

Summary

Ageing is a biological process that, if we are fortunate enough to avoid premature fatal illness or accident, affects each one of us. Any changes or developments in age-related policy or research are therefore relevant to all in society. Life expectancy has substantially increased, but healthy lifespan has not kept pace, resulting in an ageing society where people are spending more time in poor health during older age.¹ The UK Government recognises the issues surrounding our ageing society in the proposal of its Healthy Ageing Grand Challenge – which aims to ensure that all of us experience at least 5 extra healthy years of life by 2030.² To maximise the effectiveness of any policy intervention or research innovation implemented to help achieve this goal, the key challenges of ageing must first be identified and clearly defined. The Academy welcomes the Government's ambitious goal, but recognises the ethical components of the challenge, including intergenerational fairness, health inequalities and the tension between developing medical and non-medical interventions. To address the many ageing challenges that exist and promote healthy ageing, our response focusses on the following:

- **Prevention:** Renewed importance has been placed on prevention by the NHS and the UK Government, with preventative measures being a key focus of the NHS Long-Term Plan and the new Office for Health Promotion within the Department of Health and Social Care.^{3,4} Shifting from a reactive to a proactive mindset, encouraging health promoting environments, supporting the adoption of healthy behaviours and improving early disease detection and diagnosis is predicted to improve the health and wellbeing of the population long term in a cost-effective manner for the NHS, increasing healthy lifespan.⁵
- **Managing Multiple Long-Term Conditions (MLTC)⁶:** There is a high prevalence of MLTC in the older population. By approaching health and social care more holistically – treating the whole patient and their overlapping conditions at once, rather than one disease at a time – current healthcare systems would be better able to deal with the unique challenges arising from providing healthcare services to older people with MLTC. To facilitate this, interdisciplinary working between clinicians and researchers from different specialities and fields must be promoted, including by further integration of research in healthcare settings.
- **Inclusion of older people in clinical trials:** Many older patients, often with MLTC, are currently excluded from clinical trials, rendering data derived from such trials less representative of and less relevant to such patients. It is important to explore how post-marketing and real-world evidence can be used to provide a firmer evidence base on drug efficacy and safety for older patients with MLTC and to look for ways to safely include these patients in clinical trials.^{7,8,9,10}
- **Patient and Public Involvement (PPI):** Taking a more inclusive approach to PPI is essential to align research and policy with the specific requirements and concerns of the older population. Work from the Academy reveals that there is a desire among the public

¹ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

² UK Government, Department for Business, Energy & Industrial Strategy. *The Grand Challenge missions*. <https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions> [accessed 8 July 2021]

³ NHS (2019). *The NHS Long-Term Plan*. <https://longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf>

⁴ UK Government (2021). *New Office for Health Promotion to drive improvement of nation's health*. <https://www.gov.uk/government/publications/transforming-the-public-health-system/transforming-the-public-health-system-reforming-the-public-health-system-for-the-challenges-of-our-times>

⁵ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snippet/uploads/5807581429f81.pdf>

⁶ The term 'Multiple Long-Term Conditions (MLTC)' is defined as the co-existence of two or more chronic conditions in one individual. Also referred to as 'multimorbidity' in other pieces of Academy work.

⁷ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

⁸ The Academy of Medical Sciences (2021). *Response to the DHSC's Women's Health Strategy Call for Evidence*. <https://acmedsci.ac.uk/file-download/22836484>

⁹ The Academy of Medical Science (2019). *Cross-funder multimorbidity research framework*. <https://acmedsci.ac.uk/file-download/49628715>

¹⁰ The Academy of Medical Sciences (2018). *Next steps for using real world evidence*. <https://acmedsci.ac.uk/file-download/7021031>

to be involved in the R&D process.¹¹ Promoting the involvement of both patients and the public can help shape the research agenda, influence funding decisions and help identify ethical and practical concerns in studies to ensure research addresses patients' needs.¹² By involving the older population in both the R&D process and during policy development, the effectiveness of interventions designed to improve health outcomes as we age could be maximised.

- **Health inequalities:** There is a large social gradient in health outcomes, with significantly higher healthy life expectancy observed in individuals living in the most compared with the least affluent areas of the country.^{13,14} Policy and interventions should be developed and implemented to reduce this gap and to strive towards addressing such inequalities.

Introduction

The Academy of Medical Sciences promotes advances in biomedical and health research and supports efforts to translate these advances into healthcare benefits for society. In June 2021, the Nuffield Council on Bioethics opened a [call for evidence](#) to inform the specific challenges of ageing research and healthcare, with special consideration given to reducing health inequalities and developing an inclusive framework with respect to healthcare and research settings. Our response is based on our previous policy work across a broad range of topics with relevance to the future of ageing. Our previous policy work was informed by the expertise of our Fellowship, which includes some of the UK's foremost experts in clinical and academic medical research. The consultation asked for evidence on 10 questions.¹⁵ Our response focusses on questions 2 and 4-10.

The advantages of taking a more inclusive approach (e.g. in design, in healthcare, in wider social policy) to 'design in' the needs of older people to mainstream approaches (Question 2)

- 1.1 Ageing is a process that affects the entire population, so ageing policies should take an inclusive life course approach to promote healthy ageing. This involves intervening throughout life to create health promoting environments, encourage healthy behaviours, and prevent age-related conditions or diagnose them as early as possible.¹⁶ One advantage of taking a life course approach is that intervening early in life presents an opportunity to predict and possibly prevent future illness. For example, providing preventative care to women postnatally can prevent health conditions in later life, with regular pelvic floor exercises performed by new mothers postnatally preventing urinary incontinence in old age.^{17,18} In another example, preventing people from ever smoking could reduce their risk of dying from lung cancer by 15 times compared to smokers.^{19,20} Therefore, preventative interventions to achieve healthy ageing should be inclusive of, but not exclusive to, older populations. As discussed at the Academy/Royal Society *Healthy Ageing* conference in 2020, effective policy to promote healthy ageing should incorporate early social interventions in younger populations to yield improved health outcomes in later life.²¹ For example, monitoring biomarkers for Alzheimer's disease during young adulthood

¹¹ The Academy of Medical Sciences (2019). *From subjects to partners: putting patients at the heart of medical research*. <https://acmedsci.ac.uk/file-download/95794119>

¹² National Institute for Health Research (2009). *Exploring impact: public involvement in NHS, public health and social care research*. <http://www.invo.org.uk/wp-content/uploads/2012/01/INVOLVEexploringimpactSummary2009.pdf>

¹³ The Academy of Medical Sciences (2016). *Influencing the trajectories of ageing*. <https://acmedsci.ac.uk/snip/uploads/58521f0caf63a.pdf>

¹⁴ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

¹⁵ Nuffield Council on Bioethics (2021). *The future of ageing: responding to our call for evidence*. <https://www.nuffieldbioethics.org/publications/the-future-of-ageing/call-for-evidence> [accessed 13 July 2021]

¹⁶ The Academy of Medical Sciences (2019). *Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'*. <https://acmedsci.ac.uk/file-download/8511369>

¹⁷ The Academy of Medical Sciences (2021). *Response to the DHSC's Women's Health Strategy Call for Evidence*. <https://acmedsci.ac.uk/file-download/22836484>

¹⁸ Woodley SJ, et al. (2020). *Pelvic floor muscle training for prevention and treatment of urinary and faecal incontinence in antenatal and postnatal women*. Cochrane Database of Systematic Reviews **5**, CD007471.

¹⁹ Cancer Research UK (n.d.). *Lung Cancer Risk*. <https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer/risk-factors#heading=Two> [accessed 30 July 2021]

²⁰ Doll R, et al. (2005). *Mortality from cancer in relation to smoking: 50 years observations on British doctors*. British Journal of Cancer **92**(3), 426-429.

²¹ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing* <https://acmedsci.ac.uk/file-download/35061800>

(30-40s) can enable disease pathology to be observed before symptom presentation occurs.²² This kind of life course approach could be utilised to gain a more holistic understanding of complex disorders such as Alzheimer's disease, identify previously-unknown drug targets that may present at early stages of disease pathology, and be used to inform patients of interventions they could take to reduce the risk of, or delay, disease progression.²³

- 1.2 There is a strong correlation between age and prevalence of multiple long-term conditions (MLTC) with high incidences of MLTC observed in older people across the world, in low-, middle- and high-income countries.^{24,25,26} Patients with MLTC are often prescribed multiple drugs simultaneously, putting them at risk of inappropriate polypharmacy. Moreover, MLTC patients are commonly excluded from clinical trials (see section 5), resulting in drug efficacy and safety data being less relevant for such patients.²⁷ Both of these factors increase the likelihood of adverse drug reactions and interactions.²⁸ MLTC patients are too often excluded from various aspects of healthcare and research that would benefit from their inclusion.
- 1.3 Health inequalities are observed between many groups across society, often exerting significant effects on the likelihood of developing age-related conditions. For example, socioeconomic health inequalities are observed from the earliest stages of life, with higher infant mortality rates observed in babies born in the most deprived regions of England when compared to the least deprived.²⁹ These discrepancies continue to be observed in later life, manifesting as differences in healthy life expectancy (see section 6.2)³⁰. Low socioeconomic status is also associated with high MLTC prevalence.³¹ By taking an approach that is inclusive of diverse groups in the design of healthcare systems, interventions, and research, these inequalities can be prioritised, tackled and minimised. An analogous inclusive approach to the various ageing challenges we face could exert a similar advantageous narrowing of health inequalities.
- 1.4 Providing an inclusive and holistic approach to both clinical and research settings would improve care provision for patients with MLTC, many of whom are older people, 'designing in' their needs to the system. Large components of healthcare systems around the world focus on specialisation and dealing with specific conditions or body systems rather than taking a holistic approach to treatment.³² Patients with MLTC report miscommunication and lack of co-ordination between the various healthcare professionals responsible for their care with poor continuity of care resulting in sub-optimal treatment for their complex healthcare issues.^{33,34} The Department of Health and Social Care's (DHSC) recent white paper outlined plans to promote both regional and UK-wide collaboration between public health, health care and social care organisations in the form of new Integrated Care Systems.³⁵ This new focus on developing a more integrated and holistic health care system that fosters greater collaboration between health and social care could lead to an environment that is more understanding of and better equipped to deal with the complex

²² *ibid*

²³ *ibid*

²⁴ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

²⁵ Violan C, et al. (2014). *Prevalence, Determinants and Patterns of Multimorbidity in Primary Care: A Systematic Review of Observational Studies*. PLoS ONE, **9**(7), e102149.

²⁶ Garin N, et al. (2016). *Global Multimorbidity Patterns: A Cross-Sectional, Population-Based, Multi-Country Study*, The Journals of Gerontology: Series A **71**(2), 205-214.

²⁷ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

²⁸ *ibid*

²⁹ Office for National Statistics (2021). *Childhood and infant mortality in England and Wales: 2019. 7. Inequalities*.

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/childhoodinfantandperinatalmortalityinenglandandwales/2019#inequalities> [accessed 27 July 2021]

³⁰ Office for National Statistics (2021). *Healthy state life expectancies by national deprivation deciles, England: 2017-2019*.

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthinequalities/bulletins/healthstateifeexpectanciesbyindexofmultipledeprivationimd/2017to2019> [accessed 27 July 2021]

³¹ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

³² *ibid*

³³ Hays R, et al. (2017). *Threats to patient safety in primary care reported by older people with multimorbidity: baseline findings from a longitudinal qualitative study and implications for intervention*. BMC Health Services Research **17**, 754.

³⁴ Schiötz ML, et al. (2016). *Involving patients with multimorbidity in services planning: perspectives on continuity and care coordination*. Journal of Comorbidity **6**(2), 95-102.

³⁵ Department of Health and Social Care (2021). *Integration and innovation: working together to improve health and social care for all*.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/960548/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-web-version.pdf

needs of older patients with MLTC, and can tackle their conditions holistically rather than individually. However, whilst containing some promising steps forward, the Academy believes the recent DHSC white paper missed an opportunity to include and integrate research into health and social care.^{36,37}

- 1.5 A holistic and inclusive form of healthcare will require interdisciplinary working between different hospital departments, between healthcare practitioners from different specialties, and between clinicians, researchers and local authorities to fully 'design in' the needs of older patients with MLTC to health and social care services and extend healthy lifespan.^{38,39} Existing organisations in the health and social care sector already host interdisciplinary teams bringing together academic researchers and public health professionals (e.g. Cambridge Institute of Public Health, University of Glasgow Institute of Health and Wellbeing), with increasing evidence highlighting that this integration of research teams across academia and healthcare has advantages, accelerating the transition of novel research developments into the clinic and improving patient health outcomes.^{40,41,42} To more fully embed research within the NHS and foster interdisciplinary collaboration between health and social care and academia, the Academy made a series of recommendations in its report, *Transforming health through innovation: Integrating the NHS and academia*. These included supporting higher education institutions in increasing the number of honorary clinical academic positions, encouraging research funders to design schemes that promote and facilitate a greater degree of mobility between sectors such as academia, industry, public health, the NHS and local authorities, offering healthcare professionals contracts that include dedicated research time, and constructing undergraduate curricula in a manner that better equips healthcare students with the skills to engage in research.⁴³ In addition to these steps, to encourage this integration of public health research with health and social care delivery, the Academy recommends that regional hubs of engagement between health and social care professionals and researchers should be developed.⁴⁴

The ageing challenges that should be prioritised by medical and technological developments (Question 4)

- 2.1 Social care will have an important role to play in addressing the ageing challenges faced by society. However, as highlighted in the Academy report *COVID-19: Preparing for the future*, social care has been hit by the pandemic, particularly care homes, where reduced bed occupancy has left many providers in financially precarious circumstances.⁴⁵ Combined with the fact that our ageing population are spending longer periods of time in ill health towards the end of life compared to 2010, ensuring social care is appropriately resourced to care for an ageing population and support innovations in care will be vital.⁴⁶ This will have the added benefit of reducing pressures and burden on the NHS.⁴⁷ Recent health and social care organisational changes proposed by the DHSC's white paper presents an opportunity to deliver integrated and holistic health and social care to older people (see 1.4).⁴⁸ Older people and their carers should be involved in co-developing and designing

³⁶ Department of Health and Social Care (2021). *Integration and innovation: working together to improve health and social care for all*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/960548/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-web-version.pdf

³⁷ The Academy of Medical Sciences (2021). *Response to the House of Commons' Health and Social Care Select Committee inquiry into the Department's White Paper on health and social care*. <https://acmedsci.ac.uk/file-download/17381964>

³⁸ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

³⁹ Academy of Medical Sciences (2020). *Letter to the Secretary of State for Health and Social Care*. <https://acmedsci.ac.uk/file-download/90869115>

⁴⁰ The Academy of Medical Sciences (2020). *Transforming health through innovation: Integrating the NHS and academia*. <https://acmedsci.ac.uk/file-download/23932583>

⁴¹ Ozdemir BA, et al. (2015). *Research Activity and the Association with Mortality*. PLoS One **10**, e011823.

⁴² The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snippet/uploads/5807581429f81.pdf>

⁴³ The Academy of Medical Sciences (2020). *Transforming health through innovation: Integrating the NHS and academia*. <https://acmedsci.ac.uk/file-download/23932583>

⁴⁴ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snippet/uploads/5807581429f81.pdf>

⁴⁵ The Academy of Medical Sciences (2021). *COVID-19: Preparing for the future*. <https://acmedsci.ac.uk/file-download/4747802>

⁴⁶ Institute of Health Equity (2020). *Health Equity in England: The Marmot Review 10 Years On Executive Summary*. https://www.health.org.uk/sites/default/files/2020-03/Health%20Equity%20in%20England_The%20Marmot%20Review%2010%20Years%20On_executive%20summary_web.pdf

⁴⁷ The Academy of Medical Sciences (2021). *COVID-19: Preparing for the future*. <https://acmedsci.ac.uk/file-download/4747802>

⁴⁸ Department of Health and Social Care (2021). *Integration and innovation: working together to improve health and social care for all*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/960548/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-web-version.pdf

these changes to social care services, so that they can be tailored towards the specific needs and concerns of these groups (see 4.2).

- 2.2 As mentioned in more detail elsewhere (see 1.2 & 5.1), one major ageing challenge is the high prevalence of MLTC in the older population. Issues such as increased polypharmacy, exclusion from clinical trials, increased healthcare burden and expenditure and reduced wellbeing associated with MLTC represents a significant challenge in older populations at higher risk of developing multiple conditions.⁴⁹ As the number of long-term conditions experienced by a patient increases, so does the prevalence of further age-related conditions such as frailty.⁵⁰ This cumulative detrimental effect of developing MLTC stresses the importance of diagnostic tools and biomarkers (see 2.4), or indeed preventative measures (see 2.3), to either facilitate the detection of one condition so that it can be treated before it has the opportunity to influence the emergence of another, or reduce the likelihood of a condition occurring in the first place.
- 2.3 Prevention research should be a priority in meeting the Healthy Ageing Grand Challenge, aligning with the emphasis on prevention in the NHS Long Term Plan.^{51,52} This shift to proactive, preventative measures would have the added benefit of curbing the increasing demand for care and improve the sustainability of the healthcare system.⁵³ Discussions at an Academy/Royal Society meeting on Healthy Ageing emphasised the importance of a preventative health strategy to extend healthy lifespan in an equitable manner. This included fostering healthy attitudes and behaviours towards alcohol, smoking, diet and exercise from a young age to reduce age-related health risks.⁵⁴ Utilising tools, initiatives and policies designed to promote healthy behaviours at all ages have been shown to reduce healthcare expenditure and burden. For example, a study following hospitals utilising the Ottawa Model for Smoking Cessation identified that the smokers admitted to hospital who received this intervention (which included personalised counselling and nicotine replacement therapy) displayed a significant reduction in healthcare usage and rate of mortality, compared to smokers that did not.^{55,56} Making use of preventative rather than responsive interventions could also be seen as representing a more ethical choice as preventative measures should reduce the likelihood of patients developing ill health. However, despite representing a highly cost-effective approach to public health, prevention research is poorly funded, accounting for only 5.4% of total public spending on health research.^{57,58,59} An increase in investment in preventative research and initiatives would help address the many ageing challenges we face as a society.⁶⁰
- 2.4 An important ageing challenge will be to design and develop tools that facilitate disease diagnosis. The high rates of MLTC in older populations worldwide highlight the need for rapid and accessible diagnostic tools to detect the plethora of conditions that affect older patients.^{61,62} Early detection and subsequent treatment of such conditions would potentially minimise the likelihood of further age-related conditions and disabilities developing (see 2.2) and improve patient health outcomes. For example, data show that early detection of most cancers results in an increased likelihood of survival in patients.^{63,64} By identifying

⁴⁹ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>
⁵⁰ Hanlon P, et al. (2018). *Frailty and pre-frailty in middle-aged and older adults and its association with multimorbidity and mortality: a prospective analysis of 493737 UK Biobank participants*. *Lancet Public Health* **3**, e323-e332.

⁵¹ UK Government, Department for Business, Energy & Industrial Strategy. *The Grand Challenge missions*.

<https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions> [accessed 8 July 2021]

⁵² NHS (2019). *The NHS Long-Term Plan*. <https://longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf>

⁵³ *ibid*

⁵⁴ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

⁵⁵ Ottawa Model for Smoking Cessation (n.d). <https://ottawamodel.ottawaheart.ca> [accessed 12 July 2021]

⁵⁶ Mullen KA, et al. (2017). *Effectiveness of a hospital-initiated smoking cessation programme: 2-year health and healthcare outcomes*. *Tobacco Control* **26**, 293-299.

⁵⁷ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

⁵⁸ Van Gils PF, et al. (2010). *Cost-effectiveness research on preventative interventions: a survey of the publications in 2008*. *Eur. J. Public Health*, **21**, 260-264.

⁵⁹ Norman Freshney Consulting (2016). *UK research landscape for population health research and public health practice*. <http://www.acmedsci.ac.uk/phlandscapemapping>

⁶⁰ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

⁶¹ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

⁶² Garin N, et al. (2016). *Global Multimorbidity Patterns: A Cross-Sectional, Population-Based, Multi-Country Study*, *The Journals of Gerontology: Series A* **71**(2), 205-214.

⁶³ Hawkes N (2019). *Cancer survival data emphasise importance of early diagnosis*. *BMJ* **364**, 1408.

⁶⁴ The Academy of Medical Sciences (2018). *Accelerating the translation of early detection and diagnosis research in cancer*. <https://acmedsci.ac.uk/file-download/87699839>

effective, standardised diagnostic tools capable of rapidly measuring key health metrics, screening programmes can be introduced to facilitate disease detection at earlier stages, allowing for effective, more timely interventions. However, there are risks associated with any screening programme introduced following the development of novel diagnostics. Such risks include high rates of false positive readings that result in an elevated frequency of incorrect diagnoses, which could subsequently lead to unnecessary medical interventions.⁶⁵ Therefore, great care should be taken to ensure such novel diagnostic tools are highly precise and accurate. In addition to the valid concerns surrounding diagnostic accuracy, it must be acknowledged that due to the lack of effective treatment options currently available for some conditions (e.g. degenerative conditions like Huntington's disease and Dementia (including Alzheimer's disease)), disease diagnosis does not necessarily result in improved patient outcomes.^{66,67} For example, diagnosis of Alzheimer's disease can result in negative emotional or psychological responses from patients, such as feelings of anxiety and helplessness.^{68,69} However, timely diagnosis of complex degenerative conditions such as Alzheimer's disease can yield benefits. These include providing patients with access to support/care services at an earlier stage of disease progression and allowing patients to play an active role in planning for the future, making care arrangements and medical decision-making before their cognitive faculties significantly deteriorate.^{70,71} This balance of benefits and risks associated with diagnosis highlights that patient care, including whether to take diagnostic tests, should involve shared decision-making between healthcare professionals and patients to ensure each patient is comfortable with and well-informed about any decision that is made regarding their health, and the potential consequences of that decision.⁷² In addition, it is important to mention the issues associated with the pace of progression throughout the early detection technology pipeline, with these technologies generally taking 15 years to progress from conception to market and adoption of such technologies felt to be very slow within the NHS.⁷³ A more collaborative approach between healthcare organisations, and indeed between all life science sectors, should also speed up the translation and adoption of innovative diagnostic developments into patient benefit in the clinic.⁷⁴

Likely benefits and possible harms of developments in ageing research (Question 5)

- 3.1 As more is discovered and understood about the molecular basis of ageing and the biological pathways involved, more druggable targets will be revealed, leading to an increase in the identification of novel therapeutics.⁷⁵ Whilst the development of novel medications for age-related conditions will have benefits in terms of improving health outcomes of older people and extending healthy lifespan, a need for caution remains. Firstly, to promote healthy ageing and to avoid increasing health inequalities (see 1.3), it is important to ensure equity of access to novel therapeutics, non-medical interventions and health and social care services in general (see 6.3). Furthermore, older people commonly take several drugs for multiple conditions, and the harmful effects of inappropriate polypharmacy in the older community may increase further with the advent of novel treatments. Care is needed to minimise the possibility of adverse drug reactions

⁶⁵ *ibid*

⁶⁶ NHS (n.d.). *Treatment and support: Huntington's disease*. <https://www.nhs.uk/conditions/huntingtons-disease/treatment/> [accessed 27 July 2021]

⁶⁷ NHS (n.d.). *Treatment: Alzheimer's disease*. <https://www.nhs.uk/conditions/alzheimers-disease/treatment/> [accessed 27 July 2021]

⁶⁸ Dubois B, et al. (2015). *Timely Diagnosis for Alzheimer's Disease: A Literature Review on Benefits and Challenges*. *Journal of Alzheimer's Disease* **49**, 617-631.

⁶⁹ Gauthier S, et al. (2013). *Diagnosis and management of Alzheimer's disease: Past, present and future ethical concerns*. *Progress in Neurobiology* **110**, 102-113

⁷⁰ Dubois B, et al. (2015). *Timely Diagnosis for Alzheimer's Disease: A Literature Review on Benefits and Challenges*. *Journal of Alzheimer's Disease* **49**, 617-631.

⁷¹ Gauthier S, et al. (2013). *Diagnosis and management of Alzheimer's disease: Past, present and future ethical concerns*. *Progress in Neurobiology* **110**, 102-113

⁷² The Academy of Medical Sciences (2017). *Enhancing the use of scientific evidence to judge the potential benefits and harms of medicines*.

<https://acmedsci.ac.uk/file-download/44970096>

⁷³ The Academy of Medical Sciences (2018). *Accelerating the translation of early detection and diagnosis research in cancer*.

<https://acmedsci.ac.uk/file-download/87699839>

⁷⁴ The Academy of Medical Sciences (2020). *Transforming health through innovation: Integrating the NHS and academia*.

<https://acmedsci.ac.uk/file-download/23932583>

⁷⁵ The Academy of Medical Sciences (2016). *Influencing the trajectories of ageing*. <https://acmedsci.ac.uk/snippet/uploads/58521f0caf63a.pdf>

associated with polypharmacy.⁷⁶ Considering the emerging evidence about the benefits of non-medical interventions (see 6.3), striking a balance between medical and non-medical interventions will be vital.

- 3.2 Many technological advances currently under development have the potential to both improve quality of life as people age and reduce burden on healthcare systems.⁷⁷ There are significant healthcare burdens associated with medical non-adherence. Prescription drug wastage – including non-adherence to prescription programmes – is thought to cost NHS England around £300 million a year, and medical non-adherence in older populations is associated with higher rates of hospitalisation and mortality.^{78,79} Advances in wearable technologies or mobile applications can monitor and remind patients to take medications at appropriate and timely intervals, potentially resulting in a reduction to such costs and better health outcomes.^{80,81} Trials are currently ongoing to assess the results of introducing home sensors that can collect data which are subsequently analysed by artificial intelligence (AI), to track and predict health outcomes.⁸² Data from such homes are transmitted to a GP, notifying them when health outcomes and predictors deteriorate. Such technological advances can lead to continuous monitoring of health metrics without increasing burden on GPs and other healthcare professionals, and potentially reduce the frequency of visits older patients must make to their GP. Again, with all these novel technologies, inclusivity is imperative when attempting to maximise societal gain. To ensure these technologies are used effectively and consistently by older patients, they should possess suitable interfaces for the older community to guarantee and simplify usability, and be equitably accessible to individuals from different socioeconomic or ethnic backgrounds.⁸³ Finally, similar to the scrutiny placed on the development of pharmaceutical interventions, these technological innovations should be data-driven and built upon a strong evidence base that is representative of the target population for the technology, to ensure the costs and efforts of implementing these measures across the healthcare system have a tangible and effective benefit and to help avoid unforeseen harms.⁸⁴

The role of older people, and of intergenerational public input, in helping shape research and innovation directed towards the needs of current and future older populations (Question 6)

- 4.1 Evidence shows that the UK public is very supportive of scientific research, with 74% of people agreeing that science makes people's lives easier and 82% of people believing we should all take an interest in science.⁸⁵ Evidence suggests that there is a desire for both patient and public to be involved in the R&D process; and that this relationship would benefit the research community and society at large.⁸⁶ For example, public involvement in research has a positive effect in terms of highlighting previously unseen ethical concerns and shaping the research agenda to address communities' and patients' unmet need.^{87,88,89} Recent patient and public involvement (PPI) activities undertaken by the Academy have demonstrated the desire of patients and the public to be involved in discussions around

⁷⁶ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

⁷⁷ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

⁷⁸ York Health Economics Consortium & the School of Pharmacy, University of London (2010). *Evaluation of the scale, causes and costs of waste medications*. <https://discovery.ucl.ac.uk/id/eprint/1350234>

⁷⁹ Walsh CA, et al. (2019). *The association between medication non-adherence and adverse health outcomes in ageing populations: A systematic review and meta-analysis*. *British Journal of Clinical Pharmacology* **85**(11), 2464-2478.

⁸⁰ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

⁸¹ The Academy of Medical Sciences (2014). *Patient adherence to medicines*. <https://acmedsci.ac.uk/file-download/37126-552f6b3fdab3a.pdf>

⁸² The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

⁸³ The Academy of Medical Sciences (2019). *Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'*. <https://acmedsci.ac.uk/file-download/8511369>

⁸⁴ *ibid*

⁸⁵ Department for Business, Energy and Industrial Strategy (2020). *Public attitudes to science 2019*.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905466/public-attitudes-to-science-2019.pdf

⁸⁶ The Academy of Medical Sciences (2019). *From subjects to partners: putting patients at the heart of medical research*. <https://www.acmedsci.ac.uk/file-download/95794119>

⁸⁷ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*.

<https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

⁸⁸ National Institute for Health Research (2009). *Exploring impact: public involvement in NHS, public health and social care research*.

<http://www.invo.org.uk/wp-content/uploads/2012/01/INVOLVEexploringimpactSummary2009.pdf>

⁸⁹ Connected Communities (2011). *Towards co-production in research with communities*.

https://www.dur.ac.uk/resources/geography/reframing_state//CCDiscussionPaperDurose2etal.pdf

policy decisions that have a broad societal impact – such as the coronavirus pandemic.⁹⁰ The challenges surrounding ageing and health in old age similarly represent issues that deeply impact all in society, and more meaningful attempts to involve the public in age-related policymaking and research decisions should be made. PPI should be viewed as an essential component of research, and not simply a favourable, yet optional, supplement to it.⁹¹ Such steps include establishing PPI as a key skill included in undergraduate health courses, and including the public at much earlier stages of the developmental research pipeline.⁹² Since the young generation of today is the older generation of tomorrow, there is value in encouraging voices from all age groups to contribute to the ageing discussion.

- 4.2 Whilst intergenerational public input can provide many benefits in research settings, the lived experience of older people and carers provides them with unique insights into the challenges surrounding ageing that should play a substantial role in the future development of ageing research. The experiences and opinions of older people, and their carers, should be listened to and harnessed to maximise suitability, uptake and effectiveness of any intervention. The involvement should also include increased inclusion of older people in clinical trials (see 5.1). As discussed at the Academy/Royal Society Healthy Ageing Conference, whilst encouraging healthy behavioural changes in older people would significantly improve health outcomes, such individuals would require regimes and environments tailored to their specific needs.⁹³ And with individual-centric interventions more likely to benefit the most affluent and potentially widen health inequalities, care must be taken to ensure engagement with a wide range of older people belonging to diverse groups (e.g. across different gender, ethnicity, socioeconomic groups, etc.) to fully comprehend and incorporate the specific needs of different groups of older people during policy development at a national level.⁹⁴

How to better represent older people in clinical trials relevant to them, and ethical aspects of the regulatory challenges raised by the field of ageing (Questions 7 & 8)

- 5.1 In order to identify benefits and side-effects of novel medications whilst minimising potential confounding effects, clinical trials commonly focus on patients that only have the single condition that is under investigation – with MLTC patients (many of whom are older people) often excluded from such trials (see 1.2).⁹⁵ This results in data that are not representative of a significant proportion of the population. The combined effect of clinical trial data being less representative of MLTC patients, and polypharmacy in such patients, contributes to an increased likelihood of adverse drug reactions in MLTC patients.^{96,97} This poses an ethical challenge as those groups not being included in clinical trials are at risk of receiving substandard healthcare. In addition to exploring how post-marketing and real-world evidence can be used to provide a more solid foundation of evidence regarding drug efficacy and safety for older patients with MLTC, steps should be taken to enable clinical trials that are safe and inclusive of MLTC patients, and consist of diverse and representative populations.⁹⁸ Such steps would involve increasing awareness of MLTC patients in research and healthcare settings, and ensuring MLTC-related research is not disadvantaged due to complexity or breadth of study. By safely including MLTC/older patients in clinical trials, we stand to gain more information about how medications interact with, and benefit, a more representative slice of society.

⁹⁰ The Academy of Medical Sciences (2021). *COVID-19: Preparing for the future*. <https://acmedsci.ac.uk/file-download/4747802>

⁹¹ The Academy of Medical Sciences (2017). *Enhancing the use of scientific evidence to judge the potential benefits and harms of medicines*. <https://acmedsci.ac.uk/file-download/44970096>

⁹² The Academy of Medical Sciences (2019). *From subjects to partners: putting patients at the heart of medical research*. <https://acmedsci.ac.uk/file-download/95794119>

⁹³ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

⁹⁴ The Academy of Medical Sciences (2019). *Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'*. <https://acmedsci.ac.uk/file-download/8511369>

⁹⁵ The Academy of Medical Sciences (2018). *Multimorbidity: a priority for global health research*. <https://acmedsci.ac.uk/file-download/82222577>

⁹⁶ *ibid*

⁹⁷ Moffat K & Mercer SW (2015). *Challenges of managing people with multimorbidity in today's healthcare systems*. *BMC Family Practice* **16**, 129.

⁹⁸ The Academy of Medical Science (2019). *Cross-funder multimorbidity research framework*. <https://acmedsci.ac.uk/file-download/49628715>

- 5.2 The majority of regulatory processes are planned around developing interventions that target specific conditions.⁹⁹ Designing interventions or clinical trials to generally target 'ageing' could pose a challenge in terms of identifying a specific endpoint for regulatory purposes. However, regulatory agencies may be increasingly willing to accommodate 'ageing' as a target for medications, as signalled by the FDA approving the *Targeting Ageing with Metformin (TAME)* study.^{100,101} Looking forward, delegates at the Academy's *Influencing the trajectories of ageing* symposium suggested that, for regulatory purposes, selecting specific manifestations of ageing to target remains an option, so that clear endpoints and outcomes can be established.¹⁰²
- 5.3 Technological advances in healthcare have the potential to tackle some of the ageing challenges that we face (see section 3.2). However, the wealth of patient data that is collected by technologies such as home sensors, wearable devices and AI must be responsibly and ethically handled by the NHS (and organisations acting on its behalf) and used to inform development of effective interventions. The Academy's *Our data-driven future in healthcare* report outlined patient and public concern that widespread utilisation of novel technologies may result in loss of patient-practitioner interaction and lack of opportunity to discuss treatment and care options.¹⁰³ Furthermore, some groups, including older people who are frail, deaf or cognitively impaired, may find it difficult or daunting to engage with healthcare practitioners virtually (see 6.3), resulting in reduced engagement with the health system and/or reduced quality of care. These factors, coupled with data privacy concerns, represent an ethical challenge raised by technological developments in ageing research. Data-driven technologies must be designed and utilised in a manner that meets regulatory, legal and ethical requirements; respects and protects patient confidentiality; and informs patients when, where and how their data will be used.¹⁰⁴

The role played by biomedical and technological approaches versus greater emphasis on other policy approaches in terms of 'levelling up' the health spans of the most disadvantaged to the least (Question 9)

- 6.1 Novel biomedical and technological approaches could have an important role to play in equalising health spans of the most disadvantaged to the least. Technological advances in AI, apps and diagnostic devices can be vital in the monitoring of health metrics without necessarily increasing burden on healthcare professionals and in ensuring adherence to medication programs (see 3.2).^{105,106} Evidence suggests a social gradient may exist in relation to disease detection and medical adherence for certain conditions, and patients and the public strongly feel that data-driven technologies should only be utilised if discrimination or unequal access to care is avoided.^{107,108,109,110,111} Therefore, great care should be taken to ensure novel health-related technologies are deployed in an equitable and appropriate manner. If technologies are specifically designed for and targeted to areas of greatest need – regardless of socioeconomic status – they could go some way to 'levelling up' health spans across the socioeconomic spectrum.

⁹⁹ The Academy of Medical Sciences (2016). *Influencing the trajectories of ageing*. <https://acmedsci.ac.uk/snip/uploads/58521f0caf63a.pdf>

¹⁰⁰ *ibid*

¹⁰¹ Barzilai N, et al. (2016). *Metformin as a tool to target aging*. *Cell Metabolism*, **23(6)**, 1060-1065.

¹⁰² The Academy of Medical Sciences (2016) *Influencing the trajectories of ageing* <https://acmedsci.ac.uk/snip/uploads/58521f0caf63a.pdf>

¹⁰³ The Academy of Medical Sciences (2018). *Our data-driven future in healthcare*. <https://acmedsci.ac.uk/file-download/74634438>

¹⁰⁴ *ibid*

¹⁰⁵ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

¹⁰⁶ The Academy of Medical Sciences (2014). *Patient adherence to medicines*. <https://acmedsci.ac.uk/file-download/37126-552f6b3fdab3a.pdf>

¹⁰⁷ Tomic K, et al. (2018). *Socioeconomic status and diagnosis, treatment, and mortality in men with prostate cancer. Nationwide population-based study*. *International Journal of Cancer* **142(12)**, 2478-2484.

¹⁰⁸ Petersen JD, et al. (2021). *Association of Socioeconomic Status With Dementia Diagnosis Among Older Adults in Denmark*. *JAMA Network Open* **4(5)**, e2110432.

¹⁰⁹ Gast A & Mathes T (2019). *Medication adherence influencing factors – an (updated) overview of systematic reviews*. *Systematic Reviews* **8**, 112.

¹¹⁰ Burch LS, et al. (2016). *Socioeconomic status and treatment outcomes for individuals with HIV on antiretroviral treatment in the UK: cross-sectional and longitudinal analyses*. *Lancet Public Health* **1**, e26-e36.

¹¹¹ The Academy of Medical Sciences (2018). *Our data-driven future in healthcare*. <https://acmedsci.ac.uk/file-download/74634438>

- 6.2 Although ageing affects us all, both life expectancy and disability-free life expectancy exhibit a social gradient.^{112,113} People born in the most affluent areas of England can expect to live 18-20 more years in good health compared to those living in the least affluent regions, with the COVID-19 pandemic widening this gap between rich and poor.^{114,115} So, whilst biomedical and technological advances (outlined in Section 3) display promise, they must be considered as part of a suite of interventions put in place to tackle the health inequalities present across society.¹¹⁶ The current gaps in health outcomes between most and least deprived individuals reveal striking improvements to health inequalities can likely be made by addressing social determinants of health, without relying entirely on such advances in biomedical and technological approaches. For example, the *Fair Society, Healthy Lives: The Marmot Review* report and subsequent *10 Years On* review set out recommendations to address the social determinants of ill health and reduce inequalities, which include giving every child the best start in life, enabling all people to maximise their capabilities and have control over their lives, creating fair employment and good work for all, ensuring a healthy standard of living for all, creating and developing healthy and sustainable places and communities, and strengthening the role and impact of ill health prevention.^{117,118}
- 6.3 Non-medical health interventions can be effective in improving health and wellbeing in older people, and have secondary beneficial effects of potentially reducing polypharmacy and overall burden on the NHS.¹¹⁹ 'Social prescribing' is a form of non-medical intervention that can operate alongside or independently of medical treatment, whereby a link worker is assigned to a patient to bridge them to cultural or community activities such as book clubs, volunteering or museums.¹²⁰ A recent WHO review highlighted the potential protective impact of cultural and artistic engagement on wellbeing, mental health and cognition – irrespective of an individual's socioeconomic status.¹²¹ Engagement in such cultural activities in older age specifically, including playing musical instruments and reading, is associated with slowing the rate of cognitive decline and a lower risk of developing dementia.¹²² Whilst the UK government recently committed to increasing access to social prescribing as part of the NHS Long Term Plan, care must be taken to ensure that such initiatives do not widen health inequalities.¹²³ As discussed at the Academy/Royal Society Healthy Ageing conference, in order to promote and influence behavioural changes, health-orientated policies or initiatives should be coupled with support for higher priority issues for individuals residing in more deprived areas, like debt and insecure housing.¹²⁴
- 6.4 The COVID-19 pandemic has changed the way we experience healthcare. Digital GP consultations are one such technological development that have been primarily driven by the pandemic.¹²⁵ Such consultations have been beneficial to the older population during the pandemic by reducing social mixing and risk of transmission that arises from frequent in-person GP visits, and allows the possibility for carers and relatives to join the call if

¹¹² The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*.

<https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

¹¹³ The Academy of Medical Sciences (2016). *Influencing the trajectories of ageing*.

<https://acmedsci.ac.uk/snip/uploads/58521f0caf63a.pdf>

¹¹⁴ Office for National Statistics (2021). *Healthy state life expectancies by national deprivation deciles, England: 2017-2019*.

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthinequalities/bulletins/healthstateifeexpectanciesbyindexofmultipledeprivationimd/2017to2019> [accessed 27 July 2021]

¹¹⁵ Rayleigh V (2021). *What is happening to life expectancy in England?* The King's Fund, 15 April.

<https://www.kingsfund.org.uk/publications/whats-happening-life-expectancy-england> [accessed 14 July 2021]

¹¹⁶ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*.

<https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

¹¹⁷ Institute of Health Equity (2010). *Fair Society Healthy Lives (The Marmot Review)*. <https://www.instituteofhealthequity.org/resources-reports/fair-society-healthy-lives-the-marmot-review/fair-society-healthy-lives-exec-summary-pdf.pdf>

¹¹⁸ Institute of Health Equity (2020). *Health Equity in England: The Marmot Review 10 Years On Executive Summary*.

https://www.health.org.uk/sites/default/files/2020-03/Health%20Equity%20in%20England_The%20Marmot%20Review%2010%20Years%20On_executive%20summary_web.pdf

¹¹⁹ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

¹²⁰ *ibid*

¹²¹ World Health Organization (2019). *What is the evidence on the role of the arts in improving health and well-being? A scoping review*.

<https://apps.who.int/iris/bitstream/handle/10665/329834/9789289054553-eng.pdf>

¹²² Fancourt D, et al. (2018). *Cultural engagement predicts changes in cognitive function in older adults over a 10 year period: findings from the English Longitudinal Study of Ageing*. *Scientific Reports*, **8**, 10226.

¹²³ National Health Service (2019). *The NHS Long Term Plan*. <https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf>

¹²⁴ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing*. <https://acmedsci.ac.uk/file-download/35061800>

¹²⁵ The Academy of Medical Sciences (2021). *COVID-19: Preparing for the future*. <https://acmedsci.ac.uk/file-download/4747802>

needed. However, many older people possess sensory and/or cognitive impairments which may leave them less able to interact and engage with the technology required to mediate the consultation.¹²⁶ In a similar manner, such consultations are at risk of widening socioeconomic health inequalities, with those in less affluent areas potentially less likely to access and engage with GPs or healthcare professionals remotely.¹²⁷ The Academy has also heard from patients and carers that individuals should be able to access healthcare in different ways so that those unable to access care digitally are not excluded.¹²⁸ One potential remedy would be to prioritise in-person GP visits for those in society – many of them potentially older – that may not be as able to benefit from remote digital consultations.¹²⁹

The responsibilities of the various stakeholders (older people themselves, their families, professionals, wider society, the state) with respect to a healthier old age (Question 10)

- 7.1 Studies have suggested that genetic contribution to ageing trajectories are outweighed by the influence of various environmental factors, including the important role that maintaining healthy behaviours and a range of socio-economic factors can play in achieving healthy ageing.¹³⁰ Observational studies show that lifestyle modifications can be highly beneficial in minimising negative health outcomes that occur during ageing.¹³¹ Population studies show that improvements in just four health-related behaviours (exercise, smoking, alcohol intake, fruit and vegetable consumption) can predict a 14-year increase in lifespan, emphasising the positive effect to health outcomes afforded by healthy behavioural adaptations in the population.¹³² However, there is evidence that education is not enough to encourage such personal behaviour change, with social determinants of ill health often explicitly or implicitly preventing positive behavioural change.^{133,134} Indeed, there are concerns that informational approaches (e.g. nutritional labelling, anti-smoking campaigns) may result in widening health inequalities across the socioeconomic spectrum, primarily due to more advantaged groups being more likely to adopt the advice offered by such campaigns.¹³⁵ Therefore, it is important that any attempts at influencing behaviour should be coupled with policy efforts to address social determinants of ill health and provide people with the necessary support to adopt healthy lifestyle changes (see 6.2 & 6.3). A careful balance should be struck between personal, environmental and societal roles in terms of improving the health outcomes of the country in an equitable manner.
- 7.2 Government also has an important role to play with respect to fostering and encouraging healthy behaviours across society. Higher level policy or government interventions may reduce health inequalities to a greater extent than educational campaigns; for example, stricter regulatory interventions such as alcohol and tobacco taxation have often yielded the greatest behavioural changes.¹³⁶ Such health policies must be developed with the needs of diverse groups of society in mind, because different groups can have different attitudes and expectations regarding ageing and health.^{137,138} Therefore, public

¹²⁶ *ibid*

¹²⁷ Parker RF, et al. (2021). *Inequalities in general practice remote consultations: a systematic review*. BJGP Open **5**(3).

¹²⁸ The Academy of Medical Sciences (2021). *COVID-19: Preparing for the future*. <https://acmedsci.ac.uk/file-download/4747802>

¹²⁹ *ibid*

¹³⁰ Moayyeri A, et al. (2016). *Ageing Trajectories in Different Body Systems Share Common Environmental Etiology: The Healthy Twins Aging Study (HATS)*. Twin Research and Human Genetics **19**(1), 27-34.

¹³¹ The Academy of Medical Sciences (2019). *Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'*. <https://acmedsci.ac.uk/file-download/8511369>

¹³² Khaw KT, et al. (2008). *Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study*. PLoS Medicine **5**(1), e12.

¹³³ The Academy of Medical Sciences/The Royal Society (2020). *Healthy Ageing Conference* <https://acmedsci.ac.uk/file-download/35061800>

¹³⁴ Hands A (2020). *A ripe old age should be for everyone*. The Academy of Medical Sciences, 30 July. <https://acmedsci.ac.uk/more/news/a-ripe-old-age-should-be-for-everyone>

¹³⁵ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*.

<https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

¹³⁶ *ibid*

¹³⁷ The Academy of Medical Sciences (2019). *Response to the House of Lords Science and Technology Committee consultation on 'Ageing: Science, Technology and Healthy Living'*. <https://acmedsci.ac.uk/file-download/8511369>

¹³⁸ The Academy of Medical Sciences (2016). *Improving the health of the public by 2040*.

<https://acmedsci.ac.uk/snip/uploads/5807581429f81.pdf>

engagement is important during the conception and development of health policies to ensure voices and concerns are heard at every stage.

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