THE FUTURE OF CANCER PREVENTION

OUR PREVENTION RESEARCH STRATEGY

Together we will beat cancer

CANCER RESEARCH UK

CONTENTS

EXECUTIVE SUMMARY

THE MISSION

Preventing cancer is one of our strategic research objectives.

We have a track record of supporting highly impactful epidemiology and behavioural research which has transformed our understanding of cancer risk factors and how to modify these to prevent cancer.

But more can, and must, be done to beat cancer.

A new era of biological tools and insights has unlocked an opportunity to transform what we consider possible in cancer prevention research. The current consensus is that around 40% of cancers can be considered to be preventable[1] through reduction in known modifiable risk factors such as tobacco and obesity. However, increasing the translation of fundamental biological insights has the potential to significantly increase the proportion of cancers considered preventable and to develop much more precise preventive interventions.

The individual impact of every cancer diagnosis for patients and their communities can be devastating, and the costs of cancer detection and treatment add to the challenges the NHS faces (while the incidence of many cancers continues to rise). Early detection and therapeutic innovation will make great strides in addressing this, but it is primary prevention of cancer that will have the greatest impact when it comes to saving lives and unburdening health systems across the UK.

Primary prevention of cancer will have the greatest impact when it comes to saving lives and unburdening health systems across the UK.

THE CHALLENGE

While there has undoubtedly been impact through, for example, smoking reduction and HPV vaccination, cancer prevention research has been held back by numerous issues which we must seek to address.

As a field, it has been chronically under-studied, in the UK and worldwide. Funding has mainly focused on epidemiology and behavioural intervention, missing opportunities to explore how mechanistic insights could underpin novel prevention research. Cancer prevention research is also constrained by the requirement for huge scale studies and lengthy timelines to deliver definitive outcomes, with too few surrogate endpoints or innovative methodologies that might accelerate progress. These limitations result in an insufficient pipeline of new investigators in the field and contribute to a significant market failure in delivering new cancer prevention interventions.

THE OPPORTUNITY

We will deliver a radical step-change in our approach to primary cancer prevention research and a re-evaluation of what we consider possible in cancer prevention, built on mechanistic understanding.

In line with our refreshed research strategy and new organisational strategy, we will put discovery at the heart of all we do. This long-term strategy for prevention research is a statement of intent to the global research community and will guide our planning and investments in this area. To address the challenges and deliver this step-change, we will focus on five strategic themes:

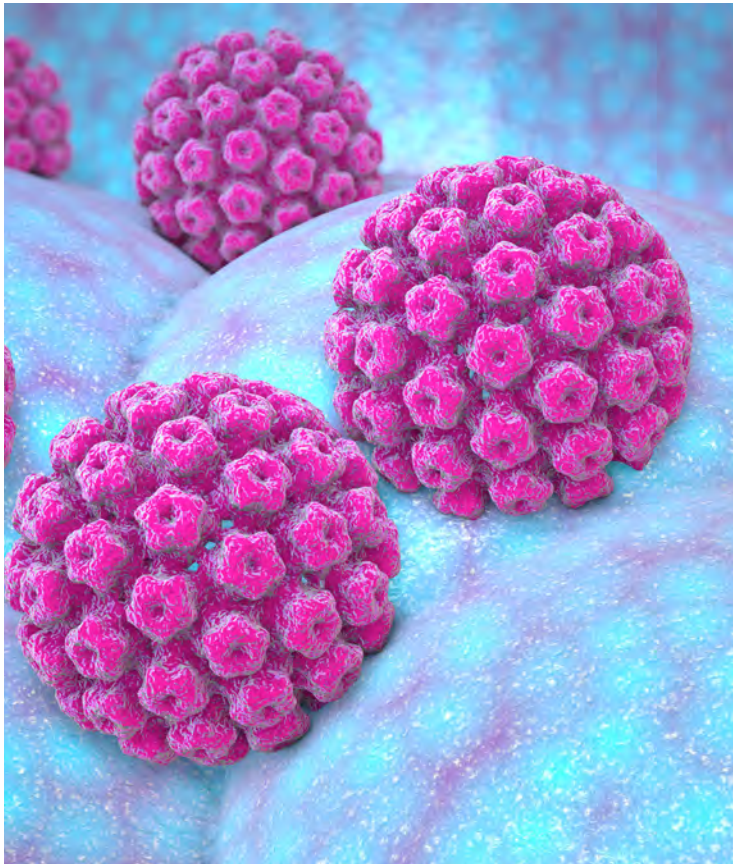
- **Bringing biology to prevention**
  We will harness fundamental biological discoveries to provide new prevention targets and interventions.
- **Deepening understanding of risk**
  We will deliver a more thorough and integrated understanding of population and individual risks of developing cancer, in order to underpin precision prevention.
- **Reaching further with precision prevention**
  We will develop disruptive preventive interventions, precisely targeting risk factors and mechanisms, through behavioural, pharmacological and immunological means.
- **Understanding and addressing health inequalities in cancer incidence**
  Delivering research to support a more effective and equitable public health approach to cancer prevention.
- **Building prevention research capacity and community**
  Reaching beyond the current prevention community to attract new researchers and novel thinking, across career stages and disciplines.

THE INTERVENTION

Across these strategic themes, we've identified a number of priority research areas where action is most needed, and opportunity is greatest.

We will accelerate progress in cancer prevention by investing in research to understand and address how cancers develop, progress and may be prevented, in relation to:

- **tobacco and vaping**
- **obesity, metabolism, diet and physical activity**
- **infection, immunity, inflammation and the microbiome**
- **accumulation of somatic mutations**



In order to deliver against these strategic themes and accelerate progress in these priority research areas, we will:

- engage and build a broader, multidisciplinary prevention research community and a network of partner organisations with aligned interests
- stimulate new types of prevention research aligned to this strategy's themes, build relationships and seed new ideas through workshops, conferences and other mechanisms, and support new lines of prevention research through multiple funding routes
- increase the presence of prevention research in our infrastructure and training portfolio
- explore targeted research investments around key questions and challenges

INTRODUCTION

Cancer prevention has long been a strategic objective for us.

We support a strong portfolio of relevant research today, from epidemiology to better understand cancer risk and causes, to research aiming to develop and implement interventions to prevent cancer and reduce cancer risk. We are proud of the role that we and our research community have played, and are playing, in preventing cancer.

However, as we look forward into the next decade, we want to explore what opportunities there are to make greater progress in preventing more cancers. Where might we do more, and where might we do things differently? How can we push the boundaries of what might be considered possible in cancer prevention research?

We have consulted with over 100 experts in the UK and internationally from across the prevention research community and beyond it - from industry and, crucially, from patients and the public. We sought input from those who have made the biggest impacts in cancer prevention research and those with relevant but untapped skillsets which could potentially deliver future prevention impact. We deliberately sought diverse and divergent views from an array of fields, inviting challenge, disruption and innovation.

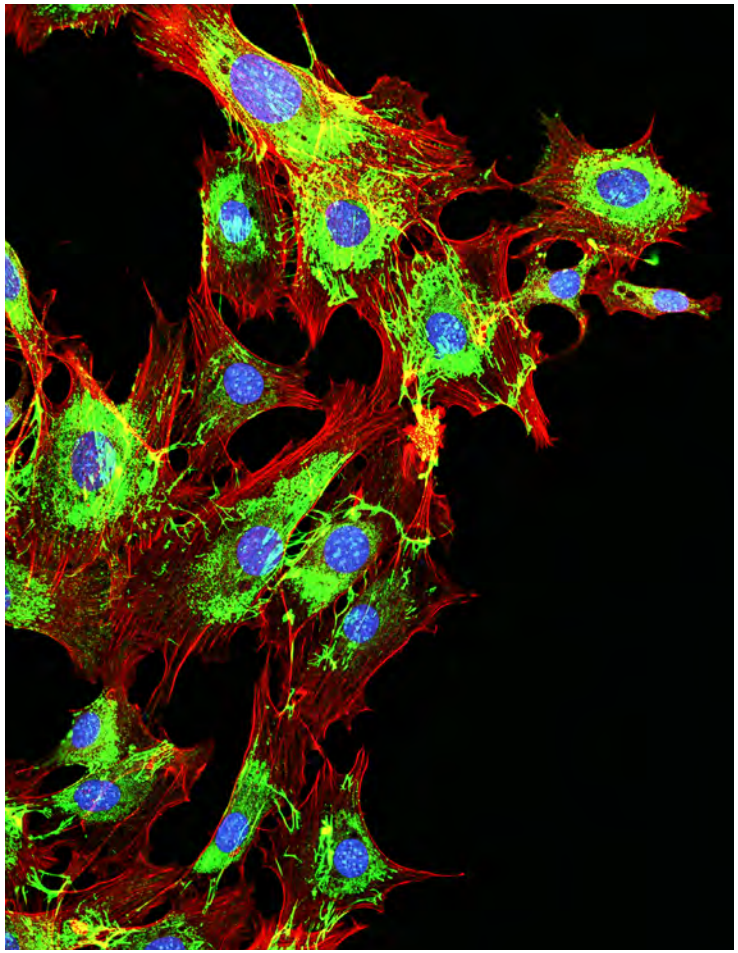
While early detection and therapeutic development are essential in tackling cancer, in our vision many more types of cancer will be prevented from developing in the first place. This strategy sets out the challenges facing us, and a vision for how we might accelerate progress in prevention research towards that future.

In our vision many more types of cancer will be prevented from developing.

THE CHALLENGE

In the UK, the number of people with cancer is set to rise from 2.5 million to 4 million people by 2030[2,3].

This rapid growth is linked to increasing longevity (with ageing being by far the most significant risk factor) and a dramatic increase in exposures to various modifiable risk factors such as obesity, poor diet, declining physical activity and other behaviour changes associated with modern life in a developed economy. This will be exacerbated by existing, significant, inequalities in public health and cancer outcomes[4,5]. Progress is being made – currently more than half of people diagnosed will survive their cancer for more than 10 years. However, the predicted increase in cancer burden will exert tremendous physical, emotional and financial strain on individuals, families and communities, and on already stretched health systems.



The COVID-19 pandemic has demonstrated the fragility of the UK's health systems and unfortunately led to significant delays or reductions in cancer diagnosis and treatment. This could be indicative of the consequences of a future with greater demand for cancer diagnosis and treatment, and less resources[6]. Treatment alone cannot remove these burdens and therefore cancer prevention approaches are essential to improve health outcomes and unburden the health system. This can only be enabled through supporting high-quality research[7,8,9].

Progress in cancer prevention research, however, has been markedly constrained due to six significant barriers. These challenges must be addressed in order to deliver new and innovative cancer prevention approaches.

> The discipline of oncology won't develop cancer prevention research. We need to engage practising clinicians to look after the health of organ systems before cancer starts. There aren't any medical cancer prevention experts – maybe there should be. We should be thinking like cardiologists with regards to maintaining health

Dr Farhat Din,
University of Edinburgh

Underfunding

Cancer prevention research is significantly underfunded, in the UK and globally. In 2019/20, only 6.9% (~£46m) of cancer research in the UK was specifically for prevention research across all major funders[10,11]. Previous prevention research has had an immense impact on health, clearly demonstrating the potential of considered long-term funding[12,13].

Lack of mechanistic insight

There is a significant disconnect between population research and research to understand the underlying biology of cancer risk and genesis. This has led to a lack of mechanistic insight underpinning prevention research. Such knowledge could enable better stratification of those at higher risk, identification of novel preventive targets and the design and delivery of innovative, precise preventive interventions addressing individual or combinations of risk factors[14].

Protracted timelines

Cancer prevention research has protracted timelines due to the lag between the exposure to causal/risk factors or preventive interventions and observable effects on cancer incidence; this is exacerbated by the lack of surrogate markers predictive of incidence or mortality[15,16]. This is a contrast to therapeutic prevention in cardiovascular disease, which has well-validated surrogate biomarkers.

Talent pipeline

The prevention research field has challenges with attracting and retaining emerging talent, which is due to factors such as lack of funding opportunities and protracted timelines meaning fewer research outputs. It is especially an issue amongst clinically trained prevention researchers, whose expertise is vital for preventive therapy clinical trials[17]. An emphasis across many key funders on prevention research could start to address this key issue.

Market failure

Due to the length and cost of prevention trials (resulting from a lack of sufficiently validated at-risk populations and surrogate endpoints), there are significant barriers to commercial translation of therapeutic prevention agents. This has resulted in a market failure to drive progress.

The perceived lack of a business model is partly due to the great cost and length of prevention trials, which only gives companies a narrow window to profit before the end of any patents generated. It is far more straightforward to develop drugs for late-stage cancer[18,19]. However, successes seen through HPV vaccines and cardiovascular disease prevention do provide clear examples of how it can work.

Widening inequalities

The cancer risk associated with certain modifiable risk factors are not spread equally across society; there is a strong systemic relationship with socioeconomic deprivation, ethnicity and gender, for example[20]. In parallel, there is real potential for preventive interventions to disproportionally benefit the most affluent parts of society, (who are generally more engaged with health maintenance), and to not benefit those who are most deprived who are at greater risk of cancer. It is key to ensure any novel preventive interventions address and do not exacerbate existing health inequalities in society.

> “The technology has previously been lacking to allow population studies to properly measure exposures and aspects of biology – now the technology is catching up, it’s a great time to increase our ambition in prevention research”

Professor Kay-Tee Khaw,
University of Cambridge

A NEW PREVENTION RESEARCH STRATEGY

We are sharpening our approach to prevention research, and re-evaluating what we consider possible in cancer prevention. This strategy is a declaration of what we want to achieve.

SCOPE AND VISION

Cancer prevention research seeks to:

- understand populations and individuals at risk of cancer and the underlying reasons for that risk
- identify targets for preventive intervention by utilising a deep understanding of the mechanisms of causes of cancer (genetic, endogenous and environmental)
- develop and evaluate interventions to prevent cancer or ameliorate risk of cancer
- generate evidence to support the implementation of effective preventive interventions

This strategy focuses on research aiming to deliver primary prevention of cancer; that is, preventing the occurrence of cancer in individuals who have not previously had it. Related, but out of scope of this strategy, are screening efforts for early cancers and prevention of relapse or recurrence in cancer survivors. These important fields are supported through other areas of our overarching research strategy.

OUR VISION FOR PREVENTION RESEARCH

We will transform our ability to precisely target significant risk factors and intervene to drive down cancer incidence equitably across society.

STRATEGIC THEMES

We aim for a future of precision cancer prevention, based on a deep and nuanced understanding of risk and of endogenous and exogenous aetiological mechanisms in the cancer cell, its microenvironment, the immune system and the whole human.

This understanding will have the purpose of delivering targeted interventions to reduce risk or prevent cancer entirely, be they behavioural, pharmacological or immunological. We will commit to this over the long term – with ten years of investment and with impact reaching much further – in order to truly drive change and progress. We will focus on five strategic themes to accelerate progress in cancer prevention through research.

Prevention research strategic themes

1. BRINGING BIOLOGY TO PREVENTION

Integration of biological discovery with behavioural and population research will yield new targets and more precise understanding of risk and will enable more impactful and precise preventive interventions at both the individual and population level[21].

We aim to engage and inspire researchers to collaborate in order to integrate understanding of mechanisms with the well-established excellence of UK prevention research. We will harness the excellence of the UK and international discovery science community (particularly within our institutes and centres) to discover mechanisms of action of risk and protective factors, supporting deeper, more effective risk stratification and, crucially, identifying new targets for preventive intervention, which together will deliver precision prevention. This should encompass understanding of variation and function in normal tissue and in cells which are resistant to cancer or which maintain normal phenotype despite seemingly harbouring driver mutations, as well as insights around the immune system, inflammation, obesity and ageing.

2. DEEPENING UNDERSTANDING OF RISK

We need to utilise these mechanistic insights to deliver a more nuanced model of cancer risk, integrating data from across germline genomic variation, somatic mutations, family history/ heritability, demographic and social factors, infection, environmental exposures, behaviours and other risk factors. Development of risk models and appropriate targeted screening approaches are essential elements of progressing this area and are closely linked to our Early Detection and Diagnosis Strategy.

Beyond screening for pre-cancers, this deeper insight into risk will also identify groups and individuals suitable for targeted preventive interventions. This will involve discovery and translational research to develop new signals and scores, but also clinical and implementation research to bring validated risk models into practice. A more precise understanding of risk will also reduce the burden of screening and interventions for those at lower risk of cancers.

In line with our new overarching research strategy, there is a significant role in this theme, and throughout this research strategy, for data science. This will be a crucial area for funding and prevention research will be a key facet of our research data strategy.

> “If individuals are identified as being at elevated risk of cancer, they will be much more likely to comply with risk-reducing or preventive interventions”
>
> Professor Claire Turnbull,
> The Institute of Cancer Research

3. REACHING FURTHER WITH PRECISION PREVENTION

Development of novel preventive interventions is a major priority for us in order to reduce the number of people affected by cancer. This will include more nuanced and targeted behavioural interventions, tailored to the risk/aetiology/behaviours of defined populations, groups or individuals (a strength for Cancer Research UK and for the UK as a whole). Importantly, this theme will also include a major shift in delivery of options for innovative chemopreventive and immunopreventive strategies (also known as therapeutic prevention) including preventive cancer vaccines (for cancers themselves, not just for the viral risk factors). This theme will also consider repurposing of agents for prevention from existing therapeutics (in at-risk groups and where the safety profile permits).

There is an important role for dialogue with the public and policymakers about the appetite for such interventions and their cost-benefit implications for individuals and healthcare systems. We will act to develop and de-risk potential approaches, lowering barriers for industry investment.

4. UNDERSTANDING AND ADDRESSING HEALTH INEQUITIES IN CANCER INCIDENCE

Making progress in prevention will require a concerted research agenda to understand the impact of inequalities between different groups of the population in their risks of cancers. Research must also address current health inequities, for example by ensuring that all sectors of the population are factored into models and stand to benefit from advances in risk assessment and prevention. We need to ensure that insights from research are derived from, and applicable to, wider populations. Behavioural and policy research will be needed to ensure that all populations are reached, and that effective interventions are implemented and utilised appropriately, reaching those at highest risk (including those who are subject to greater socioeconomic deprivation). All aspects of this strategy will require patient and public engagement and involvement, and this will be particularly crucial in this theme.

Many risk factors for cancer associated with inequities are also risk factors and causal processes for many other chronic diseases (for example, ageing, inflammation, metabolic dysfunction, air pollution, obesity, poor diet, smoking and their association with diabetes, cardiovascular disease, neurodegeneration). In order to effectively intervene in such risks (whether medical, behavioural or via policy) we will need to develop partnerships with organisations with interests across disease areas.

5. BUILDING PREVENTION RESEARCH CAPACITY AND COMMUNITY

Building additional research capacity in prevention will be critical if we are to make progress in a field which has struggled to expand its talent pool and achieve critical mass. Expanding the vision of what cancer prevention can be, will draw a wider, more diverse talent pool to attack the problem.

We will attract an array of disciplines into cancer prevention research, and will support early career researchers in establishing themselves, developing the next wave of leaders in prevention research. A new cadre of trans-disciplinary cancer prevention researchers will be trained, fluent in the languages of biomedical, population, behavioural and health system research.

The growth of this community will be enabled by a strong partnership ethos, with research funders, government agencies and industry, across disease areas and nations.

WHAT WE WON'T DO

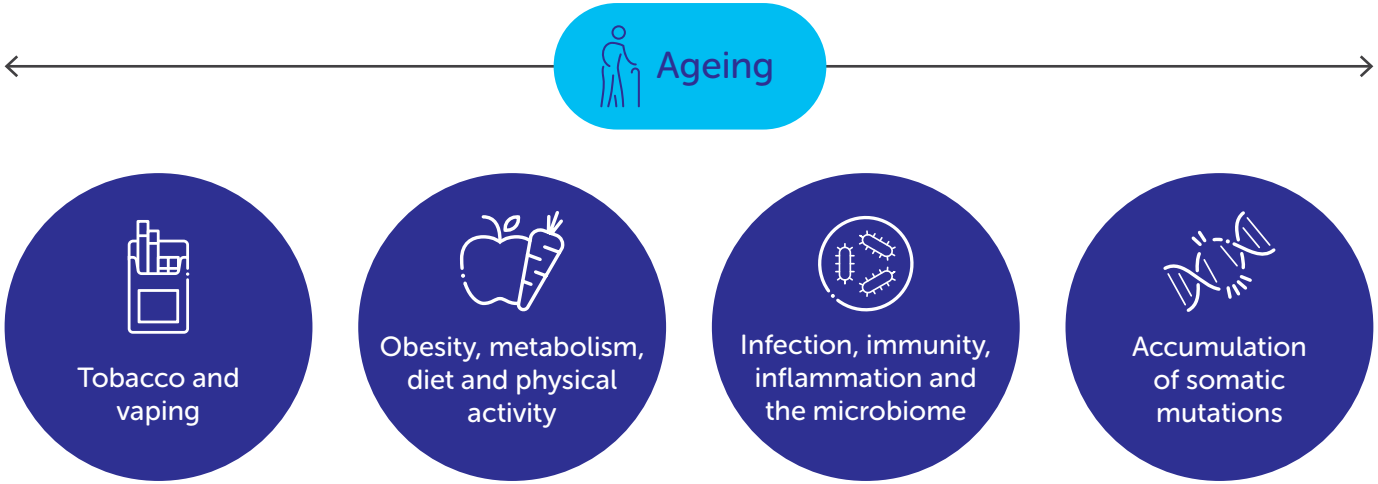
We will continue to build the research evidence base for subsequent policy interventions as they relate to cancer directly (such as diet, air pollution, smoking). We will feed this evidence into wider debates about healthier society such as those focused on air quality, education, welfare, transport, health and social care, and the activities of corporations. However, our focus will remain firmly on cancer.

Beyond engagement in multi-funder, pan-disease initiatives of relevance to cancer prevention (such as the UK Prevention Research Partnership[22]), we will not seek to fund research into the "causes of the causes" of cancer, ie the underpinning socioeconomic determinants of health.

PRIORITY RESEARCH AREAS

Extensive consultation, taking into account the challenges mentioned and building on the strategic themes, led to distillation of the following five priority research areas for cancer prevention research. We will invest in research aiming to understand and address these factors:

Cancer prevention priority research areas



1. TOBACCO AND VAPING

We have made great strides in reducing smoking rates but there is more to be achieved to prevent the large number of avoidable cancers still linked to tobacco use. This will continue to be through reducing tobacco use and understanding the risks and opportunities of vaping and other tobacco cessation interventions. We will invest in research to accelerate impact from proven interventions to reduce tobacco use, as well as development and evaluation of novel and better-targeted approaches. As more people use vaping and other cessation interventions, there is a timely need to investigate the safety profile of these interventions and ensure their appropriate use.

2. OBESITY, METABOLISM, DIET AND PHYSICAL ACTIVITY

We will support research to understand the mechanisms of how obesity and related phenomena are linked to cancer, including the interplay of genomics, diet, metabolism, physical activity, fat type and distribution, the inflammatory environment of adipose tissues etc. We will use this insight to define, develop and implement optimal cancer prevention interventions targeted to mechanism and risk strata. This includes research around the impact of weight loss on cancer risk, mechanistic insight to underpin precision intervention development (such as those targeted to particular strata of metabolism, nutrition or fat composition/distribution) and surrogate markers of cancer incidence.

3. INFECTION, IMMUNITY, INFLAMMATION AND THE MICROBIOME

We will optimise strategies for cancer prevention through reducing known cancer-associated infections. We will also support research hunting for other pathogens which increase cancer risk and to understand mechanisms of pathogen-induced cancer. We will seek to increase understanding of the effect of the microbiome and its interplay with the immune system in modulating cancer risk, understanding the interplay of the immune system/inflammation/obesity on cancer risk, and using these insights to develop and tailor preventive interventions. This may include development of measures of inflammation/immune dysregulation as surrogate endpoints for prevention interventions. We will seek to increase understanding of how well-functioning immune surveillance suppresses cancer/pre-cancers and to translate that to immunopreventive strategies.

4. ACCUMULATION OF SOMATIC MUTATIONS

We will support research to understand the contribution and mechanisms of accrual of somatic mutations on cancer incidence (ie in the proportion of cancers currently considered non-preventable). Using this evidence to identify new targets and approaches for preventive intervention will be the next step. This involves understanding pre-cancerous and non-cancerous clonal expansion, why some somatic mutations cause cancer in one biological context but not others, and how phenotypically normal tissue can harbour cancer driver mutations. We will support research to translate this mechanistic understanding to identify causal and protective mechanisms which might be amenable to preventive (or risk-reducing) intervention.

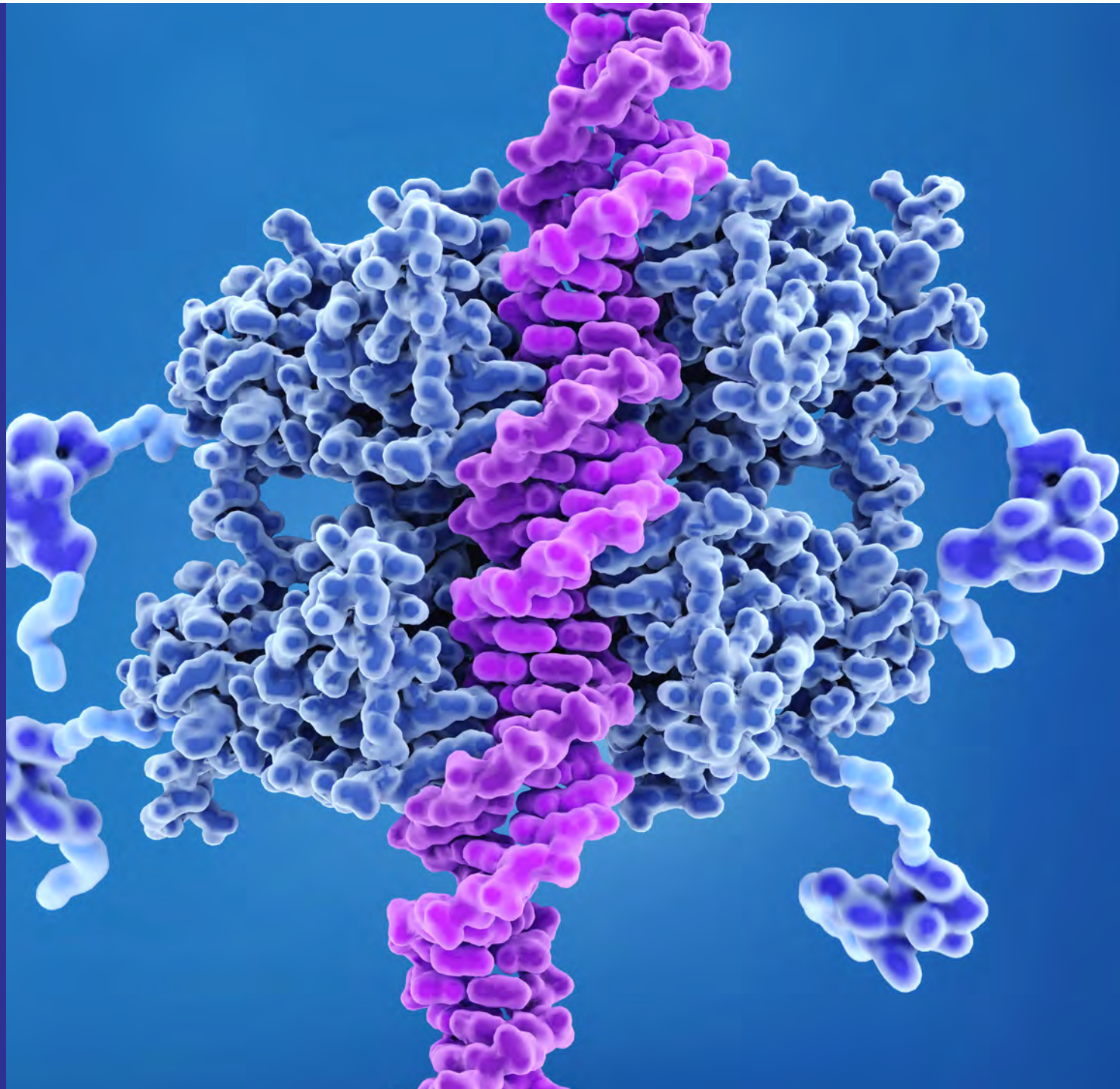
5. AGEING

Ageing is the single biggest risk factor for cancer. The impact of ageing cuts across all priority research areas. Not only do somatic mutations accumulate and accelerate with age, but also ageing impacts on response to tobacco damage, metabolism, immune competence etc. We will focus on translating the increasing understanding of the deleterious impact of the ageing process on human biology to novel targets and approaches to ameliorating this damage and preventing/reducing risk of cancer. It will also involve understanding the biology of those who do not get cancer in old age – are there unidentified protective factors which might inform preventive strategies?

We will continue to offer open, response-mode funding across the breadth of research fields pertinent to prevention research and the areas covered by this strategy, and we will continue to be receptive to great ideas and top-quality science with this strategy. This strategy is intended as a tool to aid prioritisation within response mode committees, across our infrastructural investments in centres, institutes and clinical trials units (CTUs), and in any future targeted strategic investments in prevention research.

“We lack full understanding of why the risks of many different types of cancer are so variable between different populations from different parts of the planet. Even in respect to increased cancer risk with age we are still unsure whether it is simply due to accumulation of mutations in cells during life, or perhaps to immune breakdown or other factors. If we can channel the UK’s basic science excellence into questions like this and onward into cancer prevention, there is significant potential”

Professor Sir Mike Stratton,
The Wellcome Sanger Institute

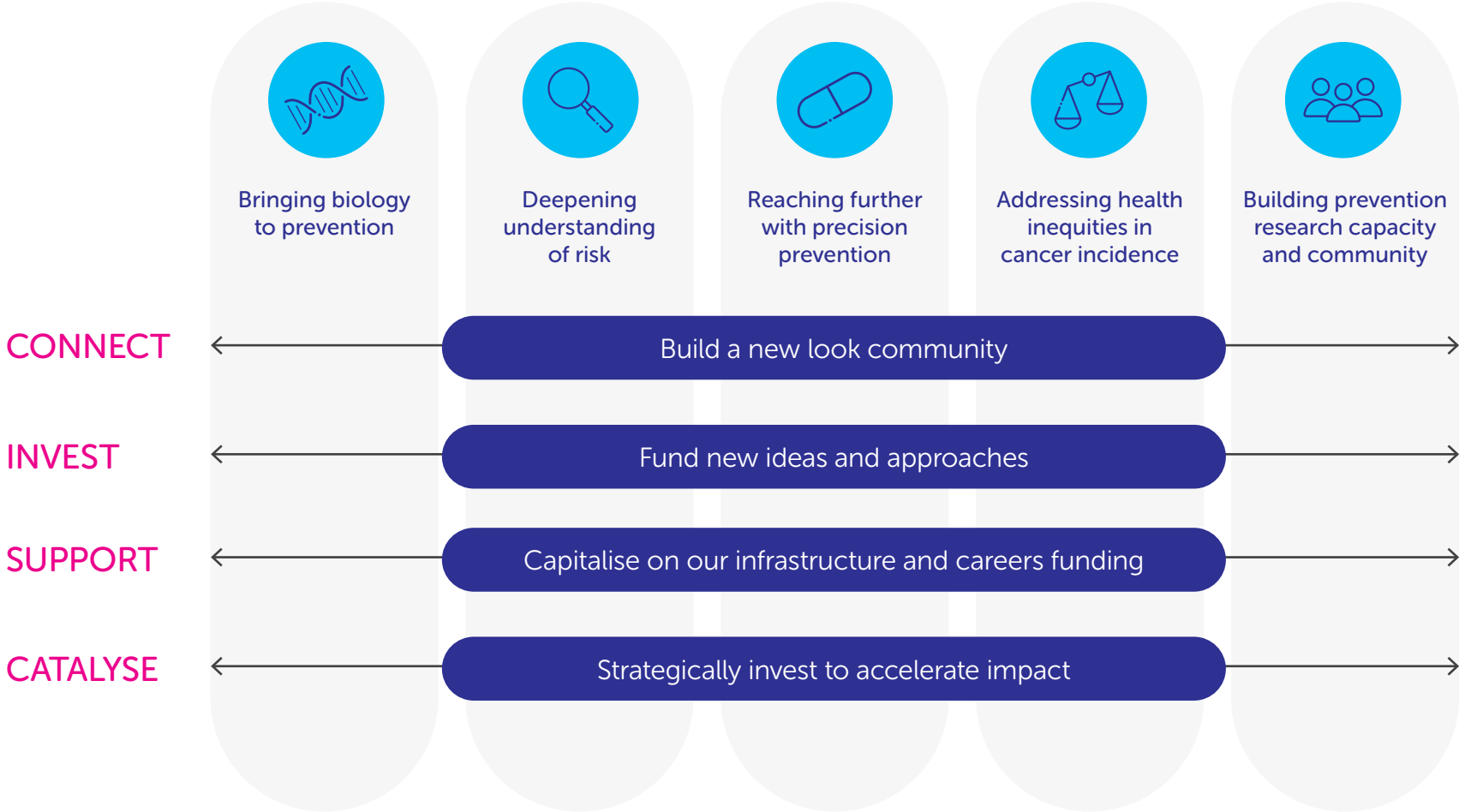


ROUTES FOR ACTION

We will employ a phased approach to supporting our increased ambition in prevention research, starting with active community-building and channelling new ideas relevant to this strategy into our existing funding routes.

As this community builds, capacity increases and deeper linkage to our science base beds in, we will look to support work of increasing ambition with strategic investment.

In order to address the challenges described above and to make progress against the strategic themes, the following tactical approaches will be adopted:


Bringing biology to prevention
Deepening understanding of risk
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Building prevention research capacity and community
CONNECT
Build a new look community
INVEST
Fund new ideas and approaches
SUPPORT
Capitalise on our infrastructure and careers funding
CATALYSE
Strategically invest to accelerate impact

CONNECT

Build a new look community

This strategy is a rallying cry to the research world, including, but also beyond, our current prevention research community (in both academia and industry). We want this ambitious new vision to draw attention to the field of cancer prevention research and attract new people, and therefore new thinking, to the challenge. We will engage, activate and grow a new and expanded multidisciplinary prevention research community.

The figure to the right illustrates the various research fields/disciplines and communities whose increased engagement with cancer prevention research will accelerate progress.

This strategy is a rallying cry to the research world.

The expansion of the prevention research community

with our current prevention research community members at the centre, will involve a broader engagement effort across many communities.

We will actively create opportunities for researchers across these fields to meet, connect and co-create. We will, for example, explore the delivery of targeted idea-generating workshops and sandpits, and the creation of a multi-disciplinary prevention conference.

The challenge of the proposed new approach to cancer prevention is significant. As such, we will have a strong focus on partnership within the UK and internationally. Partnerships will be a key feature across our prevention activities with patients, the public, industry and funders having aligned interests in cancer prevention, public health and overlapping risk factors for disease such as obesity and smoking.

INVEST

Fund new ideas and approaches

We will channel the new research teams and ideas that have been stimulated into our funding routes. This will primarily be through:

- prevention and population sciences:
  - › deepening understanding of risk
  - › reaching further with precision prevention
  - › addressing health inequities in cancer incidence
- discovery science:
  - › work on mechanistic understanding, prevention target identification and prevention intervention innovation
- early detection and diagnosis research:
  - › research into screening/detection of pre-cancerous changes which could deliver prevention

Our research committees have been involved in development of this strategy and will actively welcome high-quality proposals for new concepts in cancer prevention research aligned with this strategy. Given the nature of this strategy, it is highly likely that new proposals will straddle the traditional remits of these committees, who welcome this, and our flexible peer-review processes will ensure appropriate review.

SUPPORT

Capitalise on Cancer Research UK infrastructure and careers funding

The step-change we envisage for prevention research will require integration with our research bases in cancer biology and in clinical trials. We will work closely with the leadership and members of our network of centres, institutes, Experimental Cancer Medicine Centres (ECMCs) and CTUs, to explore how these investments might align with, contribute to and help deliver this prevention research strategy.

We will explore how the world-leading discovery and translational research platforms of our institutes and centres might contribute to the themes of this strategy. We will explore how our network of ECMCs and CTUs can help accelerate progress in clinical trials of preventive interventions, building on their great successes in therapeutic trials and a smaller existing portfolio of prevention trials.

In order to grow a thriving and sustainable prevention research community, to draw in new thinking and to seed the necessary interdisciplinarity, it will be necessary to build capacity through targeted training and career development. In addition to capitalising on our infrastructural investments as natural platforms for training, we will also seek to support the development of a new community of cancer prevention researchers and leaders of tomorrow through our programme grants and through our core funding opportunities for early- and mid-career researchers, where high quality prevention research will be highlighted as a priority area.

The step-change we envisage for prevention research will require integration with our world-leading research bases in cancer biology and in clinical trials.

CATALYSE

Strategically invest to accelerate impact

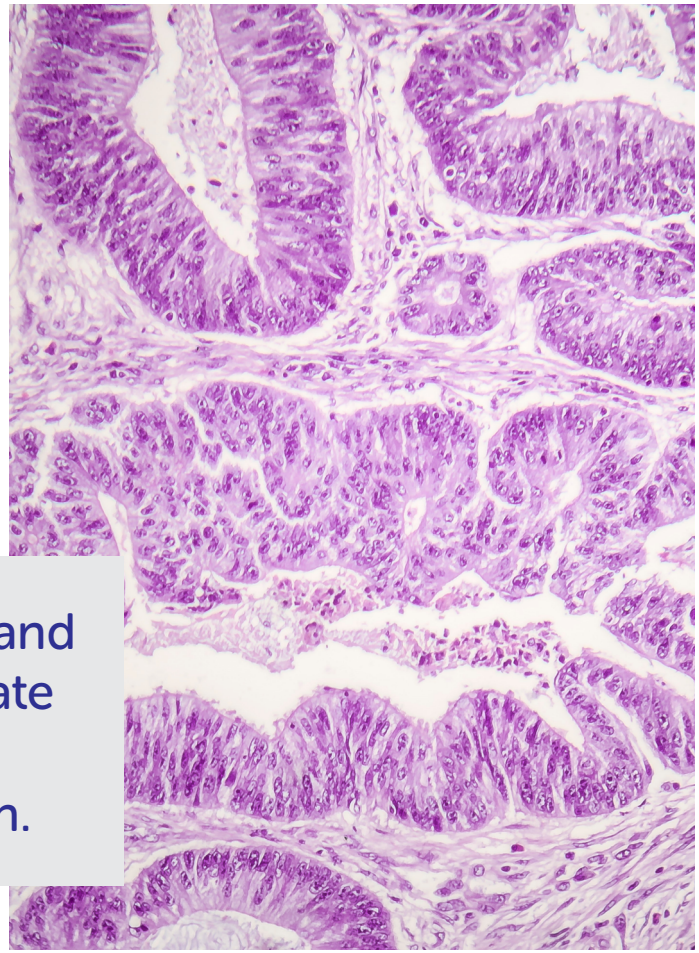
In addition to the approaches described above, we also need to take ambitious and longer-term steps to stimulate a step change in cancer prevention through research.

We will encourage researchers to bring their outstanding ideas to us for strategic interventions which may accelerate prevention impact. We will consider investments in enabling platforms or infrastructure for prevention research as well as in large-scale ambitious scientific programmes and trials of preventive interventions. Such strategic investments will be considered as our income allows and will always be judged by the prime criterion of scientific excellence.

The broad scientific community consultation which informed the development of this strategy also suggested several potential strategic investments which we will consider, for example:

- Creation of an international, multidisciplinary cancer prevention research conference, spanning the themes of this strategy, attracting and connecting researchers across biomedical, technology, clinical and population research.
- Targeted calls for research proposals to address key challenges in prevention research, for example the need for surrogate endpoints which predict cancer incidence.
- Support for a multidisciplinary, large-scale consortium-based effort to improve understanding of risk of developing cancer, through multimodal big data and advanced analytics.
- Development of registry of individuals diagnosed with pre-cancerous changes (eg Barrett's oesophagus, ductal carcinoma in situ, indeterminate lung nodules) as a research platform.

We need to take ambitious and longer-term steps to stimulate a step change in cancer prevention through research.



REFERENCES

[1]Brown KF et al. The fraction of cancer attributable to modifiable risk factors in England, Wales, Scotland, Northern Ireland, and the United Kingdom in 2015. Br J Cancer. 2018 Apr;118(8):1130-1141. doi: 10.1038/s41416-018-0029-6. Epub 2018 Mar 23. PMID: 29567982; PMCID: PMC5931106.

[2]www.cancerresearchuk.org/health-professional/cancer-statistics/incidence

[3]www.macmillan.org.uk/_images/cancer-statistics-factsheet_tcm9-260514.pdf

[4]scienceblog.cancerresearchuk.org/2020/09/30/uk-health-inequalities-20000-more-cancer-cases-a-year-in-the-most-deprived-areas/

[5]www.cancerresearchuk.org/health-professional/cancer-statistics/incidence#heading-Zero

[6]www.cancerresearchuk.org/health-professional/our-research-into-the-impact-of-covid-19-on-cancer

[7]Owen L et al. The cost-effectiveness of public health interventions. J Pub Health (Oxf). 2012 Mar;34(1):37-45.

[8]www.gov.uk/government/consultations/advancing-our-health-prevention-in-the-2020s

[9]www.england.nhs.uk/five-year-forward-view/

[10]www.icrpartnership.org/

[11]www.ncri.org.uk/how-we-work/cancer-research-database/

[12]www.cancerresearchuk.org/our-research-by-cancer-topic/our-research-into-preventing-cancer/past-research-into-preventing-cancer

[13]Falcaro et al. The effects of the national HPV vaccination programme in England, UK, on cervical cancer and grade 3 cervical intraepithelial neoplasia incidence: a register-based observational study. Lancet. 2021 Nov 3:S0140-6736(21)02178-4. doi: 10.1016/S0140-6736(21)02178-4. Epub ahead of print. PMID: 34741816.

[14]Lippman SM et al. AACR White Paper: Shaping the Future of Cancer Prevention - A Roadmap for Advancing Science and Public Health. Cancer Prev Res (Phila). 2018 Dec;11(12):735-778. doi: 10.1158/1940-6207.

[15]Wild CP et al. Cancer Prevention Europe. Mol Oncol. 2019 Mar;13(3):528-534.

[16]Serrano D, Bonanni B, Brown K. Therapeutic cancer prevention: achievements and ongoing challenges - a focus on breast and colorectal cancer. Mol Oncol. 2019 Mar;13(3):579-590. doi: 10.1002/1878-0261.12461.

[17]Fabian CJ et al. Barriers to a Career Focus in Cancer Prevention: A Report and Initial Recommendations From the American Society of Clinical Oncology Cancer Prevention Workforce Pipeline Work Group. J Clin Oncol. 2016 Jan 10;34(2):186-93. doi: 10.1200/JCO.2015.63.5979.

[18]Budish E, Roin BN, Williams H. Do firms underinvest in long-term research? Evidence from cancer clinical trials. Am Econ Rev. 2015 Jul;105(7):2044-2085. doi: 10.1257/aer.20131176.

[19]www.nytimes.com/2015/12/29/upshot/why-preventing-cancer-is-not-the-priority-in-drug-development.html

[20]www.kingsfund.org.uk/publications/tackling-obesity-nhs

[21]Paul Brennan, PhD, George Davey Smith, MD, FRS, Identifåying Novel Causes of Cancers to Enhance Cancer Prevention: New Strategies are Needed, JNCI: Journal of the National Cancer Institute, 2021;, djab204, https://doi.org/10.1093/jnci/djab204

[22]ukprp.org/

To read our research strategy, visit **cruk.org/research-strategy**

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