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Google

THE ROYAL SOCIETY

The shift to prevention

A new ecosystem of health promotion and protection

Contents

Executive summary and context

This report outlines a transformative vision of the future of the NHS, shifting from a reactive, treatment-focused model to a proactive and preventative approach. It has been developed by Deloitte, Google and the Royal Society to articulate a perspective on the future for a new ecosystem for health promotion and protection.

Currently, the NHS faces mounting pressure from increasing disease burden across a range of health challenges. These include mental health disorders, lifestyle-related issues (such as smoking, alcohol consumption, poor nutrition, and physical inactivity), obesity, vaccine-preventable diseases, and chronic conditions like heart disease and cancer. Tackling this complex landscape calls for a paradigm shift in our approach to health strategy. Rather than focussing primarily on treatment when illness occurs, interventions should aim to extend the span of a healthy life and prevent prolonged periods of illness before they occur.

This new ecosystem as envisaged aims to keep people healthier for longer by improving their understanding of their personal health, informed by earlier intervention through leveraging advanced screening, digital technology (e.g. AI, wearables, virtual health navigators), enhanced health education, and (where needed), support from multi-disciplinary primary care teams. This will deliver hyper-personalised insights and empower individuals to manage their health.

The system is based on the following principles:

1. Increased focus and spending on preventative interventions, with a 'left shift' towards earlier life stages.
2. Establishing a cross-sector, collaborative ecosystem that extends beyond the NHS, involving individuals, retail health providers, non-profit organisations, educators, private sector innovators, employers and workforces, and wider government.
3. Critical enablers for supporting this shift include significant investment in data and technology infrastructure and digital skills, financial and other incentives, and addressing public trust in data sharing and technology.

Throughout this report, the term 'prevention' is used broadly to encompass strategies that delay or mitigate the onset of illness and disability, thereby maximising the number of years lived in good health, rather than necessarily preventing disease altogether.

By 2035, the goal is to **create a human-centred health promotion and protection system driven by** advancements in **genomics, health education** and **digital infrastructure**, powered by **AI**, to provide hyper-personalised health insights for everyone, at every life stage.

Leading to benefits...

For individual citizens

- Increased healthy life expectancy
- Increased equity

For the economy

- Increased workforce resilience & productivity
- Increased digital literacy & skills

For the NHS

- Later entry to healthcare system
- Increased self-care/ lower demand on **urgent & emergency care**
- Reduced **staff burnout**

Tackling the biggest modifiable risk factors:

- **Lifestyle** (e.g. smoking, alcohol, nutrition, exercise)
- **Health literacy** (e.g. poor maternal health)

That could address:

- **Mental health** (incl. sleep)
- **Obesity**
- **Cancer**
- **Vaccine preventable diseases**
- **Heart health**
- **Neuro-degenerative disease**

To achieve this, we have focused on several "Principles"

Increased focus and spending on preventative interventions

across a person's life stages – with a **'left shift'** towards earlier stages, and activated through place-based-change

To deliver these changes requires input from cross-sector actors, in addition to the NHS

as input largely comes from actors that are non-NHS

Enablers are critical to support this change

across data, AI and tech, changes to policy and law, and incentivising citizens to make healthy choices, for example:

- Investing in empowering communities, including digital skills
- Aligning incentives & dedicated budget
- Foundational data, tech and addressing trust

Here we have outlined the **specific preventative interventions across different life stages**, for birth to old age.

That will **form a new health and social contract relying** on the **collaborative role** of various **actors** to address the wider determinants of health.

Enabling **citizens to self-care**, whilst **targeting support** to those at **highest risk** and **seldom heard communities.**

With these enablers in place, an increased focus on health protection could deliver benefits in terms of greater healthy life expectancy, reduced health inequalities, delayed entry into the healthcare system, and a more resilient, prosperous, and productive workforce.

Existing technologies can be leveraged to scale and modernise tried-and-tested interventions, such as expanding screening and vaccination programmes to reach larger segments of the population.

Additionally, innovation can be used to construct new pathways, like integrating prevention programmes into local communities and fostering neighbourhood-led initiatives in settings such as schools and pharmacies. This approach requires a fundamental shift in policy, emphasising protection as the cornerstone of a sustainable and equitable healthcare system that leverages the potential of targeted screening, AI-driven coaching, and data-enabled personalised interventions.

Most importantly, this vision is underpinned by data sharing between individuals and all actors within the protection ecosystem. Given this, significant investment in the appropriate data and technology infrastructure, not yet in place, is needed. While the government works towards the 2035 vision, substantial ongoing resources for disease treatment will remain necessary alongside increasing the emphasis on preventative strategies to prolong a healthy lifespan.

A vision for a healthier future in 2035

This report presents a vision for the future of the NHS in 2035. Our focus has been on articulating the aspirational 'what', rather than answering the pragmatic questions of 'how' we transition from a system that focuses on disease treatment to one fundamentally rooted in prevention.

The vision set out in this report focuses on the transformative potential of new innovations made possible by technological and scientific advancements. While we spotlight the exciting, newly possible frontiers of preventative healthcare, we also acknowledge that there are significant gaps at present in basic preventative measures. We recognise that alongside the innovative possibilities, there remains a critical need to scale up the foundational prevention strategies that are currently under-utilised or ineffectively implemented.

By 2035, our vision is for a human-centred health promotion and protection ecosystem, driven by three broad categories of interventions:

1. **Harnessing the power of advanced screening:** Leveraging advancements in comprehensive health screening across the life course (including early years, school, and employer provided checks), as well as clinical examinations, biochemical tests and radiological imaging and genomics, to understand the predispositions of individuals to diseases, and to tailor health strategies based on individual risk profiles. This multi-faceted approach will enable highly personalised interventions, maximising their effectiveness.
2. **Empowering individuals through health education:** Equipping individuals with the knowledge, skills, tools, and incentives to take informed action and access interventions that empower them to adopt healthy lifestyle choices. This includes providing accessible and engaging health information, promoting health literacy, and fostering a sense of control and choice over personal well-being.

3. **Building a robust digital infrastructure:** Leveraging the power of technology, including artificial intelligence (AI), wearable health trackers, and connected digital platforms, to provide personalised health insights, support self-management of health conditions, and enable proactive interventions. This will include facilitating public trust in digital technology and enabling individuals to control access to their data and choose how much data they share.

Our vision focuses on achieving longer and healthier lifespans, not simply on avoiding disease altogether. We use the term 'prevention' to describe a range of interventions, all of which contribute to minimising the period of life spent in ill health or disability. These interventions should be delivered across the life course, with a 'left shift' towards greater intervention at an earlier age compared to the present-day approach to prevention.

Critical prevention-focused interventions across the life course

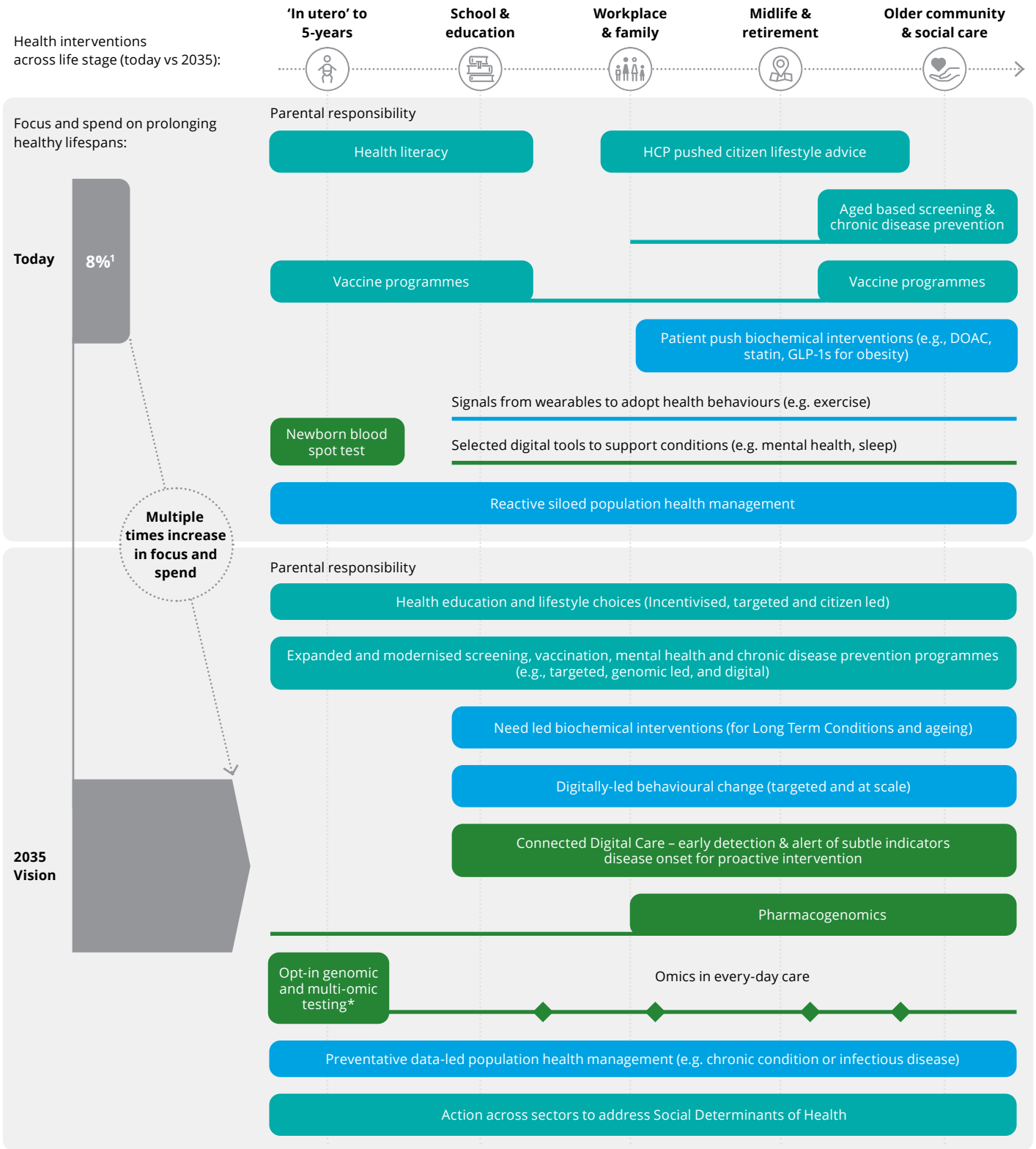
Within the three categories of screening, health education and digital infrastructure, we envision a series of key interventions across the life course. These interventions will be data-driven and personalised, moving away from a one-size-fits-all approach. Figure 1 describes a range of examples of these interventions, which can be summarised as follows:

- **'In utero' to 5-years:** This critical period lays the foundation for lifelong health. Parents will focus on optimising early development through expanded newborn health checks and screening programmes, offering opt-in genomic testing (contingent on policy and regulations that support their ethical use) to identify potential risks early on, and providing comprehensive parental support programmes to encourage healthy habits from infancy.
- **School & education:** The education system plays a vital role in shaping health behaviours. Our vision includes integrating comprehensive health education and digital literacy into the national curriculum, giving children and young adults the knowledge and skills and empowering them to make healthy choices and to receive health checks and vaccinations. This involves training teachers, school nurses and support staff to deliver engaging health education and promote mental health awareness.
- **Workplace & family:** The workplace presents a significant opportunity to influence health behaviours and promote well-being. Health and work will be seamlessly integrated with smart workspaces featuring sensors that monitor employee physical and mental wellness, providing real-time feedback of posture, stress levels and early signs of burnout, so that employers can intervene early on with workplace wellness programmes and healthy lifestyle strategies. Community solutions will be supported for those who cannot access support in a workplace (e.g. people who work in small businesses, in the field or at unsociable hours, or who are unemployed).
- **Midlife & retirement:** As individuals age, the focus shifts towards managing age-related health risks and maintaining a good quality of life. Interventions will prioritise targeted screening for common chronic conditions, implementing programmes that delay the onset of chronic disease, and providing support for older adults to stay healthy, including physical activity, social engagement, and cognitive stimulation.
- **Older community & social care:** This stage requires tailored support to address the unique needs of older adults. The approach includes leveraging connected digital care technologies to provide remote monitoring, support independent living, and facilitate timely interventions. Additionally, it emphasises improving access to community resources, social support networks, and high-quality social care services, as well as targeted health protection through organisations which support the frail elderly, housebound, or isolated, or people residing in care homes.

For examples of the potential impact of these types of intervention, see case studies in the *Appendix*.

Our vision focuses on achieving longer and healthier lifespans, not simply on avoiding disease altogether.

Figure 1. The focus and spend on health protection will increase, driven by more comprehensive interventions across life stages

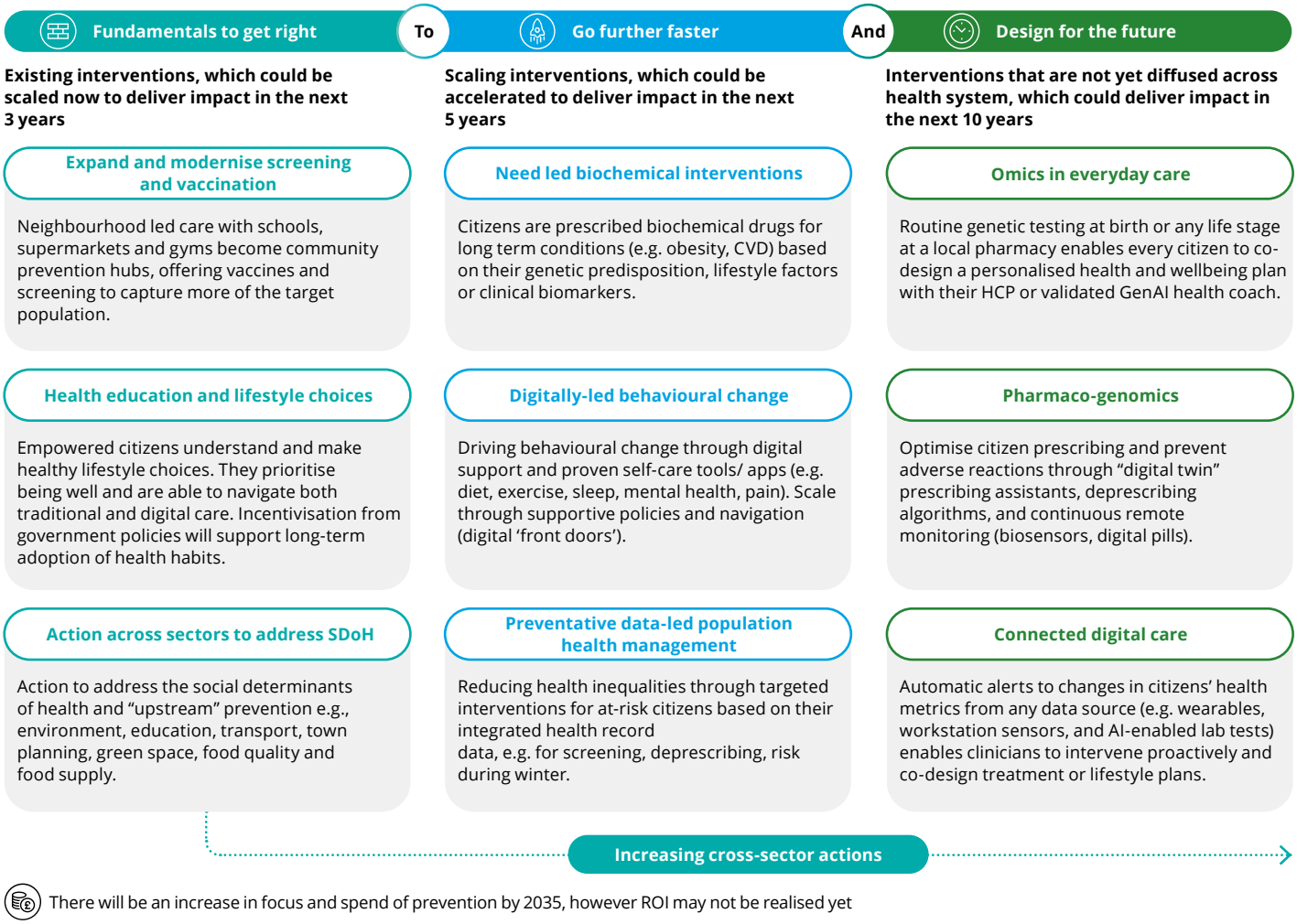


Key Fundamentals to get right | Go further faster | Design for the future

* Early life testing, in the absence of preventive therapies that can be applied immediately, is something that requires careful ethical consideration

Source: 1 ONS, 'Healthcare expenditure, UK Health Accounts: 2022 and 2023', Figure 5: Government spending on preventive care decreased in 2022.

Figure 2. To achieve a technology-enabled future state, there are many fundamentals to get right, and areas where we could move further, faster



To realise this personalised and technology-led approach to healthy living, the ecosystem should prioritise the following areas to be realised in the given timeframes (Figure 2):

- **In the next three years:**
  - **Expand and modernise screening and vaccination programmes:** Capturing more of the target audience by delivering neighbourhood-led care through community prevention hubs.
  - **Health education and lifestyle:** Embed and strengthen health and wellbeing in the education system, as well as digital literacy empowering individuals to understand and make healthy choices. Offering incentives like healthy food subsidies or tax breaks for healthy behaviours can support long-term adoption of healthy choices.
  - **Action across sectors to address social determinants of health:** Addressing the wider determinants of health through structural changes to address poverty, provide access to the natural environment and green spaces, and improve education, transport, and food security.
- **In the next five years:**
  - **Need-led biochemical interventions:** Prescribing medication based on genetic predisposition, lifestyle factors, or clinical biomarkers.
  - **Digital behavioural change:** Driving behavioural change through science-based, scalable and accessible digital health apps (e.g. talking therapies and support mechanisms for better mental health).
  - **Preventative data-led population health management:** Reducing health inequalities through targeted interventions to address external health factors for at-risk individuals. For example, proactive alerts regarding air pollution levels for individuals at risk of asthma.

- **In the next ten years:**
  - **Omics in everyday care:** Routine opt-in genetic testing at birth or later in life, enabling personalised health and wellbeing plans. Genomics will complement interventions that target environmental factors by leveraging polygenic risk scores to identify those that are at high-risk of a particular disease.
  - **Addressing polypharmacy:** Optimising individual prescribing and preventing adverse reactions through digital twin prescribing assistants, de-prescribing algorithms, and continuous remote monitoring.
  - **Connected digital care:** Where individuals authorise data sharing with the health system, automatic alerts to changes in their health metrics (e.g. from wearable devices), enabling clinicians to intervene proactively and co-design treatment or lifestyle plans.

Figure 3 outlines the technologies that are available now, soon, and in the future, to enable our 2035 vision as described.

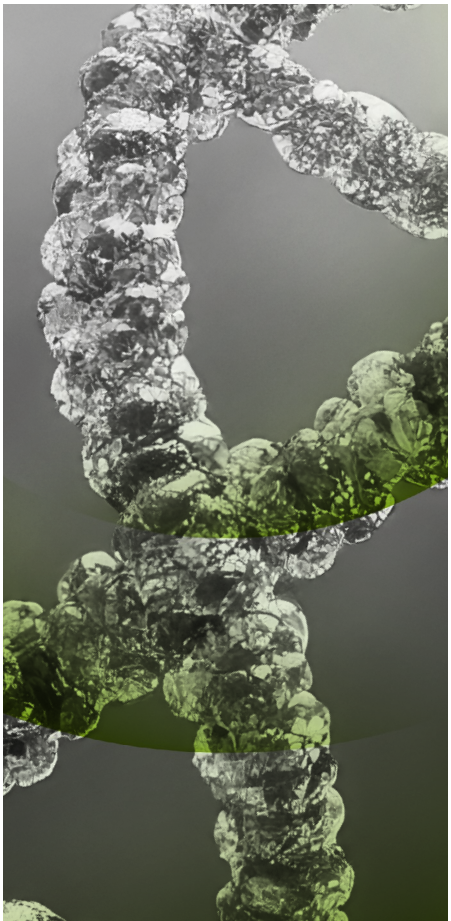


Figure 3. Types of innovations for reaching a tech-enabled health promotion and protection ecosystem.

Technology available today*	Technology coming soon	Technology for the future
Wearables and sensors are increasingly **more advanced, more available** and **less obtrusive**.	Increase capacity for wellness checks by **automating and moving technology into the community** – robotic capture and reporting of metrics, health checks from home, AI identifies those in need of follow up or support.	**Hyper-personalised** content and recommendations – time, place, language, form, voice.
AI can identify individuals and communities most **at risk of developing target conditions** ("C the signs" is already operating in NHS – AI for cancer prediction).	Beyond identifying at risk groups, AI helps **target the right population** with the right interventions. This **reduces waste** whilst directing human resources to those most in need.	First touchpoint with the NHS is a **companion app** – bringing data and recommendations together, proactive memory, place-based nudging, personalised health promotion plans.
Increased capacity for existing cancer screening programmes – AI to support and **increase radiologist capacity** and **reduce time to diagnosis/treatment** (e.g. mammography, medical devices with AI).	Modelling risks includes **wider indicators of health** – climate, weather, environment, transport.	**Continuous screening for many conditions** based on captured data and subjective measures – at an individual and population level.
Widespread access to tools to support **better mental health** - behavioural change apps, digital therapeutics, supporting parents to manage children's mental health before it becomes a bigger problem.	**NHS app** takes on a role in health promotion as a portal for content, appointment scheduling, reminders.	Identification and **use of novel signals** (signals from retail, dementia from retinal imaging).
Health promotion content is more accessible than ever- video, language, tone, reading age, availability, specificity to condition - AI features, **greater health literacy** for all stages of life.	**Monitoring via wearables** and phone-based sensors is commonplace. **Data is meaningfully shared** with the healthcare system for individual and population health monitoring.	Data sharing is the **user's control**.
The healthcare system becomes comfortable with the role of **patient-captured data** in understanding health and wellness.	Individuals have greater interactions with their wearables allowing **subjective data collection** such as mood.	**Contactless testing and screening** – no human needed to access, triage or determine next steps.
	Agentic support means data is no longer overwhelming or discouraging and **behaviour change nudges** can be delivered in a personalised way (e.g. coaching).	
	Opt-in sharing of greater amounts of personal information to support personalisation and population health monitoring.	
	AI models **identify new trends, new genomic and other biomarkers** for screening and monitoring health.	
	By meeting individuals' sensory and safety needs we can manage **elderly patients** at home for longer.	

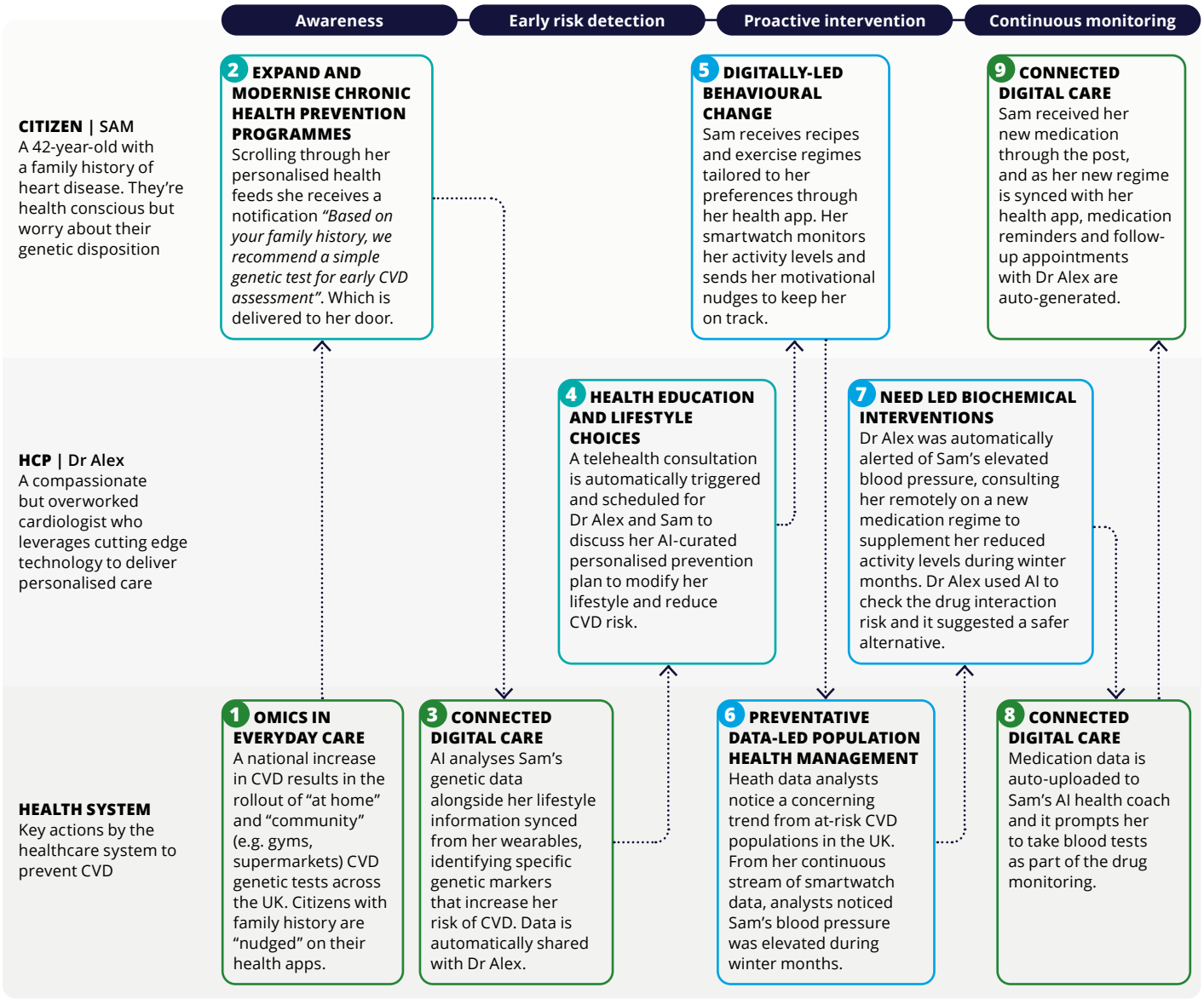
*'Today' includes examples of technology currently available, while 'coming soon' and 'for the future' details examples of how technologies could develop.

How will the tech-enabled health prevention journey feel for individuals in 2035?

To illustrate our vision, this section considers the journeys in 2035 of three individuals who have been identified as at-risk for either cardiovascular disease, cancer or osteoporosis (Figures 4-6). Technology is vital throughout their health journey, from early risk detection and prevention to continuous monitoring and treatment adjustments. The seamless integration of AI, wearables, and telehealth enables timely and automated interventions, improves adherence to treatment plans, and empowers both patients and healthcare professionals to make informed decisions.

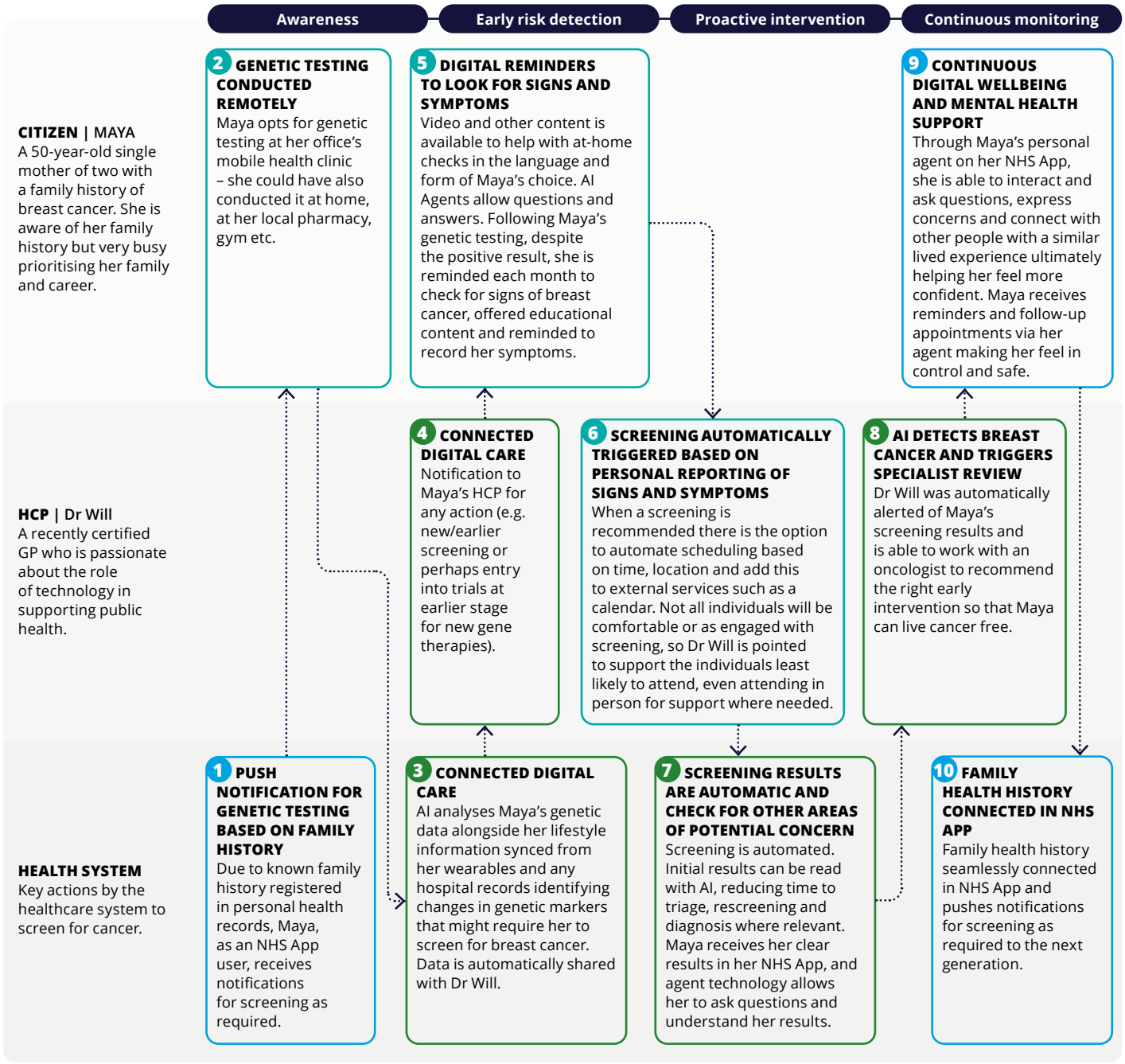
To realise this tech-enabled vision, some key challenges must be addressed. These include safeguarding data privacy, ensuring the ethical use of individuals' health information, and implementing governance structures that give individuals control and ownership over their data sharing preferences.

Figure 4. Imagine a future where HEART ATTACKS are so predictable that they are preventable.



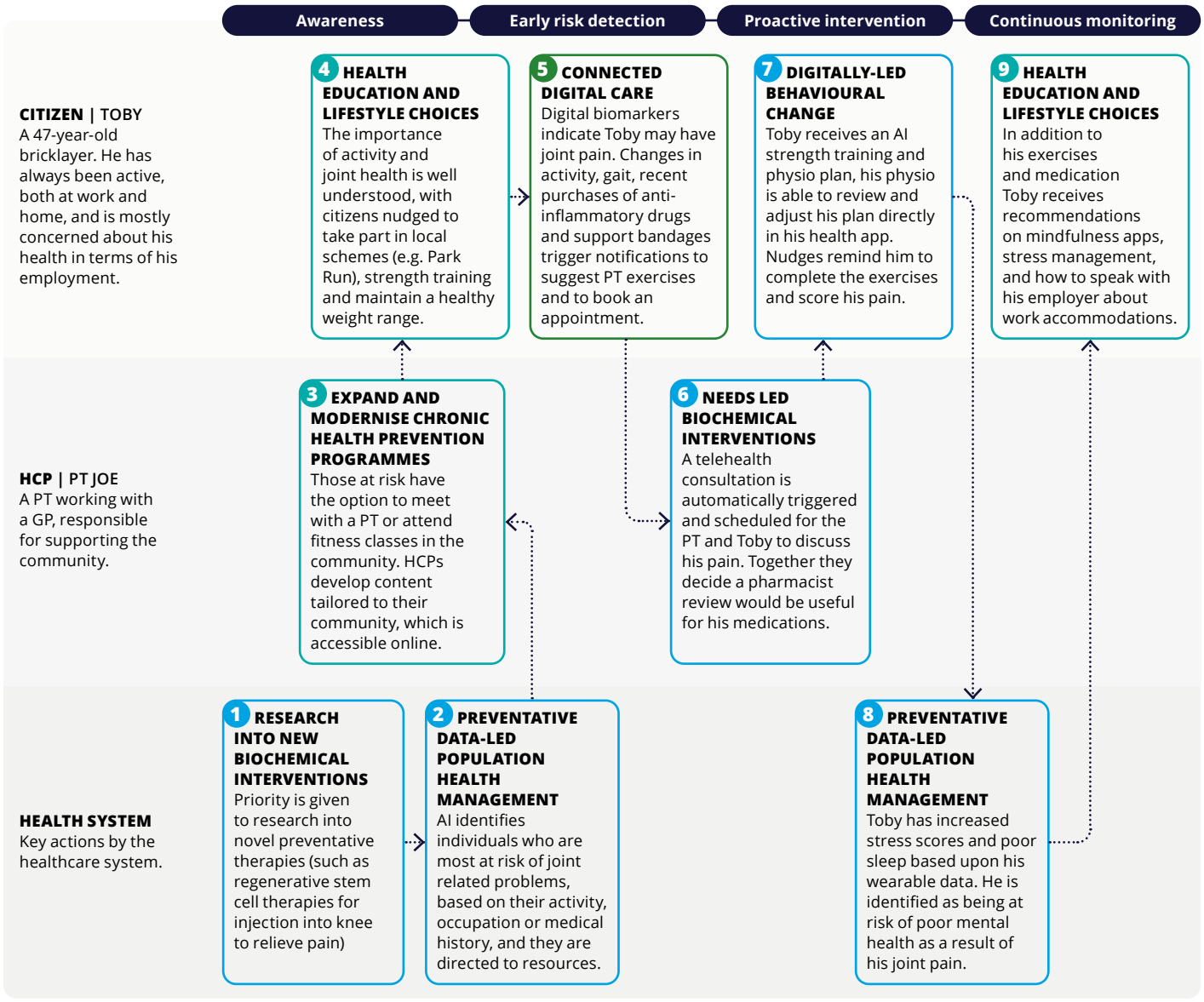
Key Fundamentals to get right | Go further faster | Design for the future

Figure 5. Imagine a future where CANCER is detected before it starts.



Key Fundamentals to get right | Go further faster | Design for the future

Figure 6. Imagine a future where OSTEOARTHRITIS individuals live pain free.



Key Fundamentals to get right | Go further faster | Design for the future

To further illustrate our 2035 vision, Figure 7 suggests how individuals could engage with a "clinician in their pocket"'. Currently, wearable devices offer basic health insights, allowing individuals to track their activity levels. In future, this concept evolves to a more advanced system, giving them control over their diverse health data, all accessible from their personal devices. It will leverage the power of agentic AI and act as a friendly patient 'advocate in the pocket' to connect data from various sources as desired – wearables, health records, genomic information, and even consumer data. This will provide:

- Personalised health insights: Going beyond simple metrics, individuals will be offered tailored advice and recommendations based on their unique health profile.
- Proactive health promotion: Customised interventions and coaching, similar to those a healthcare professional would provide, empowering individuals to take control of their well-being.

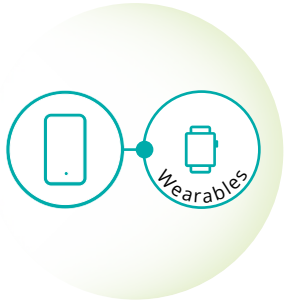
This will empower individuals to become active participants in their own health journey, with agentic AI offering an avenue for building trust and enabling them to become comfortable with sharing their health data. Armed with a deeper understanding of their health and personalised guidance, they can confidently navigate the healthcare system, seeking professional support when needed.

Currently, wearable devices offer basic health insights, allowing individuals to track their activity levels.

Figure 7. Empowering individuals through an AI-driven health companion – 'A clinician in my pocket'.

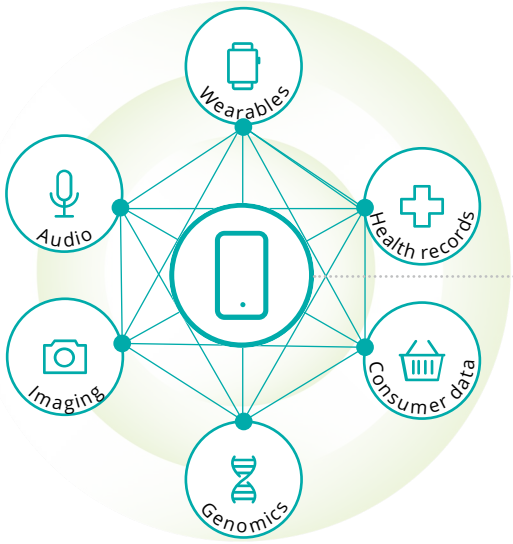
TODAY...

Individuals using wearables engage with a **'coach'** to **understand** their **wearable data** and **make recommendations** about their **activity** or **sleep.**



TOMORROW...

Imagine technology which individuals can choose to **access not just to limited wearable data**, but to authorise access to **health records** and **chosen** consumer generated data, omics, imaging, audio data too.



Agentic AI technology will radically transform how health promotion interventions are delivered, putting a **friendly clinician patient advocate in the pocket of all individuals, personalised** to them.

Individuals will be able to 'talk' to their health record and engage with their data through text, voice, audio, video and sharing images to:

- **Increase their understanding** of their **health data**
- **Prepare for interactions** with **healthcare professionals** and checking their understanding of a plan or result
- **Ask questions** such as:
  - *'"Help me write some questions to ask my GP"*
  - *"Create me a physio plan based upon my X-ray result"*
  - *"Tell me more about my heart health and how I can improve it"*

Benefits of an ecosystem approach to health promotion and protection

This ecosystem as envisaged delivers significant benefits for not only individuals and healthcare professionals, but the wider health system and the UK economy. Figure 8 illustrates some of these, using the example of a case of a major cardiovascular event. In general, benefits include:

- Individuals: By preventing disease (or years lived with a disease) and promoting well-being, individuals can enjoy a higher quality of life, greater independence, and more years spent with loved ones.
- Healthcare professionals: Extended healthy lifespans will alleviate the burden on healthcare professionals, allowing them to work at the top of their scope of practice, increasing their job satisfaction, and allowing them to focus on providing holistic care and building stronger relationships with patients. Our vision will also equip them with advanced tools and technologies to enhance their decision-making and improve patient outcomes (e.g. equipping newly-trained GPs and community-allied health professionals to recognise and manage risks).
- Health system: By reducing the incidence of preventable diseases, the NHS can delay the entry of individuals to the health system and reduce the rate of preventable hospitalisations. In the long term, this frees up resources to invest in innovation, improve access to care, and address the growing demands of an ageing population.
- UK economy: A healthier population translates to a more productive workforce, reduced absenteeism, and reduced reliance on government support payments. The vision is to boost economic growth, foster the UK's innovative medical technology industry, enhance global competitiveness, and create a more prosperous future for the UK.

Figure 8. Potential benefits of health promotion and protection, in the case of a major cardiovascular event.

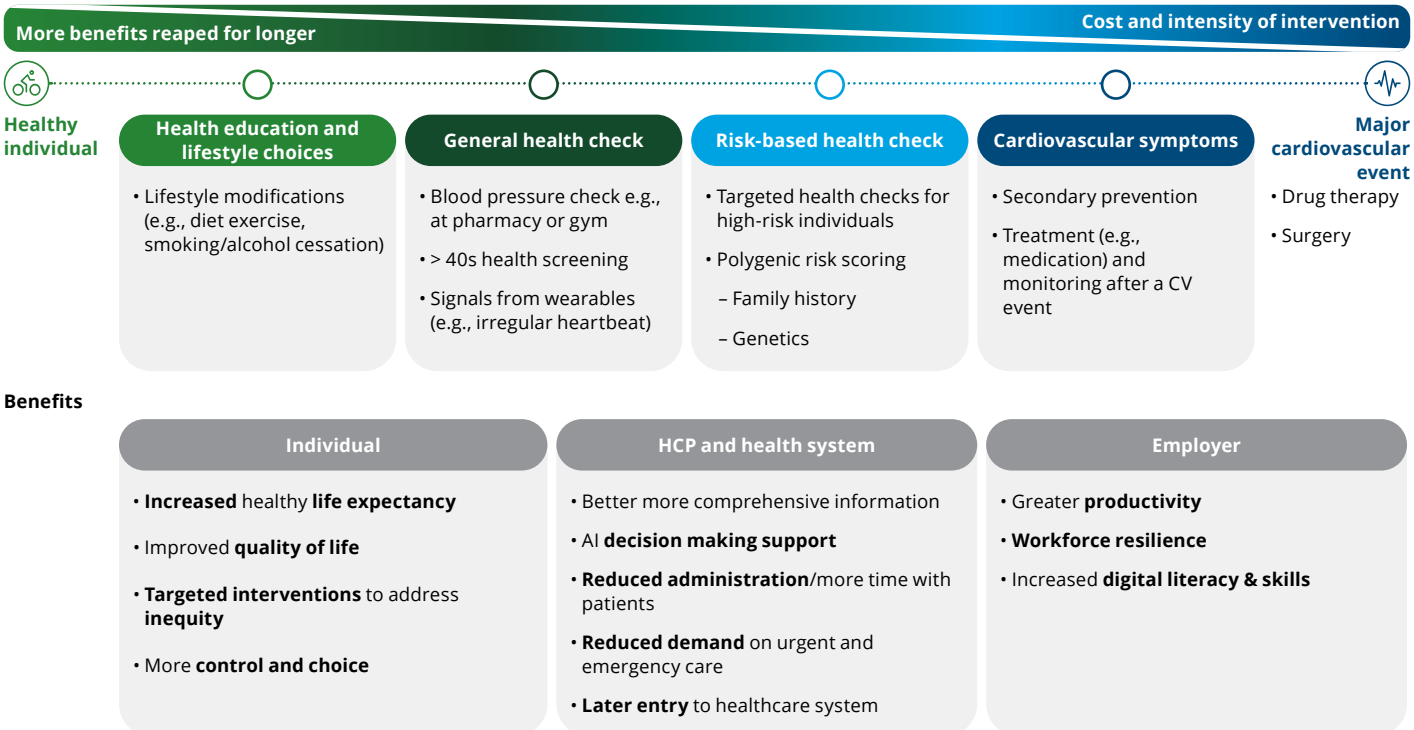


Figure 9 demonstrates how technology will be incorporated throughout the health promotion and protection journey from the perspective ofindividuals, healthcare professionals, and the health system.

Figure 9. Technology will transform each stage of the health promotion and protection journey.

	Awareness	Early risk detection	Proactive intervention	Continuous monitoring
INDIVIDUALS Individuals take responsibility for their health relying on a ecosystem of apps, wearables and agents to support behaviour change.	Hyper-personalised content from authoritative figures, and generated in voice, language and education level tailored to the individual.	Health promotion ecosystem supports access to tools for better mental health and sleep.	Wearables are common place, miniaturised, AI-enabled and incorporated in to everyday objects e.g., watches, headphones.	Behaviour change interventions like reminders and nudges for health promoting behaviours and activities.
	Agent technology supports individuals as a patient advocate in your pocket, answering questions and making recommendations.	Data sharing is managed by the individual. Individuals choose to augment their medical record with wearable, retail, internet search, consumer app and other data.		
HEALTHCARE PROFESSIONAL Healthcare professionals are technology savvy with many administrative tasks managed for them, leaving more time for health promotion and care delivery.	Wearables are common place, data is accessible to clinicians who understand how and when to use in practice.		AI readers increase access to existing screening programmes, freeing up person time to support individuals less likely to attend and speeding up time to diagnosis.	Agent technology supports clinicians to understand data sets & population risks to target interventions.
HEALTH SYSTEM Agent technology is the first touch point for individuals with the healthcare system.	AI enables new screening programmes identifying those most at risk of major condition groups and recommending interventions.	New individual generated data and AI screening methods identify novel signals for early risk detection.	The NHS app takes on a new, central role as a patient advocate and clinician in an individual's pocket.	Continuous objective and subjective data inputs enable continuous risk assessment of individuals and populations.

Healthcare professionals are technology savvy with many administrative tasks managed for them, leaving more time for health promotion and care delivery.

Decentralising preventative care through a collaborative ecosystem

The success of this health promotion and protection approach relies on a shift towards decentralised healthcare, where keeping healthy should be a non-medicalised, convenient part of everyday life.

Stakeholders beyond the NHS involved in this ecosystem include (see also Figure 9):

- **Empowered individuals:** Individuals are at the heart of this new ecosystem, empowered to make healthy choices and control their own well-being. This is achieved by providing access to personalised health information and advice and the skills to evaluate this information critically. Individuals have access to convenient digital tools, and support networks for understanding their health beyond the NHS. Individuals can choose which interventions they would like to engage with, as well as choosing how and when they share personal health data.
- **Non-profit organisations:** Non-profit organisations – such as health charities – play a crucial role in reaching under-served communities, building trust, and disseminating evidence-based health information. They will be instrumental in engaging peer groups, delivering targeted interventions, raising awareness of health issues, and advocating for policies that support health equity.
- **Education sector:** Schools and educational institutions are vital partners in encouraging healthy habits from a young age. Integrating health education and bringing both health and digital literacy into the curriculum, will empower future generations to make healthy choices and navigate the evolving healthcare landscape.
- **Retail and community health providers:** By providing access to health information and services outside of traditional primary care settings, pharmacies, supermarkets, and other community hubs will transform into accessible points of contact to support wellbeing. This includes offering health screenings (e.g. mid-life health checks for all to screen for the most common conditions), providing lifestyle advice, and connecting individuals with relevant resources within their communities.

- **Innovators in health:** The private sector, particularly health technology companies, will drive innovation in areas such as wearable technology, AI-powered health platforms, and personalised medicine. Fostering active collaboration between the NHS and health innovators will be crucial for developing and deploying cutting-edge solutions in efficient and effective ways.
- **Employers and health insurers:** Employers have a vested interest in promoting employee health and wellbeing: incentivising behaviours to stay healthy, integrating health and wellbeing into the workplace culture, and in some cases providing access to comprehensive health insurance plans.
- **Central and local government:** Governments play a critical role in shaping the overall health environment through policies, regulations, and investment. This includes implementing policies across all sectors of government that encourage healthy behaviours and address social determinants of health. Examples include investment in affordable and good quality housing, social security benefits, taxation on unhealthy food and drink, improving air and water quality, and incentivising active transport and other healthy choices.

Governments play a critical role in shaping the overall health environment through policies, regulations, and investment.

Figure 10. A health promotion and protection approach requires input from cross-sector actors beyond the NHS to enable these changes.

Central government
DWP | MHCLG | DfT | DEFRA

In 2035, **DHSC** will solidify its **"Health in All" policies approach, collaborating cross-departmentally** with **all external actors** to **address prevention factors beyond healthcare**, such as **housing, employment** and the **environment**.

Retail and community health and local government
Pharmacies | GPs | Supermarkets | Dentists | Hearing & optical | Local government

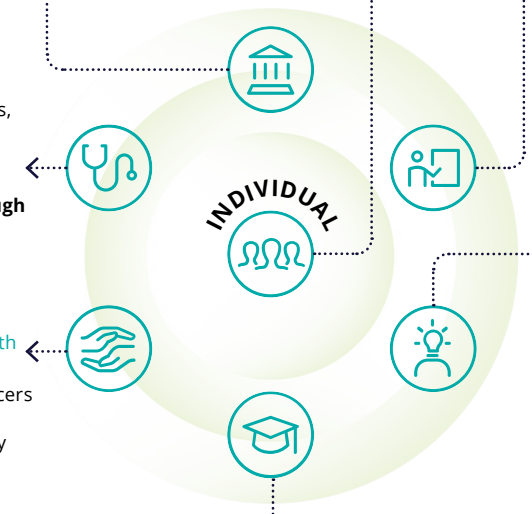
In 2035, retail and community health providers, *alongside the devolved local government*, work collaboratively to provide access to health information and **prevention services on the high street**, based on **needs identified through insights from wearables, remote tech, and people's connected health records.**

Non-profit
Mental health charities | Physical health charities | Age-related charities

In 2035, charities are important digital influencers to **disseminate trusted health information** and advice to under-served communities. They **orchestrate local and virtual communities** focused around primary and secondary prevention.

Individuals
Family | Friends | Social media (influencers)

In 2035, **individuals choose who they trust with health data** and are empowered to **access verified sources of health information**. Mitigations against the **dangers of mis-information** will exist. Individuals will **be active in making healthy choices, and creating and implementing local solutions to their unique health challenges.**



Employers and health insurers
Employers (all industries) | Payers | Insurers

In 2035, **employers** will **cultivate a culture of well-being** to promote the health and productivity of employees and their families.

Health and work will be seamlessly integrated with smart workspaces featuring **sensors monitoring air quality, lighting,** and **noise levels** to **optimise the work environment** for **physical** and **mental health** and **provide real-time feedback** on **posture, stress levels** and early signs of **burnout**.

Employee data will provide **more accurate risk assessments** for **insurers/payers**, and in turn incentivise and reward preventative behaviours from employees, improving health and productivity.

Innovators in the health space
Pharma/biotech | Life science research | Venture Capital funding | Private health | Consumer health | Big tech

In 2035, private sector health innovators will **offer free wearables** and digital health platforms, with **data collection being the trade-off for users. Wearables** will **revolutionise clinical trials** and **post-market surveillance**, providing pharma with **real-world** drug efficacy and safety **data**.

Personalised medicines will be developed **based on genetic profiles** and **lifestyle factors identified** through **wearable** and health **data analysis. HCPs** will be **automatically alerted** to a subtle **change in a person's heart rhythm** via their **wearable, promoting a check-up.**

Education
Schools, universities | Teachers | Support workers (e.g., social workers, counsellors)| School nurses

In 2035, schools have **thorough health education & digital skills built into national curricula**. Teachers, school nurses and support workers **encourage healthy habits and mental health awareness**. Lessons learned inspire children to **share what they learned across generations**.

Critical enablers to reap the rewards

Transitioning to a new ecosystem for health promotion and protection is a significant undertaking that will require a collective effort from all sectors of society. By embracing technological advancements, fostering collaboration, and giving individuals the means to stay healthy, all stakeholders across the ecosystem can drive a healthier and more prosperous future for all.

Several key enablers are crucial for realising this future vision. Figure 11 illustrates some of the most critical of these:

- **Empowering individuals and communities:** Empowerment starts with providing individuals and communities with the knowledge, skills, and resources to control their health. This involves promoting health literacy and providing access to trusted health information.
- **Addressing social determinants of health:** All stakeholders in the prevention ecosystem address the wider determinants and upstream prevention that can influence health outcomes (e.g., environment, education, transport, town planning, green space, and food security).
- **Developing a skilled workforce:** It will be essential to equip the healthcare workforce with the skills and knowledge to deliver targeted care and effectively utilise digital health technologies. This requires ongoing professional development, training programmes, and integrating public health competencies into healthcare education.
- **Data and technology as a foundation:** Modernising data sharing to realise the health promotion and protection ecosystem requires a robust foundation. A critical first step is to address current limitations in health data management, including interoperability and connectivity. This includes significant investment in data infrastructure to break down data silos and establish clear, consistent standards. With these foundations in place, secure and interoperable digital health records and data, empowered by AI, become achievable. This advancement will provide healthcare professionals with comprehensive patient data, facilitate coordinated care, and enable AI-driven analysis to identify at-risk individuals and develop personalised interventions.

- **Public trust in technology and data sharing:** Our vision hinges on trust in sharing personal health data and using digital technologies for health promotion activities. To secure this public trust, it is essential that robust data and privacy governance frameworks are in place, given the necessary involvement of private sector actors in developing and operating these technologies. Individuals must have ultimate ownership and control over what they share, with whom they share it, and for what purpose, so they can feel confident it is being used ethically and in their interests.
- **Shifting incentives to encourage health promotion:** It is crucial to align incentives for both individuals and healthcare providers to prioritise health promotion and protection measures and reward positive health outcomes. This includes exploring innovative payment models that reward value-based care and incentivise keeping people healthy rather than just treating illness. Incentives should also reward private sector actors who wish to develop, test and deploy preventative health innovations.
- **Policy and legislation as key drivers:** Implementing supportive policies and regulations will be essential for creating the systemic changes that are needed to make healthy choices by individuals easier and more accessible. This includes financial incentives (e.g. subsidies for healthy foods, tax breaks for healthy behaviours), non-financial incentives (e.g. increased access to healthy options through nutritional education), or disincentives (e.g. restrictions on marketing of unhealthy foods).
- **Evaluating impact and building evidence:** There must be a robust system for evaluating the impact of proposed innovations. This includes conducting randomised clinical trials, modelling, and observational evaluations to assess whether new technologies truly improve health outcomes and reduce NHS burdens. Critically examining assumptions and building a strong evidence base will enable more informed decision-making about resource allocation.

Figure 11. Key enablers powering the future of health promotion and protection.

Conclusions and provocations

Our vision for a new ecosystem of health promotion and protection is ambitious. Success hinges on a collaborative effort from all stakeholders, including the NHS, government, private sector, communities, and individuals. By embracing technology, empowering individuals, and addressing social determinants of health, the UK can create a more sustainable, equitable, and effective healthcare system for the future.

Realising this vision will require a paradigm shift. This exploration into disease prevention has raised the following critical questions for public and private sector architects of the health system to consider.

Individuals/ Society

- How does everyone build a new social contract, encouraging greater engagement by individuals in preventative behaviours?
- Will people trust the custodians of their health data, and the providers of health advice, when it is removed from traditional healthcare settings?
- How do we empower individuals to act on the information and insights made available to them?
- How do we simultaneously target those at greatest risk and inequity, whilst addressing scale opportunities?

NHS

- Can all (or most) of an individual's first contact with the health system be virtual (rather than a visit to a bricks and mortar institution)? Does it apply better for certain treatments?
- Who should control health data – individuals themselves, the NHS or other actors – balancing population level data sharing and user control? What does informed consent look like?

Government

- Would creating a single/direct line for budget and governance structure for health promotion and protection bring greater accountability?
- How do you incentivise non-NHS actors to develop and scale interventions?
- Is the government willing to make the regulatory and policy changes necessary to make the system work?

Appendix – Lessons from case studies

In this Appendix, we describe several successful case studies demonstrating the tangible impact of preventative interventions.

These examples showcase the potential of:

- Targeted screening programmes for those at highest risk (e.g., Yorkshire's Lung Health Checks)
- Community-based vaccination initiatives to prevent infectious diseases
- Improving blood pressure control through health literacy interventions
- Using AI technology to identify people with long-term conditions and offer targeted coaching (NHS North-East London)
- Leveraging data to enable personalised interventions (Digital Twin-Enabled Personalised Nutrition)
- Utilising genomics cardiovascular integrated risk tools
- Scaling colonoscopy programmes with multi-level nudges
- Implementing family-focused obesity prevention programmes.

Intervention: Expand and modernise screening and vaccination programmes

Case study 1 – Targeting screening programmes at those with the highest risk[1]

The targeted lunch health check programme started in 2019 and was expanded in 2023 to a national scheme – identifying people aged 55 -74 at increased risk of lung cancer. South Yorkshire was involved in the roll out of earlier phases.[2]

As a further phase of Yorkshire's Lung Health Checks, a second invitation is being sent those who were not diagnosed in the first check.

Invitations were not taken up by certain cohorts, e.g. smokers and some individuals affected by poverty. Analysis was able to target those individuals using data for support and navigation..

Actors

- Individuals
- Central government
- Innovators in the health space

Enablers

- Empowering individuals and communities
- Workforce
- Shifting incentives to reinforce prevention

Impact seen

Since launching in November 2018:

- 15,000 lung scans have taken place in the mobile units
- Over 340 cases of lung cancer have been diagnosed

Case study 2 – Training community health workers to provide door-to-door vaccination[3]

BRAC, a non-governmental organisation in Bangladesh, trains community health workers to provide door-to-door vaccine education and promotion in rural communities. These trusted individuals build relationships with families, address concerns, and encourage vaccination, with a focus on inclusivity.

Actors

- Individuals
- Retail and community health
- Education
- Non-profit

Enablers

- Empowering individuals and communities
- Workforce
- Shifting incentives to reinforce health promotion and protection

Impact seen

- Administered 29 million doses of COVID-19 vaccines to individuals and distributed 5 million vaccine doses across the country.
- Achieved a significant reduction in mortality due to TB (50%) and malaria (91%) since the inception of the project (2004 onwards).

Intervention: Health education and lifestyle choices

Case study 3 – Improved blood pressure control following health literacy interventions[4]

Health literacy interventions for blood pressure control (such as web-based interventions, face-to-face training, workshops, and counselling), improved blood pressure outcome. Iin a literature review six of seven studies reviewed, the studies with a significant impact had the following aims: 1) Testing intervention effect, 2) Grading the effect of hypertension effect to intention, 3) Knowing the effectiveness of an integrated programme, 4) Evaluating the effect of self-management education, 5) Evaluating the effectiveness of communication skills training on the outcomes of hypertension, and 6) Understanding the effect of evidence-based patient decision aids.

Actors

- Individuals
- Education
- Government
- Non-profit

Enablers

- Empowering individuals and communities
- Shifting incentives to reinforce prevention
- Policy and legislation incentives as key drivers

Impact seen

- Improved outcomes in hypertensive patients, health literacy skills and hypertension self-management
- Long-term impact for individuals benefitting from self-management
- Potential savings from prevented healthcare costs

Intervention: Digitally led behavioural change

Case study 4 – The Cancer Loyalty Card Study: an observational case-control study focusing on the patient interval in ovarian cancer diagnosis[5]

A change in purchasing behaviour, primarily an increase in self-medication to treat symptoms, can provide a novel opportunity for earlier detection of cancer. An increase in uptake of these medications could provide an alert about alarming symptoms, prompting women to see a clinician sooner than they might have done otherwise and potentially leading to an earlier diagnosis of ovarian cancer.

Actors

- Individuals
- Retail and community health
- Non-profit

Enablers

- Data and technology as a foundation
- Shifting incentives to reinforce health prevention
- Policy and legislation incentives as key drivers

Impact seen

- Long term impact for individuals benefitting from earlier diagnosis
- Productivity benefit avoiding chronic conditions in the workplace
- Potential £210m p.a. savings if all cancers can be diagnosed as early as in best areas[6]

Intervention: Preventative data-led population health management

Case study 5 – Patients with chronic conditions offered personalised care through population health management[7]

A group of patients in North and North East Cumbria at risk of becoming unwell due to chronic physical health problems and depression were identified using a population health management approach. A cohort of 34 people who were struggling with issues affecting their health such as finance, housing, mood and lifestyle were identified. A working group of health and care professionals including a public health consultant, GPs, a social prescribing link worker and the clinical commissioning group medical director used data from SystmOne to find and treat the group.

Actors

- Individuals
- Government
- Innovators in the health space
- Enablers
- Data and technology as a foundation
- Empowering individuals and communities

Impact seen

- Long-term impact for individuals benefitting from comprehensive diagnosis
- Potential savings from prevented healthcare costs if condition can be managed through social determinants of health

Intervention: Need-led biochemical interventions

Case study 6 – A new generation of long-acting therapies that can be used to manage risk factors[8]

Alongside existing solutions, we have a new generation of long-acting therapies that can be used to manage risk factors such as cholesterol and blood pressure based on annual injections, effectively vaccines for heart disease and stroke. Inclisiran alone could prevent 55,000 heart attacks and strokes, while treating someone for five years after they have a stroke can cost the NHS as much as £45,000.

And, for the first time, we have a new set of therapeutics that will help us tackle the biggest of all risk factors, obesity, which alone costs the country nearly 4 per cent of its GDP in illness and losses in productivity.

Actors

- Individuals
- Innovators in the health space
- Retail and community health

Enablers

- Shifting incentives to reinforce health prevention

Impact seen

- Long-term impact for individuals suffering with chronic conditions
- Productivity benefit managing chronic conditions in the workplace

Intervention: Addressing Polypharmacy

Case study 7 – Digital twin-enabled personalised nutrition improves metabolic dysfunction-associated fatty liver disease in type 2 diabetes[9]

- Postprandial hyperglycemia drives insulin resistance and inflammation, leading to metabolic dysfunction-associated fatty liver disease (MAFLD)
- Prediction of postprandial glycemic responses by digital twin (DT) technology can fashion a personalised nutrition, activity, and sleep to treat type 2 diabetes and MAFLD
- At 1 year, the digital twin solution-enabled personalised treatment for individuals with type 2 diabetes which led to significantly improved outcomes (in improved hyperglycemia and surrogate markers of MAFLD and MRI-PDFF).

Actors

- Individuals
- Retail and community health
- Innovators in the health space

Enablers

- Data and technology as a foundation
- Empowering individuals and communities

Impact seen

- Increased healthy life expectancy
- Productivity benefit avoiding chronic conditions in the workplace
- Potential savings from prevented healthcare costs if condition can be managed through healthy diet

Intervention: Omics in everyday care

Case study 8 – Genomics cardiovascular integrated risk tool[10]

- World-first trial with the NHS, HEART, demonstrated feasibility and clinical utility of Genomics cardiovascular integrated risk tool (CVD-IRT).[11]
- 24% of participants had clinically significant changes in CVD risk when genetics added to QRISK in an integrated risk tool.
- GPs reported they would change their management of 13% of the study population as a result of their integrated genetic risk.

Actors

- Individuals
- Retail and community health
- Innovators in the health space
- Government

Enablers

- Data and technology as a foundation
- Empowering individuals and communities

Impact seen

- Increased healthy life expectancy
- Potential savings from prevented healthcare costs if CVD can be prevented.
- Increased workforce resilience and productivity if CVD can be prevented.

Intervention: Connected digital care

Case study 9 – Using multi-level nudges to scale colonoscopy programmes[12]

Penn Medicine Primary Care that uses multi-level nudges for colonoscopy prep involving behaviourally informed texts to patients to get them ready for the procedure. The preparation navigation programme included text instructions to patients and responses to questions in the week leading up to their procedure.

Actors

- Individuals
- Innovators in the health space
- Retail and community health

Enablers

- Empowering individuals and communities
- Data and technology as a foundation

Impact seen

- 28 percentage point increase in show rates to colonoscopy appointments.
- Improved colonoscopy rates will result in early treatment, as needed.

Intervention: Action across sectors to address social determinants of health

Case study 10 – Family-focused obesity prevention programme[13]

Families in the intervention group participated in cooking and nutrition education sessions, goal-setting activities, and motivational interviewing telephone calls to promote behavioural goals associated with meal planning, family meal frequency and healthiness of meals and snacks.

Actors

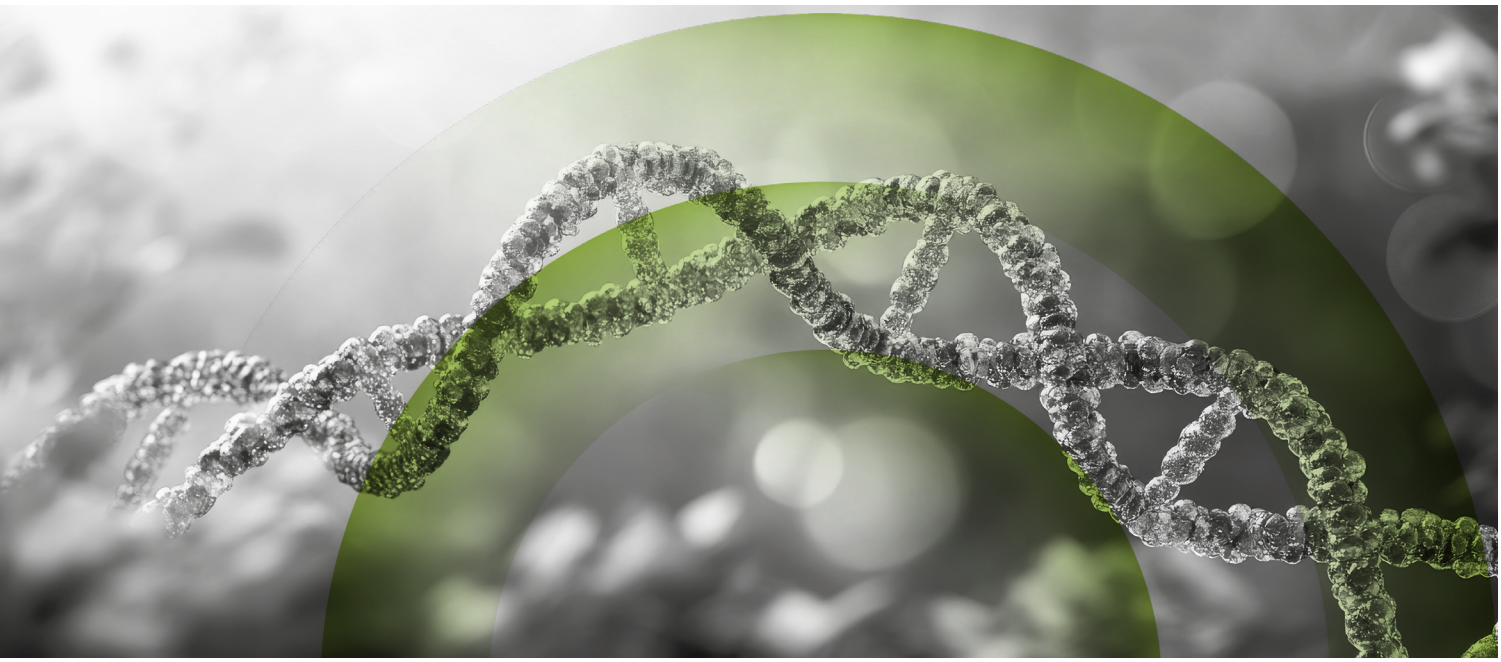
- Individuals
- Retail and community health

Enablers

- Empowering individuals and communities

Impact seen

- Parents and children reported that the most enjoyable component was cooking with their families, learning how to eat more healthily, and trying new recipes/ foods and cooking tips.
- Average session attendance across the ten months was high for families (68%) and more than half completed their home activities.



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