to provide the holistic care required for the management of multiple chronic diseases, respondents called for research into the optimal healthcare arrangements to meet the needs of patients with complex multi-morbidity and chronic conditions. One health services academic described the fundamental shifts in research and care paradigms that these challenges demand:

> *The problem of multimorbidity is not one affecting a narrowly defined segment of the population (any definition based on number of conditions will render categories too heterogeneous to be meaningful), but rather one that affects the very design of both healthcare and the research on which it is based. It means that specialists can no longer pretend it is OK to manage index conditions within their field of expertise without being also experts in highly prevalent comorbid conditions potentially affected by their management of the index conditions.* (Jose M Valderas, University of Exeter)

Respondents highlighted a need to strengthen the evidence base around effective and joined-up health and social care interventions for older people. Indeed, one academic respondent highlighted evidence gaps on the effectiveness of home care:

> *The effectiveness of shifting healthcare for older people with complex health needs from specialist settings to delivery in their homes has not been adequately considered in debates about the future of health and healthcare in England. There is a need for evaluation of the effectiveness of this approach particularly in parts of the country where community services have not been well resourced. Apparent short term gains may be offset by increased long term costs to the individual, their carers and health/social care services. This should be evaluated.* (Avan Sayer, Newcastle University)

Respondents with backgrounds in emergency medicine and academia also called for more research into geriatric emergency care. Specifically, research was thought to be needed into the costs and benefits of both preventive and emergency treatments for the very old and frail. It was also felt that a public health approach needed to be grounded in evidence to address the risk of increasing numbers of older people presenting with falls and collapses and requiring hospital admission. Specific priorities identified by respondents included evaluating the mitigation of major hazards, as well as causal factors such as polypharmacy.

Decision making and approaches to end-of-life care

A number of respondents from a range of backgrounds emphasised the need for more research into approaches to end-of-life care in general, citing underfunding and lack of recognition of the area in terms of research as well as provision:

> *The area of end of life care remains generally under-recognised as an important aspect of care in an ageing population. There are significant variations in opinions and values in this area, both within the healthcare professions and in the general public. These differences have made this area difficult to discuss or research and so there is a paucity of good quality evidence to support any particular approach.* (Steve Goodacre, Centre for Urgent & Emergency Care Research, University of Sheffield)

Particular gaps highlighted included insights into good practice in negotiating the balance between quality of life and extending life, and empowering patients and carers to make decisions appropriate for them understand the choices and care pathways available. Other suggestions included research to develop tools

for clinicians and other healthcare professionals to approach discussions around end-of-life care and help patients to discuss what it means for them to 'die well', as well as the modelling of end-of-life scenarios to support this. As one academic respondent noted:

> *Lack of attention to the need to shift fundamental social and cultural expectations of health care. These expectations (extending life by a few weeks but sacrificing quality of life for example, or offering a diagnosis and a cure for every symptom) have been fuelled by the medical and scientific professions but they are now realising that this needs to be changed and so their new ideas need to be delivered effectively to the public.* (anon.)

Another respondent highlighted how the fragmented nature of end-of-life services (e.g. primary care, social care, care homes, etc.) made research in the area more difficult, in addition to noting the lack of a core dataset to understand the health status and service use of care home residents. Primary research to establish such a data source would facilitate further studies to develop effective interventions in the sector (Adam Gordon, British Geriatrics Society).

Strengthening patient empowerment and shared decision making

Calls for research related to improving patient involvement in healthcare decisions came from respondents representing the National Institute for Health and Care Excellence (NICE) and a NIHR CLAHRC. In light of the expectation of continued policy focus on patient and service user engagement in care decisions, stakeholders from NICE emphasised the need for impact evaluations of shared decision-making interventions, as well as research exploring the potential role of patients and public in driving change, the role of EHRs, patient access to medical records and patient preferences for care:

> *Funding for research into patients' preferences while involved in shared decision making should be provided to feed preferences back in to the design of service provision to create lean, patient-centred, efficient healthcare.* (Gillian Leng and Julie Royce, NICE)

Another respondent representing a NIHR CLAHRC underlined the need to better understand how to encourage and optimise the communication of increasingly complex health information to patients. In the context of demands for shared decision making and reductions in the health workforce and time resource, this research was seen as particularly important.

Supporting the role of informal carers and delivering care at home

Respondents with expertise in child health and cancer, among others, called for research which specifically addresses the overlooked role and contribution of family and other informal carers in supporting patients at home. Due to their crucial but often invisible role in care provision, respondents highlighted the importance of understanding the complex and changing profile of carers and how to best support relatives in taking on carer roles. Predictions of reductions in carer availability, due to more people remaining childless or living far from their ageing parents, further underline the need for this research.

Respondents also raised the need for research into carer experiences of young people and older people specifically. The Royal College of Paediatrics and Child Health called for research into the impact of young carers roles on health and wellbeing and a representative of Marie Curie underlined the need to better understand the emotional and health burden on older carers as well as the provision effective bereavement support for people following the death of a loved one (Sabine Best, Marie Curie).

Training and incentives for the healthcare workforce

A number of stakeholders, with backgrounds in obstetrics, geriatric medicine and social care, noted the need for research into optimal approaches to training and structuring the health workforce, as well as tackling future challenges of workforce supply and patient demand. A respondent from the British Geriatrics Society specifically highlighted the need for behavioural science, implementation science and economic research to understand the complex drivers behind healthcare professionals' decisions to develop skills in the management of older people with complex multi-morbidity and frailty. Lack of uptake of funded training in this area was considered a barrier to meeting the needs of older populations, and would benefit from multi-disciplinary research to inform effective workforce initiatives and incentives.

In the context of increasing commissioning of fixed, time-limited interventions that are designed to be delivered by non-clinical staff, one social care expert also suggested that the differences in the efficacy and safety of certain healthcare interventions being delivered by highly qualified healthcare professionals or by less qualified staff warranted further research. He noted:

> *We do not value enough the outcomes that can be achieved from supportive interventions or the importance of the impact of their delivery by higher status professionals. The same intervention by a lower level member of staff may have less efficacy. Research into this area would be valuable.* (David Challis, PSSRU, University of Manchester)

4.2.2. Technological and medico-scientific advancements

In order to facilitate, translate and drive forward advancements in technology and medical science, respondents identified key areas, primarily related to genomics and research translation, which would benefit from further research. We discuss each area, including any divergences in opinion, below.

Evidence for the effective and equitable spread of health technology

As discussed in Section 3.2.12, the changing role of technology is widely expected to shape the future of healthcare in a number of ways. In the context of these changes, a range of respondents pointed to areas where further research would be needed to help ensure optimal organisational and patient outcomes. Gaps in current evidence and understanding of the safety, clinical effectiveness and cost-effectiveness of various technologies for health were highlighted. These included the role of AI in replacing clinicians and healthcare staff (Dave Green, NIHR public contributor), and e-health tools and services. One expert in digital healthcare highlighted evidence gaps in the field:

> *Clinical decision support is one area where RCTs and systematic reviews have been carried out with useful results, but this approach needs to be taken much more widely across the spectrum of digital tools and services.* (Jeremy Wyatt, University of Southampton)

Another key area which a range of stakeholders identified as requiring further research was the relationship that different population groups – especially children and young people and older people – have with technology. Given the perceived importance of enabling increasing self-management in health, it was felt that understanding of the behavioural science associated with the use and successful adoption of technology was needed to ensure that it can deliver its potential. In their response, the British Computer Society outlined aspects of this relationship which could be important to maximising the benefits of different technologies and ensuring appropriateness:

> *Understanding the nature of the relationship that young people have with technology will help us better engage and encourage them in adopting healthy lifestyles. … more detailed understanding of older people living with long term conditions and their relationship with their carers will improve our ability to utilise technology that they value.* (British Computer Society)

A respondent from NICE also noted the need for research to explore the potential impact of specific technologies, including artificially grown tissues for tissue replacement, point-of-care testing and diagnostics that can identify specific proteins involved in individual autoimmune cases.

Advancing and implementing personalised medicine

As noted in Section 3.2.3, predicted groundbreaking advancements in genomics research were accompanied by doubts in some quarters that advances in science would necessarily allow for effective, safe and cost-effective implementation. For example, one respondent noted specific concerns related to the short-term cost implications of the personalised treatment of cancer:

> *[…] it has been argued that personalised medicines will allow the overall cost of healthcare provision will come down, as we become more able to rapidly choose the right drug for the right person, and don't spend money on drugs that would never have benefit. It is not yet clear whether this would be the case. At the very least, there is likely to be a short-term increase in costs as expensive new treatments are introduced, and as the costs of introducing the diagnostic tests also have to be met. It remains to be seen whether the overall costs of the healthcare system drop once there is the ability to make a more targeted choice of cancer treatment.* (Sally Greenbrook, Breast Cancer Now)

Despite an increased understanding of the field of genomics, the complexity of the full range of factors that determine an individual's health status (e.g. behavioural, psychosocial and environmental factors) may mean that establishing causality for illness may be too complicated to deliver the transformational opportunities hoped for:

> *Understanding the relationships between these factors is hugely complex - perhaps too complicated to realistically lead to the oft quoted 'transformational opportunities' for understanding disease processes, finding new drug targets/therapies and providing 'individualised treatment'.* (anon.)

The complexity of these challenges drove calls from respondents for more investment in multi-disciplinary (and multi-method) research in order to make sense of the various factors that will shape the success (or failure) of personalised medicine in the future. Stakeholders underlined the necessity of perspectives from health informatics and bioinformatics as well as the physical sciences and public health.

Translating research and innovation into practice

A lack of research on effective approaches to translating research and innovation into practice was underlined by a wide range of respondents. In parallel with supportive research structures to facilitate the embedding of research in the NHS (see Chapter 5), further focus on this area was considered to be a priority in order to understand how to increase the uptake and spread of effective interventions. A respondent with a computer systems background noted the need for research into how to best utilise technology to deliver maximum health benefit cost-effectively and equitably within the NHS. In addition, one academic stakeholder spelled out the challenge for health services research in this regard, advocating a co-creation approach for greater research uptake:

Co-creation of clinical practice rather than dissemination of research findings should be the new language of health services research. More research funds should be given to collaborative teams to continue their work after they have undertaken the substantial trials they need to do to demonstrate effectiveness. I would say at least as much if not more resource should be expended on practice change. (David Richards, University of Exeter and European Academy of Nursing Science)

In addition, stakeholders from the NICE emphasised the potential for integrating strategies for practice change into models of research, as well as the importance of participatory approaches between researchers, practitioners and healthcare organisations to accelerate the adoption of evidence-based care. They also highlighted gaps in understanding around appropriate implementation of clinical guidance in different settings:

There is growing recognition that getting evidence to influence and change practice is a complex undertaking. Despite a growth in the evidence base in this area, there are gaps in understanding which types of implementation strategies are most effective for which types of guidance, for which audiences and in which circumstances. (Gillian Leng and Julie Royce, NICE)

5. Perceived priorities for supporting future health research and impact

This chapter presents stakeholder views on how the underlying health research landscapesystem and infrastructure will need to adapt to respond to the health challenges described in Chapter 3. Unlike Chapter 4, which focused on health research gaps highlighted by respondents, this chapter explores cross-cutting structures, mechanisms and processes which affect the conduct, delivery and impact of research. Broad areas of focus raised by respondents are summarised in Figure 4. These are: i) research governance and administration; ii) embedding research in the NHS; iii) driving new approaches to research; and (iv) patient and public involvement (PPI).
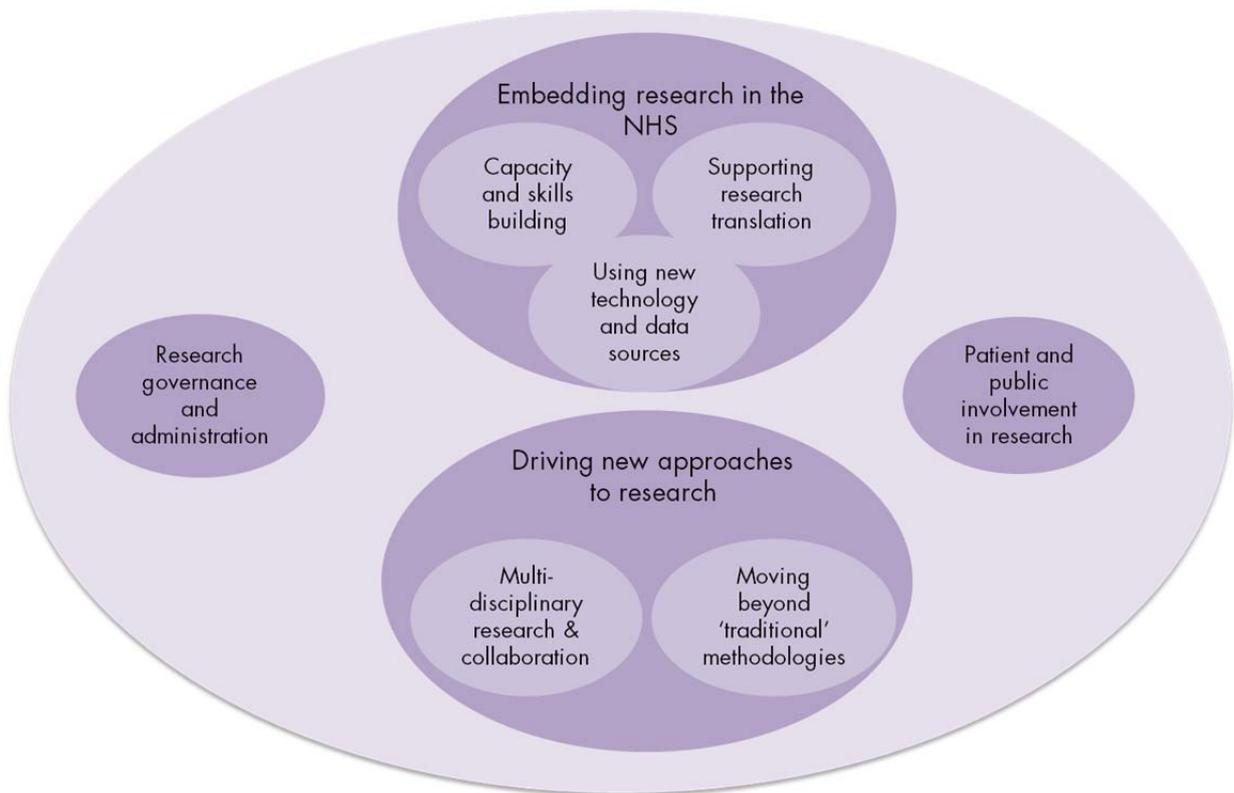

Figure 4. Overview of key themes related to supporting future health research and impact

5.1. Developing new processes and structures for research governance and administration

A number of respondents representing the NIHR, universities and the Health Research Authority (HRA), noted the emerging need for changes in health research governance systems and processes, specifically with regard to managing the introduction of digital research tools and approaches and access to new types of data.

In their response, the HRA suggested that technological developments, such as the use of AI and online platforms for remote trials, may present new challenges for regulators of research, as well as opportunities to increase efficiency by cautiously automating certain aspects of research governance and ethical review.

Given the challenge of the increasingly complex care needs which cut across services, access to linked health and non-health datasets were viewed as becoming more important to research and respondents saw a role for research coordination and governance bodies in brokering access to linked datasets and facilitating proportionate, efficient regulatory reviews. Some stakeholders were concerned that the often cumbersome current restrictions on data access would prevent research opportunities and deter patient engagement in studies:

> *The future of health needs to link healthcare interventions and services to populations to measures of function in their daily lives. These should include areas such as work, claiming of benefits, expenditure, education, neighbourhood indices, justice, and social care. We have a wealth of administrative data in all of these fields but the current, restrictive interpretations of 'medical purposes' by the Health Research Authority and 'benefits to health and (adult) social care' by NHS Digital severely restrict opportunities for linkage of administrative data for de-identified analyses that could evaluate healthcare impacts on individuals' lives.* (Ruth Gilbert, University College London)

5.2. Embedding research in the NHS

Respondents put forward three primary approaches to embedding research in healthcare practice in the NHS: the provision of training and capacity building for research, facilitating research translation and utilising new sources of health data. These are discussed in turn below.

5.2.1. Building capacity and skills for research in the NHS

The health system's ability to implement evidence-based innovations and integrate research findings into practice was seen as being constrained by poor incentives and limited resources to conduct research among clinical staff. As a remedy to this, a number of academic respondents highlighted the need to improve integration between clinical and research career pathways to enable clinicians to develop their research careers and avail themselves of synergies in terms of knowledge and skills between the two fields:

> *The pathway for university based clinician scientists is well defined - the same clarity and support needs to be achieved for research active NHS clinicians, if we are to achieve the goal of every patient having an opportunity to be a research participant.* (NIHR CRN Specialty Group for Anaesthesia, Perioperative Medicine and Pain and the National Institute of Academic Anaesthesia)

Respondents suggested that this could be addressed by offering more flexibility in continuous professional training requirements, protected research time in clinicians' schedules, and incentives in the form of funding and credentials for research-active clinicians. Indeed, a lack of funding was identified as one of the main barriers to increased clinician involvement in research. Individual respondents highlighted the particular importance of research support in the areas of psychiatry and primary and tertiary care.

Additionally, a stakeholder with a bioinformatics background identified specific future needs in skills development among clinical researchers in the data sciences to understand genomics and phenomics, as well as in health informatics and its interrelationship with bioinformatics (Chuck Cook, EMBL-European Bioinformatics Institute).

5.2.2. Approaches to translating research into practice

Respondents widely considered the improved translation of proven interventions and research findings into practice to be a key priority for improving the impact of health research. A number of respondents agreed that delays in the uptake of research or innovations were a concern and that investment in improvement research and practice could help to alleviate negative effects:

> *A particular concern is the time lag between findings and implementation, as such translational and improvement research should be supported as it can speed up the impact of research within the next 20 years. Increased support and smaller funding sources for improvement research and operational research can make a huge difference to patient care and quality of experience in addition to reducing the time for research to have an impact and in terms of supporting cost efficiencies.* (Royal College of Physicians)

There were calls among respondents for greater awareness among the research community of the complexity of translating research findings into practice, and for improved mechanisms for adopting and spreading research and innovation. For example, one academic suggested that uptake could be improved through a focus on building and presenting evidence in a manner that is accessible to target audiences.

Individual respondents also suggested specific approaches to improving the effectiveness and efficiency of research translation. These included the development of more integrated multi-disciplinary research to reflect the true NHS context; greater rationalisation of funding by increasing emphasis on using existing data that was generated by others; more flexible, efficient and timely commissioning; and greater coproduction among clinicians, patients and academics to reduce the disproportionate investment in research driven by academic interests rather than NHS needs.

5.2.3. Accessing and utilising new sources of data

In the context of the growth of wearable technologies, the Internet of Things and other potential sources of large-scale datasets, respondents saw a role for coordinating bodies in negotiating access to these new sources of big data owned by private companies and in convening analytical teams with the right range of skills to interpret it for clinical and research purposes. In addition, respondents felt that a coordinating body was needed to broker and support the improvement of routine data collection in the NHS and the linkage of NHS data with external datasets.

5.3. Driving new approaches to research

5.3.1. Facilitating multi-disciplinary, collaborative research

A range of stakeholders emphasised the importance of multi-disciplinary collaboration for health research, both across academic fields and with NHS partners. This was considered particularly important in the context of the complex challenges facing health and social care, such as the management of chronic disease and the current perceived fragmentation of health, social care, public health and community services.

Respondents saw a role for research funders and coordinating bodies in providing an infrastructure linking potential collaborators and incentivising collaborative research:

> *[…] it is essential to ensure that the need for research infrastructure and support is also adequately represented in debates around the future of health and healthcare. There is a need for co-ordination across the UK's research ecosystem, and for continued international collaboration to maximise research.* (Arthritis Research UK)

The Faculty of Pharmaceutical Medicine also noted the potential value of centralised research databases among major UK funders and charities, which could act as 'one-stop shops' for researchers and facilitate learning and collaboration. Positive examples provided were the North-West Network and the Cochrane collaboration in Southampton.

Particular areas that were expected to benefit from multi-disciplinary and cross-disciplinary collaborations included research into the social determinants of health, tackling complex multi-morbidity, prevention and public health, cancer care, dementia and brain circulation (as poor brain blood flow can lead to heart failure or high blood pressure and dementia).

Furthermore, and building on similar points raised regarding enhancing research translation, some respondents also highlighted the potential benefits of enhanced collaborations and interactions between the NHS, academia and the private sector in order to develop improved drug treatments more rapidly and share best practice:

> *We hope to see more effective interaction between industry, academia and the NHS, exploiting the excellent facilities including those such as CRFs and BRCs funded by NIHR. This could lead to the identification of more effective and more acceptable drug treatments.* (Gill Dale, South London and Maudsley NHS Foundation Trust)

5.3.2. Moving beyond 'traditional' methodologies

Reflecting wider concerns shared by some respondents about the concentration of investment and focus on a biomedical model of health and care, respondents called for a move away from more traditional approaches to clinical research, such as randomised controlled trials (RCTs), towards multi-method approaches which would allow evaluations to take account of complex interactions and fluid social contexts which shape the delivery and impact of interventions. Respondents called for greater investment in qualitative research and pragmatic trials which are capable of capturing the complexities and diversity of healthcare delivery and patient experience. This shift in methodological approach was considered appropriate for a number of complex, interdependent areas in health, as one respondent described:

> *[…] many of the questions facing us in 2017 through to 2030 do not lend themselves to RCTs (or to systematic reviews of RCTs) because they address issues that are complex, context-bound and wicked. A classic example is*

multi morbidity. Another is the explosion of digital technologies. Another is the integration of health and social care. (Trish Greenhalgh, University of Oxford)

Another drawback of traditional RCTs mentioned by respondents was their inability to reflect the individual or provide data for personalised patient groups.

In addition to methodological shifts, respondents expected the digitalisation of health research to open up possibilities for the conduct of remote or online clinical trials. Respondents suggested that such approaches could increase patient recruitment and accessibility, as they would eliminate the need to travel to hospital settings. The HRA also suggested that as conducting trials becomes easier, patients and the public may be more likely to design and conduct their own trials online, potentially bypassing traditional peer review and governance structures. However, it was felt that the likelihood that such 'citizen science approaches' to trials would become widespread was overstated.

5.4. The changing nature of patient and public involvement in research

The changing nature and increasing importance of PPI for the future of healthcare and research was a prominent theme among responses across disciplines. Respondents highlighted the need for a focus not only on the level of patient and public participation – and mechanisms to support this – but also on its representativeness in order to address current perceived inequity in the involvement of different population groups. A number of academic and NIHR respondents predicted an increasing role for PPI in health research in terms of priority setting and co-commissioning. One stakeholder with a genomics background explained why PPI was considered important for research:

> *There needs to be more patient, public and health service 'pull' to balance scientific 'push' in determining the direction and nature of innovation in healthcare.* (Philippa Brice, PHG Foundation)

Representativeness in terms of socioeconomic status and ethnicity was a particular concern raised by the South London CLAHRC and others in relation to addressing inequalities in health outcomes experienced by these groups. It was stressed that specific groups, including black and minority ethnic groups, were currently underrepresented in research in general, as well as in specific areas such as dementia. Ensuring improved participation was seen as important to determining culturally appropriate ways to increase uptake of healthcare services in these groups and reducing stigma. It was argued that new ways of influencing patient and public involvement would be needed to reduce the risk of increasing health inequalities:

> *[…] giving communities the opportunity to develop 'collective control' - the feeling of empowerment generated through collective activity - is one of the most effective ways of addressing health inequalities.* (Daniel Pearmain, People's Health Trust).

Other respondents highlighted the need to include older populations more meaningfully in health research in order to more effectively address the complex nature of chronic illness and multi-morbidities and develop appropriate services to manage them. For instance, public health stakeholders felt that the very old, who carry additional risks associated with frailty or severe cognitive impairment, are underrepresented in research on dementia.

6. Discussion

This report has synthesised a wide range of stakeholder views from survey respondents on the challenges, opportunities, trends and changes likely to shape health and healthcare in England in the coming decades, in order to inform the strategic priorities of the NIHR and the wider research community.

The survey elicited a rich and varied dataset of responses from stakeholders representing a wide range of disciplines and fields (see Appendix 2 for a list of respondents who consented to be named). Findings related to views on the opportunities and challenges facing health and social care in the future, as well as priorities for research and the research infrastructure in responding to this predicted future.

Key anticipated trends in population health include the impact of an ageing population living longer but not necessarily in better health; rising health inequalities and the increasing impact of unhealthy lifestyle choices; increases in the burden of mental health, especially among younger and older people; and increased concerns around changing patterns of disease as a result of AMR and environmental factors. Transformations in health systems and services were expected to interact with these trends in a number of ways. Moves towards more holistic models of care and prevention, supported by more multi-disciplinary team working among health and social care professionals, may address some of the challenges faced by older patients with complex needs. Advances in technology, medical science and data availability may enable the roll-out of new approaches to health and social care delivery, such as enhanced prevention and self-management and personalised medicine. However, some respondents were concerned that they risked exacerbating inequalities in health as well as driving increased demand from the 'worried well' and doubted that the major transformations predicted by some could be widely implemented in the near future.

Indeed, while the transformative potential of technology and the digital revolution was a theme with overarching and cross-cutting importance, it was underpinned by a tension between a perceived overemphasis on expensive novel technologies and treatments on one hand, and the need for greater investment in public health and low-cost, community-based health strategies on the other. Calls for a broader, more holistic approach, taking account of the health impacts of lifestyle and social factors, resonated with a widely mentioned imperative to move towards more multi-disciplinary research and pragmatic research methodologies, which are capable of taking account of complex social challenges and contexts. With an ageing population that is increasingly in need of holistic and low-level care, these tensions and debates are likely to persist. Other key areas where significant divergence was visible in respondents' views included predictions regarding the future consolidation of healthcare in hospitals versus the expansion of provision in the community, and perceptions of the future threat of AMR.

In addition to the ageing population, the health and wellbeing of children and young people and the socioeconomically disadvantaged were also cross-cutting across themes and were raised by respondents from a wide range of fields. Respondents expressed concerns over increasing physical and mental health challenges that these population groups were likely to face and underlined the need for future health and social care services to cater to their specific needs in order to avoid the continued exacerbation of health inequalities.

Priorities for research put forward by respondents mapped closely onto views on key trends and challenges for health and social care systems. Priorities included continued progress in developing new technologies and treatments, improving the effectiveness and cost-effectiveness of health and social care interventions, and a better understanding of trends and the social context within which they occur. As key actors in shaping the research infrastructure required to deliver on these priorities, respondents emphasised the pivotal role of health funders and coordinating bodies in overseeing and investing in programmes which underpin relevant and high-quality health research. Key among these programmes of work were promoting patient and public involvement and ensuring that research was primed to respond to and benefit from shifts in the wider data and technology landscape.

These findings make a valuable contribution to recent international and UK-focused literature on health futures, and support the established emphasis placed on specific key drivers and future trends. These include population health and demographic trends projected to place a strain on health services over the next 30 years, such as an increasing prevalence of obesity among UK adults (Wang et al. 2011), and an ageing population living longer and facing an increasing incidence of multi-morbidities (Age UK, 2017; Academy of Medical Sciences 2016) and dementia (Thuné-Boyle et al. 2010). Our findings also support predictions related to the transformative capacity of new technologies and science, tempered by complex social and institutional factors (Thimbleby, 2013; Durrani, 2016) and the projected impact of environmental factors such as climate change on the health of the population (Oven et al. 2012). However, previous research has largely taken a field-specific approach, and by bringing together multi-disciplinary perspectives, elicited in a non-restrictive way, this study has provided a uniquely holistic and comprehensive picture of the full diversity of expected drivers and trends, as well as shedding some light on how they may interact to produce the health and social care landscape of the coming decades.

Some limitations to this research should be noted. In order to maximise the reach of the survey and minimise any potential bias in the selection of invitees, contacts were encouraged to circulate the questionnaire among their own networks. As a result of this, it was not possible to establish the total number of stakeholders invited to participate or the response rate. Furthermore, the survey used open questions to elicit diverse perspectives and minimise the influence of researchers' preconceptions. In addition, while the future of healthcare is closely entwined with that of social care, and the respondent group included experts in the social care field, the survey questions did not explicitly elicit views on social care. A potential negative outcome of this approach could be that respondents may have neglected to raise issues that they considered important (such as social care), and therefore the absence of evidence does not indicate lack of importance.

Another limitation relates to samples, which were not intended to be representative; rather, they aimed to cover as full a range of professions and disciplines as possible. A higher or lower number of people

expressing a view may also result from a particular group being overrepresented or underrepresented. Additionally, it was not possible to weight responses or to test shared agreement or disagreement on particular issues. However, by synthesising the data across multiple responses and, where possible, indicating differences in views among stakeholder groups, this challenge has been overcome to some extent. Further participatory research should test the areas identified to weight relative importance of issues and to explore priority setting for research across disciplines. Findings from the present study would provide a valuable basis for defining the parameters of such research.

The findings of this study validate a number of prominent priorities visible in current health research and policy in England (NIHR, 2017), with a good deal of consensus across the range of respondents. These include AMR, the increasing challenge of dementia and age-related multi-morbidity, digital health and genomics. Emphasis on these and other themes, such as mental health, health inequalities and transforming health service models, cut across disciplinary boundaries. However, it is clear that there is divergence in views on the relative importance of these areas of focus, such as the threat of AMR and dementia and the promise of widely discussed advancements in technology and genomics medicine, as well as on the best approach to managing their emergence in the coming decades. In addition, certain priority areas have been mentioned by only a single respondent or a small minority. For example, tensions were visible between desires for future investment and emphasis on expensive, cutting-edge treatments and technologies in specialist care on one hand, and the perceived necessity of shifting emphasis away from the biomedical model to low-cost prevention, public health and community-based solutions on the other. It will be important for the health research community, its funders and its coordinating bodies to leverage this diversity of views in strategic discussions going forward in order to ensure that it benefits from the challenge and innovation offered by the dissenting, varied and minority viewpoints present.

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Appendix 1: Survey questionnaire

'Health Futures' survey

Thank you for participating in this survey on behalf of the National Institute for Health Research (NIHR). The NIHR is interested in gathering key stakeholder views on the future of health and healthcare in England in 20-30 years' time. By engaging experts from a variety of fields, we hope to capture both pervasive views and unique insights on key trends, shifts and drivers which will affect health and healthcare in the future, whether economic, social, technological, environmental or otherwise. The survey questions are deliberately broad and open, in order to capture nascent thinking and a wide diversity of stakeholder views.

The survey and its analysis are being conducted by researchers at RAND Europe, Cambridge, on behalf of the NIHR.

Your participation

The survey consists of five substantive questions. All responses are given via open text boxes. You are not required to answer all of the questions.

The findings of this research will be published in a report on the NIHR website and disseminated to all participants.

Please complete and submit your responses by Friday 16th June 2017.

Please click the 'next' button to proceed to the survey.

If you start the survey and do not have the opportunity to finish, simply click on your link in the email and begin where you left off, your answers will have been saved.

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Questionnaire

A. Data confidentiality and consent for public attribution

Thank you for taking the time to complete this survey. We would like to request your permission to acknowledge your participation in the study and for attributed quotations from

your responses to be shared, both in the final report and on the NIHR website. If you would prefer to keep your participation private, you are entirely free to do so and no reference to your name, gender or organisation will be made in the published findings. In this case, your responses will be available only to relevant parties at RAND Europe and the Department of Health.

All survey data will be transferred securely and stored electronically in a secured file.

1. Do you permit RAND Europe to acknowledge your participation in the study (i.e. name and affiliation) in the public report which emerges from this research?

Yes/No

2. Do you permit RAND Europe and the NIHR to publish your responses verbatim on the NIHR website and publicly attribute quotations from your responses to you in the final report?

Yes/No

B. Introduction

We would like to begin by asking you a bit about yourself. If you have indicated that you would like your participation in this survey to remain private, the information you provide below will be treated confidentially.

3. Please provide your name in the box below (name and surname).

[Text box]

4. Please indicate if you are responding to this survey as a private individual or in your professional capacity as a representative of an organisation.

   a) Private individual
   b) Professional representative

5. Please provide the name of the organisation(s) you are primarily affiliated with.

If you are responding to this survey in your professional capacity, please provide the name of the organisation(s) of behalf of which you are responding.

[Text box]

6. What is your current position in this organisation?

[Text box]

C. The future of health and healthcare in England: insights on your area of interest

In this section, we would like to hear about your views on the future of health and healthcare in England with reference to your own specific field. There are no 'right' answers to these questions, and we are interested in capturing wide-ranging views. All responses have a 2,500 character limit (not including spaces).

7.   In relation to your area of interest (discipline or geography), what differences do you foresee in the state of health and provision of healthcare in England in 20-30 years' time? In your answer, please consider if/how these changes might affect some populations (within England) differently to others, i.e. socioeconomic, ethnic groups and/or geographic groups.

Your response could include (but is not limited to) issues relating to epidemiology, health services, technology, treatment and prevention.

[Text box with 2,500 character limit]

8.   What do you think will be the key drivers of the changes you have described?

Drivers might be (but are not limited to) scientific, environmental, technological, social and economic factors.

[Text box with 2,500 character limit]

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D. The future of health and healthcare in England: wider insights

In this section, we would like to hear about your views on the future of health and healthcare in a broader sense, potentially going beyond your specific field of interest to consider wider trends and insights which may affect health and healthcare in England.

9.   In your view, what will be the major trends in health and healthcare in England over the next 20-30 years?

Responses may include (but are not limited to) technological, epidemiological, behavioural, health services, policy or regulatory trends.

[Text box with 2,500 character limit]

10.   Are there any commonly discussed issues related to the future of health and healthcare in England which you believe to be overstated? If so, why do you believe them to be overstated?

[Text box with 2,500 character limit]

11. Are there any issues that are underrepresented in the debates around the future of health and healthcare in England? If so, please describe them and explain why you think merit greater attention.

[Text box with 2,500 character limit]

FINAL PAGE

Thank you for participating in this survey – your responses will be valuable to the NIHR.

Should you have any questions about this survey please feel free to contact Jennie Corbett at RAND Europe (jcorbett@rand.org) or FoH@dh.gsi.gov.uk.

Appendix 2: List of survey respondents

The following table reports the name, the responding capacity and the affiliation of those respondents who acknowledged their participation. Although the reported information is copied verbatim from respondents' inputs, in some cases professional representatives did not clearly highlight if they were responding on behalf of their institution or group.

Table 3. List of survey respondents

Respondent name	Responding in what capacity?	Reported primary organisational affiliation(s)
Alex Hulme	Professional representative	Academy of Medical Sciences
Robert J Moots	Professional representative	Aintree University Hospital NHS Foundation Trust
Alzheimer's Research UK	On behalf of an institution/group	
Ameet Bakhai	Private individual	Amore Health Limited
Catherine Meads	Private individual	Anglia Ruskin University
Arthritis Research UK	On behalf of an institution/group	
Stuart White	Private individual	Association of Anaesthetists Great Britain and Ireland; Royal College of Anaesthetists
Sheuli Porkess	Professional representative	Association of British Pharmaceutical Industry
Association of Directors of Public Health	On behalf of an institution/group	
Association of Medical Research Charities	On behalf of an institution/group	
Dag Aarsland	Professional representative	Biomedical Research Centre For Dementia
Birmingham Health Partners	On behalf of an institution/group	
Jane West	Professional representative	Bradford Institute for Health Research
Anne Heaven	Private individual	Bradford Institute for Health Research

Sally Greenbrook	Professional representative	Breast Cancer Now
Hugo Critchley	Professional representative	Brighton and Sussex Medical School
John C Kingswood	Professional representative	Brighton and Sussex University Hospitals Trust
Amanda Roberts	Private individual	British Association of Dermatologists
British Computer Society	On behalf of an institution/group	
John Wallworth	Professional representative	British Computer Society
Adam Gordon	Professional representative	British Geriatrics Society
Lee Page	Professional representative	British Pharmacological Society
Chris Lowry	Professional representative	British Society for Immunology
Matthew Brookes	Professional representative	British Society of Gastroenterology
Carol Brayne	Professional representative	Cambridge Institute of Public Health
Theresa Marteau	Professional representative	Cambridge Institute of Public Health
Paul Pharoah	Professional representative	Cambridge Institute of Public Health
Andrew Grace	Private individual	Cambridge University Health Partners
Yafeng Cheng	Professional representative	Cambridge University, Medical Research Council Biostatistics Unit
Susan Michie	Professional representative	Campaign for Social Science
Cancer Research UK	On behalf of an institution/group	
Sue Adams	Professional representative	Care and Repair England
Martin Burton	Professional representative	Cochrane UK
Upeka De Silva	Professional representative	Compassion in Dying
Kausik Chatterjee	Private individual	Countess of Chester NHS Foundation Trust
Judith Pashley	Private individual	Cromwell Place surgery
Joanne Hubbold	Private individual	Cumbria Partnership NHS Foundation Trust
Jonathan Batchelor	Private individual	Derby Teaching Hospitals NHS Foundation Trust
Elizabeth Robertson	Professional representative	Diabetes UK, Diabetes Clinical Studies Group
David Pitches	Private individual	Dudley Metropolitan Borough Council
Kani Varshneya	Professional representative	Dudley Public Health Registrars
Engineering and Physical Sciences Research Council	On behalf of an institution/group	
Chuck Cook	Professional representative	European Molecular Biology Laboratory - European Bioinformatics Institute
Mike Clarke	Private individual	Evidence Aid; Queen's University Belfast; Cochrane UK
Nigel Hewett	Professional representative	Faculty for Homeless and Inclusion Health
Anna Batchelor	Professional representative	Faculty of Intensive Care Medicine; Critical Care Leadership Forum

Faculty of Pharmaceutical Medicine	On behalf of an institution/group	
Faculty of Public Health	On behalf of an institution/group	
Alastair Kent	Professional representative	Genetic Alliance UK
John Chisholm	Professional representative	Genomics England
Christine Pierce	Private individual	Great Ormond Street Hospital
Guy's and St Thomas' NHS Foundation Trust	On behalf of an institution/group	
Finbarr Martin	Private individual	Guy's and St Thomas' NHS Foundation Trust
Mark Holloway	Professional representative	Head First
Health Research Authority	On behalf of an institution/group	
Edward Nash	Professional representative	Heart of England NHS Foundation Trust
Richard Mupanemunda	Private individual	Heart of England NHS Foundation Trust
Iyad Ismail	Professional representative	Heart of England NHS Foundation Trust
Joanne Reeve	Private individual	Hull and York Medical School
Claire Merrifield	Private individual	Imperial College Healthcare NHS Trust
Nick Bosanquet	Professional representative	Imperial College London
Eric Alton	Private individual	Imperial College London
Derek Bell	Private individual	Imperial College London
Paul M Matthews	Private individual	Imperial College London
Imperial College London, Biomedical Research Centre	On behalf of an institution/group	
Ian Campbell	Professional representative	Innovate UK
Institute of Biomedical Science	On behalf of an institution/group	
Martin Leach	Private individual	Institute of Cancer Research
Katharine Knox	Professional representative	Joseph Rowntree Foundation
Elaine Hay	Professional representative	Keele University, Primary Care and Health Sciences
Lee Tomlinson	Professional representative	Kent Community Health NHS Foundation Trust
Lucy Chappell	Private individual	King's College London
Steven Kiddle	Private individual	King's College London
Ndaba Mazibuko	Professional representative	King's College London
Kirsty Winkley	Professional representative	King's College London
Matthew Hotopf	Professional representative	King's College London
Louise Howard	Professional representative	King's College London, Section of Women's

		Mental Health
Rory O'Conor	Private individual	Kirklees Council; Public Health England
Philip Brown	Private individual	Lancashire Care Foundation NHS Trust
Janette Rawlinson	Private individual	Lay member on several healthcare and health research bodies
Jacqueline Andrews	Professional representative	Leeds Teaching Hospitals NHS Trust
Liverpool Health Partners	On behalf of an institution/group	
Stephen Turrell	Private individual	Local Authority
Ruth Ponsford	Professional representative	London School of Hygiene and Tropical Medicine
Anne Clayson	Professional representative	Manchester Metropolitan University
Sabine Best	Professional representative	Marie Curie
Kruti Shrotri	Professional representative	Medical Schools Council; Association of UK University Hospitals
Ian Hudson	Professional representative	Medicines and Healthcare Products Regulatory Agency
Essam Abdulhakim	Private individual	Medinova
Jenny Edwards	Professional representative	Mental Health Foundation
Karin Oien	Professional representative	National Cancer Research Institute Cellular Molecular Pathology Initiative
Martin Allaby	Private individual	NICE
Gillian Leng	Professional representative	NICE
Julie Royce	Professional representative	NICE
Rosie Lovett	Professional representative	NICE
Jeremy Wight	Private individual	NICE
Hannah Patrick	Professional representative	NICE Centre for Health Technology Evaluation
Doug Turnbull	Private individual	Newcastle University
David Burn	Private individual	Newcastle University
Liam Spencer	Private individual	Newcastle University
Avan Sayer	Private individual	Newcastle University
Hywel Williams	Professional representative	NHS
Ifor Evans	Private individual	NHS
Nicholas Watkins	Professional representative	NHS Blood and Transplant
Celia Ingham Clark	Private individual	NHS England
Jean O'Hara	Professional representative	NHS England
Anjan Banerjee	Private individual	NHS; Care UK
Helen Compton	Professional representative	NIHR, Central Commissioning Facility
Kathryn Abel	Professional representative	NIHR CRN
NIHR CRN Health Services	On behalf of an	

Research National Specialty Group	institution/group	
NIHR CRN, National Specialty Group for Primary Care	On behalf of an institution/group	
Anne GM Schilder	Professional representative	NIHR CRN, Ear, Nose and Throat; Cochrane UK; Royal College of Surgeons
Paul Dark	Professional representative	NIHR CRN Critical Care Specialty Group
Cheng-hock Toh	Professional representative	NIHR CRN Haematology
Matthew Costa	Professional representative	NIHR CRN Injuries and Emergencies Specialty Group
Jane West	Professional representative	NIHR CRN Public Health National Specialty Group
NIHR CRN Specialty Group and the National Institute of Academic Anaesthesia	On behalf of an institution/group	
Mark Hull	Professional representative	NIHR CRN, Gastroenterology National Specialty Group
NIHR CLAHRC South London	On behalf of an institution/group	
Rosalind Raine	Professional representative	NIHR CLAHRC North Thames
Mark Gabbay	Professional representative	NIHR CLAHRC North West Coast
Ganesh Sathyamoorthy	Professional representative	NIHR CLAHRC Northwest London
Anne Rogers	Professional representative	NIHR CLAHRC Wessex
Jenny Donovan	Professional representative	NIHR CLAHRC West
Deb Smith	Private individual	NIHR CLAHRC West Midlands
Helen Walters	Professional representative	NIHR Evaluation and Trials Coordinating Centre
Public Members of the NETSCC, Patient and PPI Reference Group	Professional representative	NIHR Evaluation, Trials and Studies Coordinating Centre (NETSCC)
Ed Macalister-Smith	Private individual	NIHR Health Services and Delivery Research; University Hospitals Coventry and Warwickshire NHS Trust; Care Quality Commission and Cotswolds Area of Outstanding Natural Beauty
Peng T Khaw	Professional representative	NIHR Moorfields Biomedical Research Centre
Guruprasad P Aithal	Professional representative	NIHR Nottingham Biomedical Research Centre, Gastrointestinal and Liver disorder Theme
Philip Kalra	Professional representative	NIHR Renal Disorders group; UK Kidney Research Consortium
Dave Green	Private individual	NIHR Research led board
Richard Hobbs	Professional representative	NIHR School for Primary Care Research; University of Oxford, The Nuffield Department of Primary Care Health Sciences

Martin Knapp	Professional representative	NIHR School for Social Care Research
Peter Thompson	Professional representative	NIHR Trainees Coordinating Centre
Lesley Pattenson	Private individual	Northfield Stroke Club; Pink Sou'westers LGBT network
Nuffield Council on Bioethics	On behalf of an institution/group	
Oxford AHSN on behalf of the AHSN Network	On behalf of an institution/group	
Daniel Pearmain	Professional representative	People's Health Trust
Philippa Brice	Professional representative	PHG Foundation
Roberto Sans	Private individual	Plymouth Hospitals NHS Trust
Corinna Mossop	Professional representative	Plymouth Hospitals NHS Trust
Debby Lennard	Private individual	PPI and lay member of various research projects; NIHR boards; Cancer Research UK
Phillippa Cook	Private individual	Private Individual
Martyn Regan	Private individual	Public Health England
Bernie Hannigan	Private individual	Public Health England
Vicki Chalker	Professional representative	Public Health England
Aysegul Dirik	Private individual	Queen Mary University of London
Rupert Pearse	Private individual	Queen Mary University of London
James H Naismith	Professional representative	Research Complex at Harwell
Bill Sang	Private individual	Retired
Amanda Matse-Orere	Professional representative	Roche Diagnostics Ltd
Alasdair Gray	Professional representative	Royal College of Emergency Medicine Research Committee
Louise Silverton	Professional representative	Royal College of Midwives
Claire Dunn	Professional representative	Royal College of Obstetricians and Gynaecologists
Mandy Sainty	Professional representative	Royal College of Occupational Therapists
Martin Ward-Platt	Private individual	Royal College of Paediatrics and Child Health
Royal College of Paediatrics and Child Health	On behalf of an institution/group	
Royal College of Physicians	On behalf of an institution/group	
Hugo Critchley	Professional representative	Royal College of Psychiatrists, Academic Faculty
Peter Hindley	Professional representative	Royal College of Psychiatrists, Faculty of Child and Adolescent Psychiatry
Royal College of Radiologists	Professional representative	Royal College of Radiologists
Martin James	Professional representative	Royal Devon and Exeter NHS Foundation Trust

Jeanne Carlin	Private individual	School for Social Care Research
Sonia Saxena	Professional representative	School of Public Health, Imperial College London
Science and Technology Facilities Council (STFC)	On behalf of an institution/group	
June Andrews	Professional representative	Sedaca Ltd; University of Stirling
Shona Kelly	Private individual	Sheffield Hallam University
Andrew Cash	Professional representative	Sheffield Teaching Hospitals NHS Foundation Trust
Sarah Weld	Private individual	South Gloucestershire Council - Public Health and Wellbeing Division
Gill Dale	Professional representative	South London and Maudsley NHS Foundation Trust
Marianne Plater	Private individual	Southern Health
Peter Whincup	Professional representative	St George's, University of London
Steve Gillard	Professional representative	St George's, University of London, Mental Health Research Group
Katherine Daniels	Private individual	Swindon Borough Council
Andrew Walden	Professional representative	Thames Valley Local CRN critical care specialty group
Peter Ratcliffe	Professional representative	The Francis Crick Institute
Jennifer Dixon	Professional representative	The Health Foundation
Natalie Lovell	Professional representative	The Health Foundation
Natalie Lovell	Professional representative	The Health Foundation
The Natural Environment Research Council	On behalf of an institution/group	
Chris Brookes	Private individual	UK Health Forum
Danielle Costigan	Professional representative	UK Health Forum
Paul Lincoln	Private individual	UK Health Forum
Modi Mwatsama	Professional representative	UK Health Forum
David Kidney	Professional representative	UK Public Health Register
Tanweer Ahmed	Professional representative	United Lincolnshire Hospitals NHS Trust
Harry Hemingway	Professional representative	University College London
Michael Bloomfield	Private individual	University College London
Ruth Gilbert	Professional representative	University College London
Martin Marshall	Private individual	University College London
Stuart Taylor	Private individual	University College London
Detlef Bockenhauer	Private individual	University College London
Glyn Lewis	Private individual	University College London
Greta Rait	Private individual	University College London

Marcel Levi	Professional representative	University College London Hospitals NHS Foundation Trust
Francesco Muntoni	Private individual	University College London, Great Ormond Street, Institute of Child Health
University College London, Great Ormond Street, Institute of Child Health	On behalf of an institution/group	
Claudia Estcourt	Professional representative	University College London, i-sense
Anne Johnson	Professional representative	University College London, i-sense
Rachel McKendry	Professional representative	University College London, i-sense
Pam Sonnenberg	Professional representative	University College London, i-sense
Jo Gibbs	Professional representative	University College London, i-sense
Soazig Clifton	Professional representative	University College London, i-sense
David Wynick	Professional representative	University Hospitals Bristol NHS Foundation Trust
Martin O Weickert	Private individual	University Hospitals Coventry and Warwickshire NHS Trust
Peter Searle	Private individual	University of Birmingham
Fang Gao	Professional representative	University of Birmingham, Perioperative, Critical Care and Trauma Trials Group; College of Medical and Dental Sciences
Eric Deeson	Private individual	University of Birmingham; University Hospitals Birmingham NHS Foundation Trust
Ann Moore	Private individual	University of Brighton; The Council for Allied Health Professions Research
Dimitrios Siassakos	Private individual	University of Bristol
John Iredale	Professional representative	University of Bristol
Athene Lane	Private individual	University of Bristol
Patrick Chinnery	Private individual	University of Cambridge
Martin White	Private individual	University of Cambridge, Medical Research Council Epidemiology Unit; NIHR School of Public Health Research
Leanne Miller	Private individual	University of East Anglia; Norfolk and Norwich University Hospital NHS Trust
Jenni Harrison	Private individual	University of Edinburgh
Jose M Valderas	Private individual	University of Exeter
Stuart Logan	Private individual	University of Exeter Medical School
Tamsin Ford	Private individual	University of Exeter Medical School
David Richards	Private individual	University of Exeter; European Academy of Nursing Science
Sally Wyke	Private individual	University of Glasgow
Linsay Gray	Professional representative	University of Glasgow, Medical Research Council; Scottish Government, Social and Public

		Health Science
Diane Fox	Private individual	University of Kent
Ann-Marie Towers	Private individual	University of Kent, Personal Social Services Research Unit
S. Kilminster	Private individual	University of Leeds
Mary Madden	Private individual	University of Leeds
Alexandra Gilbert	Professional representative	University of Leeds
Samantha Crossfield	Private individual	University of Leeds
University of Leeds, School of Medicine	On behalf of an institution/group	
Matt Bown	Professional representative	University of Leicester
Liz Prendergast	Professional representative	University of Liverpool
David Taylor-Robinson	Private individual	University of Liverpool
Liz Prendergast	Professional representative	University of Liverpool
Nicky Cullum	Private individual	University of Manchester
David Challis	Private individual	University of Manchester, Personal Social Services Research Unit
Eileen Kaner	Professional representative	University of Newcastle upon Tyne
Jim Thornton	Private individual	University of Nottingham
John Atherton	Private Individual	University of Nottingham, Faculty of Medicine and Health Sciences
Bee Wee	Private individual	University of Oxford
Luke Allen	Private individual	University of Oxford
Trish Greenhalgh	Private individual	University of Oxford
Michael Sharpe	Private individual	University of Oxford
Marian Knight	Private individual	University of Oxford
Tim Skerry	Private individual	University of Sheffield
Jon Nicholl	Private individual	University of Sheffield
Ilaria Bellantuono	Private individual	University of Sheffield
Neil Harris	Professional representative	University of Sheffield
Steve Goodacre	Professional representative	University of Sheffield, Centre for Urgent and Emergency Care Research (CURE)
Marco Viceconti	Private individual	University of Sheffield, Insigneo Institute; Sheffield Teaching Hospital NHS Foundation Trust
Fiona Lecky	Private individual	University of Sheffield; University of Manchester; Salford Royal NHS Foundation Trust
Jeremy Wyatt	Private individual	University of Southampton
Mike Thomas	Private individual	University of Southampton
University of Southampton,	On behalf of an	

Medical Research Council Lifecourse Epidemiology Unit	institution/group	
Saul Faust	Private individual	University of Southampton; University Hospital Southampton NHS Foundation Trust
Philip Evans	Private individual	University of Surrey; The National Cancer Research Institute (NCRI), Clinical and Translational Radiotherapy Research Working Group (CTRad)
Jim McCambridge	Private individual	University of York
Paul Tiffin	Private individual	University of York
Mary Nettle	Private individual	Various as mental health user consultant
Helen Atherton	Professional representative	Warwick Medical School
Aileen Clarke	Professional representative	Warwick Medical School, Centres for Leadership in Applied Health Research; Care West Midlands, Prevention and Detection theme
Jacqui Gath	Private individual	Yorkshire and Humber NHS Genomic Medicine Centre; Independent Cancer Patients' Voice
John Cordwell	Private individual	
Anita Patel	Private individual	
Charles Wallace	Private individual	
Matthew Gillman	Private individual	
Kyla Thomas	Private individual	
Carol Sinnott	Private individual	
Andrew Pratt	Private individual	
Helen Burchmore	Private individual	
Annette Smith	Private individual	