

# Bioscience for Health

Strategic Research Framework:  
2015 – 2020



Stock Copyright Thinkstock

# Bioscience for Health

## Strategic Research Framework: 2015 – 2020

### Scope and context

*Bioscience for Health* is one of three key strategic research priorities set out in BBSRC's Strategic Plan<sup>1</sup>. The scope of the priority takes in bioscience and enabling biotechnology that informs, and delivers research impact from, a better understanding of healthy human systems, and exploiting the value of comparative biology and 'one health' approaches for the improved health and welfare of both humans and animals.

This framework expands upon BBSRC's Strategic Plan by setting out a high-level vision for BBSRC's support for research and innovation under this priority. It aims to provide BBSRC-funded researchers and the wider stakeholder community with a roadmap for BBSRC's key expected contributions to the wider health research landscape, and will guide BBSRC activities to support research and innovation within this priority area.

The framework builds on recent analysis of BBSRC's Bioscience for Health funding portfolio, undertaken by the *Health Portfolio Working Group*, reporting to the *Bioscience for Health Strategy Advisory Panel*. This work aimed to better understand the key strengths of BBSRC-funded health research and identify areas for further strategic consideration and development. A key conclusion of that work was that BBSRC needed to clarify the scope of the *Bioscience for Health* Strategic Research Priority, and define the areas where BBSRC has key strategic research contributions to make within the wider funding landscape. The Strategic Research Framework aims to meet this need, and has been developed in close collaboration with the *Bioscience for Health Strategy Advisory Panel*.

BBSRC strategy in *Bioscience for Health* will remain dynamic and responsive to emerging opportunities for world-class research and innovation with impact.

### BBSRC Bioscience for Health Vision

To support world leading bioscience research with impact to:

- achieve a deep, integrated understanding of healthy human systems across the lifecourse by revealing the biological mechanisms underlying normal physiology and homeostatic control
- understand the roles of nutrition, physical activity and other factors in maintaining health and wellness under biological or environmental stress, informing strategies to promote healthy development and ageing
- develop multidisciplinary approaches and exploit emerging technologies to underpin improvements in both human and animal health
- promote effective translation of basic bioscience to meet the key challenge of enabling people to live healthier lives for longer, and to support innovation across a wide range of health-relevant UK industrial sectors.

### Key long term (10-year) goals

Building on a strong research base, by 2025 we aim for BBSRC *Bioscience for Health* investments to have:

- contributed to a comprehensive baseline knowledge of the key moderators of physiological health in human and animal systems, drawing on data-rich, integrative approaches to inform a whole system understanding of what 'healthy' is
- underpinned the development of new indices and biomarkers to monitor health and health improvements
- made measurable contributions to the knowledge base and platform technologies that will improve the health and wellbeing of UK citizens, particularly among the elderly
- underpinned the development of new tools and approaches, including effective and efficacious vaccines and diagnostics, to ameliorate the impacts of zoonotic disease in both people and animals, particularly farmed animals
- made measurable underpinning contributions to benefit society, UK policy, and economic growth and sustainability.

# i. Strategic Drivers of Bioscience for Health Research and Innovation

**BBSRC funded research will make a unique and underpinning contribution to addressing urgent healthcare, social and economic challenges**

**The UK has an ageing population, but average healthspan is not extending at the same rate as lifespan.** Advances in medicine and public health mean that people are living for longer. However, a significant proportion of that increased lifespan is spent in a prolonged state of declining health and wellbeing. Those in later life are spending longer living with chronic medical conditions, reduced independence and in need of care - all of which place increasing pressure on medical, health and social services. There is a pressing social and economic need for bioscience research to generate new knowledge and tools which will extend health and independence, reducing reliance on medical interventions.

**Changing lifestyles are having significant impacts on health.** Diets, physical and social behaviours and living/working environments have profound implications for health, with long-term and transgenerational consequences. We need a deeper understanding of healthy function across the lifecourse in order to fully understand the biological challenges posed by modern lifestyles. Such understanding, allied to social science that seeks to understand and influence behaviours, will bring improved information, products and social systems to benefit long-term health outcomes.

**Globalisation presents specific and urgent health challenges in zoonotic and antimicrobial resistance.** Globalisation has increased the speed and threat of emerging infectious zoonoses and vector-borne diseases of animals and humans, with significant socioeconomic, health and welfare implications. A better understanding of the epidemiology and pathogenicity of emerging

and re-emerging zoonoses will improve diagnosis and inform the development of novel tools for effective intervention. The scale and spread of broad-spectrum antimicrobial resistance<sup>2</sup> also demands fundamental research to understand its development and propagation, and underpin the development of innovative tools to combat microbial infections.

**Bioscience has a key underpinning role in generating a wide range of socioeconomic benefits for the UK.** The flow of cutting edge knowledge and research skills between academia and industry will be essential to foster innovation in research intensive sectors such as food production, healthcare, pharma and consumer goods. Industrial innovation based on productive integration with the research base will be crucial to the UK's appeal for commercial R&D and manufacturing activities, contributing significantly to economic growth.



## ii. New opportunities for BBSRC *Bioscience for Health* research



**To draw on a foundation of world class bioscience.** BBSRC funding has built a strong UK world-class bioscience community undertaking research that seeks to reveal the fundamental mechanisms of biological systems, and to dissect shared characteristics of human and animal physiology. *Bioscience for Health* aims to build upon this foundation of data, tools and skills to develop a deep, integrated understanding of physiological health and the factors through which it is maintained and challenged.

**To effectively engage Omics and Big Data technologies and integrative approaches.** These present exciting opportunities to interrogate the highly complex biological systems which underlie health phenotypes. For example, next-generation sequencing and metagenomics tools are enabling researchers to address fundamental questions around the microbiome and its relationship to

gut health. Across the health research landscape, high throughput data acquisition and interpretation, supported by modelling (including *in silico*, *in vivo* and *ex vivo* approaches) is supporting multidisciplinary and systems-scale analyses to tackle previously intractable research questions.

**To harness the power of new research capability (such as synthetic biology) and new paradigms for data acquisition (such as crowd sourcing).** These fast developing areas have the potential to significantly enhance our understanding of physiological health. As the leading UK funder of basic bioscience research and biotechnology, BBSRC can make a critical contribution to ensuring that the opportunities presented are effectively exploited. We will support researchers in making full use of new types and scales of approach and coordination in realising *Bioscience for Health* research goals.

**To realise the benefits of multidisciplinary and translational research approaches.**

There are opportunities to increase the impact of *Bioscience for Health* research through more effective integration and translation across bioscience disciplines, with the medical, social, environmental and physical sciences, between academia and industry, and in understanding and informing the evidence needs of key policy makers. BBSRC-funded bioscience has a crucial foundational role in the research aims of other public and private sector funders. Collaborative research approaches across the UK and international landscapes will be essential to maximise the impact of *Bioscience for Health* research, and supply the knowledge and tools needed to meet key health related grand challenges facing society.

# iii. BBSRC's existing *Bioscience for Health* investments

## The *Bioscience for Health* Strategic Research Priority builds on BBSRC-funded research excellence

BBSRC currently invests around £25M per annum on research directly aligned to *Bioscience for Health*, representing approximately 9% of overall research funding. This investment is built on a much larger (~£136M/49%) foundation of underpinning world class bioscience, and has significant connections with research primarily aligned to the *Agriculture and Food Security* (~£100M/36%) and *Industrial Biotechnology and Bioenergy* (~£29M/10%) Strategic Research Priorities.

BBSRC has a unique research and innovation portfolio that makes a crucial contribution to the overall health research landscape. BBSRC funds research into healthy human systems and both animal health and disease. Research focussed on human diseases falls outside of BBSRC's scientific remit, but working with other funders, we seek to maximise the value of shared research objectives and knowledge between studies of human health and animal health and disease, through comparative 'one biology' approaches, and a 'one health' approach to zoonosis research.

*Bioscience for Health* research investment is specifically supported through Responsive Mode priority areas<sup>3</sup> in:

- **Healthy ageing across the lifecycle**, with particular strength in the comparative, systems and cell biology of fundamental mechanisms of ageing, from development to old age
- **Food, nutrition and health**, launched in May 2014, to build on existing strength in understanding the fundamental mechanisms by which food influences long-term health

- **Animal health** of livestock species, underpinning future *One Health* approaches

The Responsive Mode priorities in **Combating Antimicrobial Resistance** and **The replacement, refinement and reduction (3Rs) in research using animals** are also of significant relevance to *Bioscience for Health* research.

A recent BBSRC Health Portfolio Review<sup>4</sup> identified particular and unique research strength in further areas that underpin *Bioscience for Health* aims and the priorities of other research funders:

- **underpinning world-class bioscience** broadly distributed across the BBSRC science portfolio

- **systems, structural and synthetic biology** approaches across a breadth of research areas

- **immunology and immune response systems**, with systems approaches well embedded. In particular, exploiting *One Health* approaches in response to infectious disease

- **fundamental neuroscience**, which underpins the research aims of other health research funders

- **microbiology**, with a highly significant and diverse portfolio of funded work



## Strategic research programmes in BBSRC funded Institutes and Universities occupy a central role in coordinated and sustained collaborative *Bioscience for Health* approaches

BBSRC funds strategic programmes relevant to *Bioscience for Health* across its research institutes<sup>5</sup>. The critical mass of infrastructure and skills at these institutes provides sustained and coordinated support for longer-term strategic programmes, covering a broad base of research into human, animal, microbial and food systems.

Through the strategic longer-larger grant (sLoLa) scheme<sup>6</sup>, BBSRC also funds larger-scale coordinated programme grants (typically 5 years in duration) to researchers working across UK universities and institutes. Several sLoLa awards have been made in *Bioscience for Health* priority areas<sup>7</sup>, and BBSRC will seek to further encourage integrative *Bioscience for Health* research through this mechanism.

## BBSRC has a track record of collaboration with other key funders of UK and international research relevant to *Bioscience for Health*

By combining resources and strategic thinking, BBSRC seeks to foster multidisciplinary research that delivers the shared aims of *Bioscience for Health* research and other funders, enhancing the impact of all partners' investments.

A significant aspect of BBSRC's collaborative funding in health-relevant research has been through the cross-Research Council **Lifelong Health and Wellbeing Programme**<sup>8</sup> (LLHW), making strategic research investments with, in particular, the Medical Research Council, Economic and Social Research Council and Engineering and Physical Sciences Research Council<sup>9</sup>. BBSRC is committed to a continued prominent role in cross-Council research coordination seeking to address the grand challenge of healthy ageing across the lifecourse.



### Examples of recent joint investment with other key funders include:

- **Innovate UK:** Nutrition for Life programme<sup>10</sup> to stimulate innovation in the food and drink industry in providing healthy and safe products
- **National Institute of Aging (US):** Joint Collaborative Research in the Biology of Ageing Initiative and follow-up co-funding agreement<sup>11</sup>; past and ongoing network calls on epigenetics<sup>12</sup>
- **UK Regenerative Medicine Platform**<sup>13</sup> (in collaboration with MRC and EPSRC), which is funding five hubs to address the technical and scientific challenges associated with translating scientific discoveries towards clinical impact
- **European Space Agency:** Life Science Research using the Human Spaceflight Analogue "Bed Rest"<sup>14</sup>
- **Action on Hearing Loss:** research highlight on the lifecourse of the auditory system<sup>15</sup>
- **UK Government:** Zoonosis and Emerging Livestock Systems Initiative<sup>16</sup> (with the Department for International Development, the Defence Science and Technology Laboratory and other Research Councils).

# iv. Bioscience for Health challenge areas

Building on existing BBSRC research strengths, we have defined four headline challenge areas which together encapsulate the *Bioscience for Health* strategic research priority.

1. Lifelong Health
2. Nutrition for Health
3. One Health
4. Biotechnology for Health

These broad challenges aim to highlight key areas of opportunity in developing a deeper understanding of what defines and determines health across the lifecourse, and the interface between animal and human health. They are intended to be complementary, with significant synergies across BBSRC's *Agriculture and Food Security* and *Industrial Biotechnology and Bioenergy* Strategic Research Priorities as well as other collaborative research programmes. Key strategic research linkages and illustrative

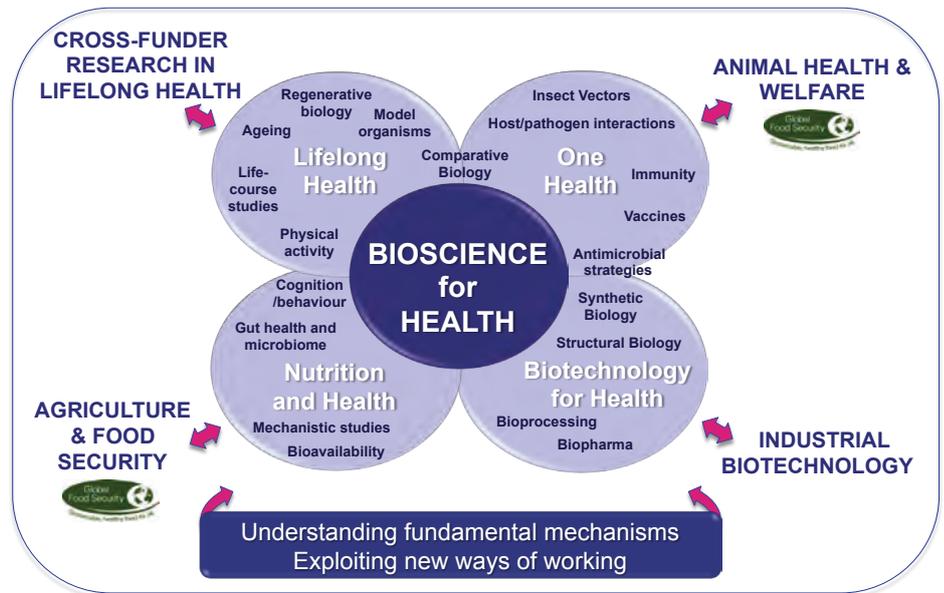


Fig. 1: *Bioscience for Health* challenge areas and key strategic research linkages  
Specific research areas are intended to be illustrative rather than exhaustive

research areas are explored in **Figure 1**. Further information on how these challenge areas relate to existing responsive mode priority areas is provided in **Annex 1**.

Across these four challenge areas, there is an overarching emphasis on exploiting world class bioscience and new ways of working<sup>17</sup> to tackle key bioscience questions. Together, the challenges are intended to promote development of an integrated understanding of the key determinants of health.

This understanding will generate an improved evidence base to underpin strategies for resilience against health challenges<sup>18</sup>. Exemplars of the key expected contributions of BBSRC-funded science in meeting this aim are set out in **Figure 2**.

The four challenge areas are described in more detail below, including subsidiary research opportunities and key markers of success for developing research impacts that will contribute to overarching *Bioscience for Health* goals.

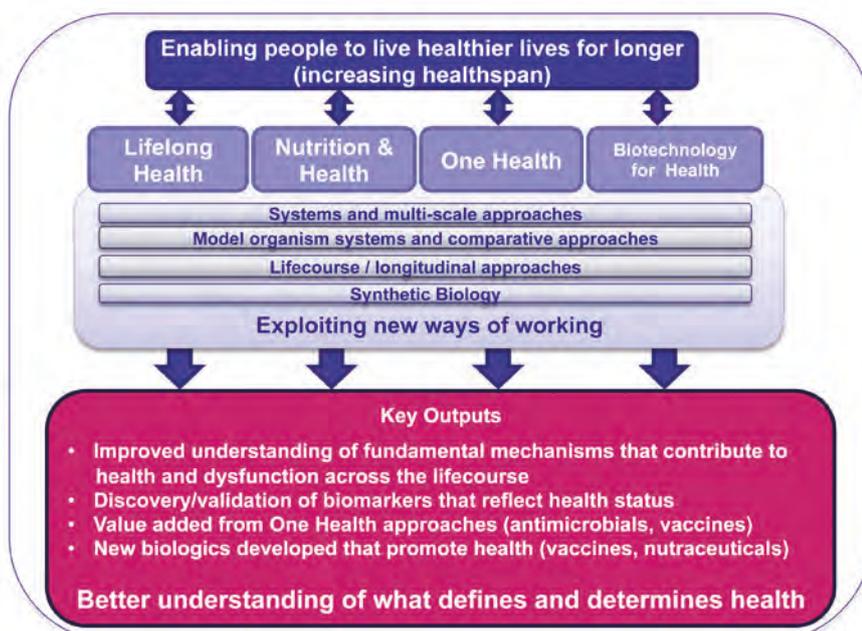


Fig. 2: An overview of key *Bioscience for Health* research, approaches and outputs

# 1. Lifelong Health

The *lifelong health* challenge area encompasses research into the mechanistic basis of lifespan and healthy ageing using human, microbial and animal systems with the long-term objective of promoting health in later life.

## Key research opportunities

- to understand the fundamental biological mechanisms of the ageing process across the lifecourse (e.g. stem cell dysregulation and replicative senescence), their modulation by nutrition, physical activity and developmental factors, the extent to which these impact on health in later life, and the extent to which they may be slowed or reversed
  - to understand how ageing processes impact on homeostasis/physiological function in areas such as the musculoskeletal, gastrointestinal, immune, cognitive, circadian and sensory systems, and how this can lead to age-related frailty and poor health
  - to understand the role of epigenetic effects in development and ageing across the lifecourse (including transgenerational effects)
  - to develop appropriate model organisms and systems that provide insight into physiological processes that are key for maintaining health in humans; and understanding the biological basis of inter- and individual differences in the ageing process
  - to increase the use of resources and data from cohort studies, biobanks and longitudinal monitoring to increase the translation of research from model organisms and systems to the human population
  - to generate new knowledge to advance regenerative biology, including stem cell and tissue engineering research, to improve the quality of life for the ageing population
- to identify 'critical periods' during the lifespan which may be particularly susceptible to biological influences/exposures and could potentially inform on the timings of interventions
  - to understand the effect of modern lifestyle on human health, for example, sedentary behaviour, night shift work and sleep disruption
  - to develop and validate appropriate outcome measures, such as biomarkers of healthy ageing, which could be used to monitor health and track the impact of interventions
  - to generate a robust evidence base which will underpin innovation in the consumer products and health industries

## Benchmark markers of success towards overall *Bioscience for Health* 10-year goals

**Near-term (1-2 years):** evidence of research capacity development in this area, including the emergence of new community networks, increased working across disciplinary boundaries and increased use of longitudinal studies.

**Longer-term (5-10 years):** development of a better understanding of 'health', providing underpinning knowledge that will allow improvements to health to be made and effectively monitored.



## 2. Nutrition for Health

The *nutrition for health* challenge area encompasses research to advance understanding of how foods, nutrients and whole diets influence cellular processes, how these influences affect overall health outcomes, and how responses vary between population groups, individuals and across the lifecycle.

### Key research opportunities

- to foster a more co-ordinated approach to research challenges in food, nutrition and health through better integration of nutrition science, agricultural production and food processing research, including fundamental plant and animal studies
  - to advance understanding of the physiological and mechanistic basis of a healthy gut and wider physiological function, and the potential for manipulation to positively influence health
  - to understand how relationships between food and health change over the lifecycle, and how these changes may be influenced by genotype, epi-genotype and microbiome
  - to understand the causal role specific diets or nutrients play in the maintenance of homeostasis and their mechanism of action
- to understand diet-mediated physiological changes on the transition between healthy and unhealthy or dysregulated states
  - to understand the health implications of modern lifestyles and food processing techniques
  - to understand the biological and behavioural determinants of food intake, including sensory qualities and satiety
  - to actively collaborate with the food industry to drive innovation in healthy food products
  - to generate a robust evidence base which will underpin policy to influence food behaviour
- There are clear synergies with the BBSRC *Agriculture and Food Security Strategic Research Priority* and cross-funder *Global Food*

### Benchmark markers of success towards overall *Bioscience for Health* 10-year goals

**Near-term (1-2 years):** evidence of a more joined up approach to food production and nutritional science, within BBSRC research areas and with other funders, towards better integration of nutrition, agricultural production and food processing sciences and fundamental plant and animal research.

**Longer-term (5-10 years):** development of a baseline mechanistic understanding of the key components and interactions (including food, nutrient and microbiome) of the healthy gut and wider physiological interactions, underpinning the potential for manipulation to positively influence health.

*Security Programme* in supporting research to inform the sustainable provision of safe, nutritious food. There is a need to develop integrated research approaches in:

- **food safety:** reducing the risks to human health from the contamination of food by pathogens, toxins or other harmful substances at any stage of the food-chain<sup>19</sup>
- **nutritional enhancement:** manipulation of the food-system, from primary production to processing, to enhance the bioavailability of micro-nutrients and other components beneficial to health - based on a robust understanding of human nutritional requirements.



# 3. One Health

The *one health* challenge area encompasses collaborative and coordinated approaches to combat infectious diseases of zoonotic origin by drawing on a common pool of scientific knowledge from multiple disciplines to improve the health and well being of animals and people in their environment<sup>20</sup>.



iStock Copyright Thinkstock

## Key research opportunities

- to improve linkages between basic bioscience, veterinary and medical research investments for knowledge sharing and development, including approaches to vaccinology
- to foster basic research on infectious disease e.g. immunology<sup>21</sup>
- to better understand the host, pathogen and their interactions in animal species, mechanisms of interspecies transmission, epidemiology, and pathogenicity (including ecology and evolution of pathogens, and host adaptation,) informing understanding of mechanisms of infectious transfer between species
- to address major research gaps in vector-borne animal and zoonotic diseases (including vector biology, distribution and evolution), food-borne zoonoses and zoonoses transmitted by contact with farmed and companion animals
- to underpin the development of novel diagnostics, including technologies, tools and strategies to improve national and global surveillance capabilities
- to develop collaborative approaches to understanding fundamental mechanisms and transmission dynamics of antimicrobial resistance. Underpinning the development of new antimicrobials, alternative strategies and rapid diagnostics
- to build on international collaborations to address international issues that impact on the UK, or UK priorities for international development

## Benchmark markers of success towards overall Bioscience for Health 10-year goals

**Near-term (1-2 years):** ongoing progress<sup>24</sup> will have been built on to connect global research efforts in partnership with other funders and international stakeholders towards a global view of the key challenges in tackling zoonotic diseases.

**Longer-term (5-10 years):** emergence of early intervention strategies (e.g. new diagnostic tools, vaccines, biologics) to tackle the threats of key current and (re-)emerging zoonotic disease, from underpinning research, including longer term initiatives<sup>25</sup>.

*One Health* aims also have relevance to the broader drivers and priorities for BBSRC funded animal health and welfare research, which are substantially developed under BBSRC's *Agriculture and Food Security*<sup>22</sup> Strategic Research Priority, including priorities developed as part of the cross-funder *Global Food Security Programme*<sup>23</sup>, and we seek to foster the added value from research that links across strategic priorities.

# 4. Biotechnology for Health

The *biotechnology for health* challenge area encompasses the development of enabling biotechnology and innovative approaches to support the translation of basic bioscience, including within the *Lifelong Health, Nutrition and Health* and *One Health* areas. It will underpin the commercial impact of research, particularly through development of platform technologies for multiple avenues of research and innovation.

## Key research opportunities

- to capitalise on model systems and approaches to develop new chemical tools and other interventions that will improve mechanistic understanding of health
- to develop basic bioscience underpinning the formulation and validation of biologics that benefit the maintenance and promotion of health, including pharmaceuticals, nutraceuticals and other bioactives
- to develop and exploit new diagnostic platforms, including imaging and systems-scale approaches, that could underpin predictive, stratified and personalised strategies for maintaining health across the lifecourse
- to develop basic understanding of stem cell biology that will enable the development of new regenerative biology technologies
- to capitalise on a strong structural biology research portfolio in health technology areas, particularly in understanding and manipulating the functions of microbial macromolecules to underpin the development of new antimicrobials
- to capitalise on synthetic biology approaches and key BBSRC investments to develop new platform technologies with a wide range of applications relevant to human health research and the production of biopharmaceuticals

*Biotechnology for Health* aims have relevance to BBSRC's *Industrial Biotechnology and Bioenergy*<sup>26</sup> Strategic Research Priority, and in particular the development of bioprocessing technologies for new chemical tools.

## Benchmark markers of success towards overall *Bioscience for Health* 10-year goals

**Near-term (1-2 years):** key platform technology investments in synthetic biology and regenerative medicine embedded in research communities, through the development of appropriate community networks.

**Longer-term (5-10 years):** next generation biomarkers of health and biologics made available to underpin future *Bioscience for Health* research and innovation aims.



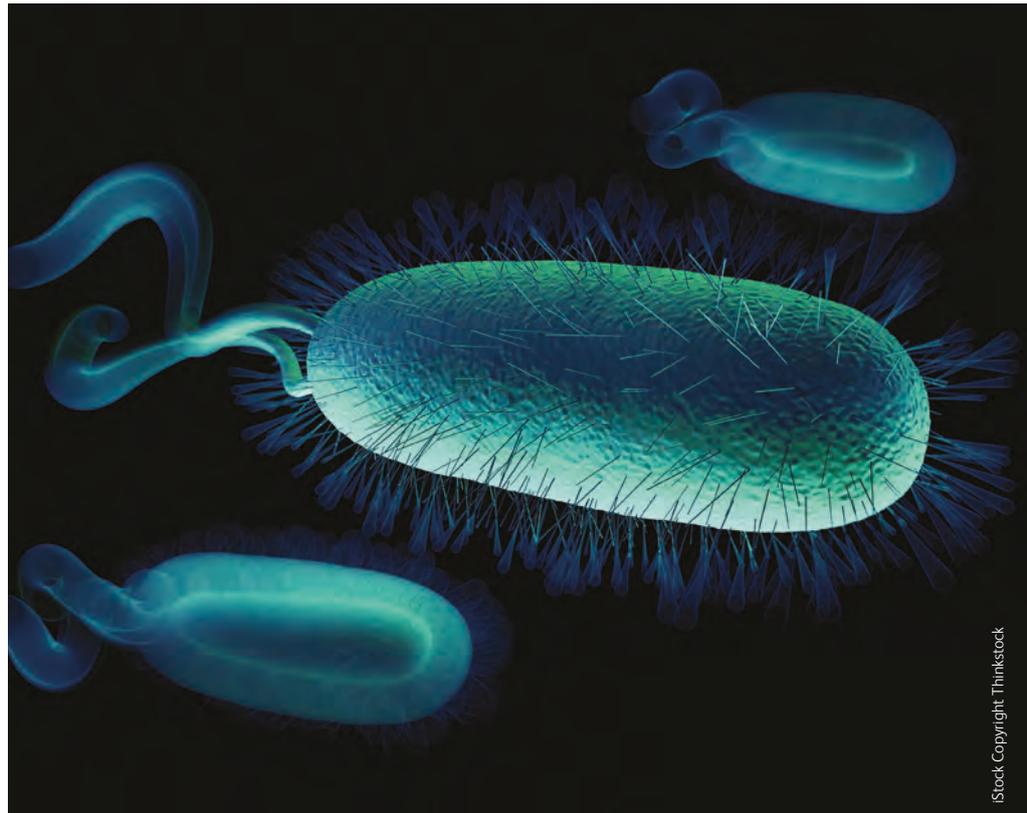
# 5. Cross-cutting research challenges relevant to Bioscience for Health

In addition to the four *Bioscience for Health* challenge areas detailed, BBSRC seeks to foster research and innovation in two responsive mode priority areas that have particular relevance to *Bioscience for Health* aims: *Combatting antimicrobial resistance (AMR)* and *The replacement, refinement and reduction (3Rs)* in research using animals.

## Combatting AMR<sup>27</sup>

We seek to support both the wide range of research aimed at combatting AMR, and research that underpins the development of strategies to mitigate the effects, e.g. through novel alternatives to antimicrobials. In the context of *Bioscience for Health* aims this includes understanding how resistance develops and is maintained, selection pressures and the dynamics of transmission, underpinning the development of novel antimicrobials and alternative mitigation strategies and the development of novel diagnostics to enable rapid identification of antimicrobial-resistant organism or presence of resistance genes.

Research focused solely on AMR in human only pathogens, transfer of AMR between humans, or alternative strategies to combat AMR in human specific diseases, falls outside of BBSRC's remit. We will, however, seek to foster coordinated working across funders to ensure joined up national research capability and aims.



iStock Copyright Thinkstock



iStock Copyright Thinkstock

## The replacement, refinement and reduction (3Rs) in research using animals<sup>28</sup>

We expect BBSRC-funded researchers to understand, promote and integrate the principles of the 3Rs. In the context of *Bioscience for Health* aims, we will particularly encourage opportunities to develop and use new models and research approaches (e.g. human cohorts, *in vitro* and *in silico* approaches) that could reduce the use of animals in our research and provide more effective and representative research tools for studying human and animal biology. This builds on BBSRC's established policy on the *Responsibility in the use of animals in bioscience research*<sup>29</sup> and the *National Centre of Replacement, Refinement and*

*Reduction of Animals in Research (NC3Rs) ARRIVE guidelines*<sup>30</sup>. We will continue to work closely with the NC3Rs and other Research Councils to address areas of mutual interest and deliver our commitment to *Working to reduce the use of animals in scientific research*<sup>31</sup>



iStock Copyright Thinkstock

## v. Enabling Innovation

### ***Bioscience for Health* aims are founded on harnessing:**

- new understanding of fundamental biological mechanisms and systems across scales of organisation from molecular to cellular to organisms, and;
- innovative new research tools and approaches to interrogate these systems and underpin new biotechnological applications.

**As the leading UK funder of basic bioscience research, training and new biotechnology, BBSRC can make a critical contribution to the innovation and policy landscape.** By supporting effective translation and exploitation, we will ensure that the impacts of *Bioscience for Health* research are realised for the economic and societal benefit of the UK.

### **Research skills and training**

**BBSRC's vision is for an integrated, vibrant and sustainable research community addressing *Bioscience for Health* strategic challenges.** We will support the development of multidisciplinary researchers using innovative techniques who are equipped to apply their skills in a range of academic, commercial and policy settings.

In particular, we recognise key opportunities to:

- support the next generation of researchers and research leaders in gaining the knowledge skills needed to address *Bioscience for Health* challenges. Developing capacity in interdisciplinary approaches (including mathematical and computational skillsets) will be critical, and we recognise the opportunities presented by large-scale investments and studentship programmes for training within interdisciplinary research environments

- promote and embed existing training and career development mechanisms which foster effective cross-pollination of knowledge, skills and new tools and approaches to realise *Bioscience for Health* strategic aims. Schemes such as *CASE studentships*<sup>32</sup> and the *Flexible Interchange Programme*<sup>33</sup> enable sharing of knowledge and skills across academic domains and between academia, industry and policy. In particular, there are opportunities to provide training opportunities for postdoctoral researchers funded on BBSRC grants to enhance careers and enable movement across disciplines and sectors.

### **Collaborative approaches with UK industry**

**BBSRC's *Bioscience for Health* research portfolio underpins innovation in a wide range of industrial sectors, including (bio) pharmaceuticals, healthcare, consumer goods, biotechnology, veterinary, diagnostic, cell therapy, agriculture and food.**

At a general level, companies exploit both the leading science that BBSRC funds and the skilled biologists it helps to train, particularly at the postgraduate level. In specific areas (for example, ageing,

neuroscience, immunology, microbiology and nutrition), BBSRC has strong and direct partnerships with industrial research and development. There is also significant industrial impact from the BBSRC-sponsored academic development of the new technologies, tools and databases on which internationally competitive health research and development depends.

**Building on past success, BBSRC will seek to increase the quality and scope of collaborative research and innovation with UK companies.**

Through ongoing mechanisms such as the *Industrial Partnership Award*<sup>34</sup>, *LINK*<sup>35</sup> and *Research and Technology Club* schemes (notably *DRINC*<sup>36</sup>), BBSRC has a track record of successful industrial collaboration in *Bioscience for Health* research. We will form stronger strategic partnerships with key relevant UK companies to build on this success, fostering interactions between industry and the academic research base which will lead to new impacts from BBSRC investment.

Working with *Innovate UK* and others, BBSRC will seek to align research priorities and mechanisms with industrial needs, supporting effective translation of *Bioscience for Health* research to commercial application.



There are particular opportunities to support collaborative industrial research which will increase the predictability of industrial R&D in areas such as personalised health and the design and manufacture of new biological, therapeutic, food and health-promoting products (Figure 3).

The costs and logistical challenges associated with industrial research have increased considerably in recent years, resulting in attrition of industrial research outputs. BBSRC aims to support underpinning bioscience research which will increase the speed and success rate of bringing innovative products to market, addressing challenges posed by changing regulatory frameworks, biologic specificity of action, demonstrating biological efficacy and achieving necessary scale-up of production.

## Informing policy and practice

**The knowledge generated through *Bioscience for Health* research can play a key role in informing related policy and practice. We will seek to develop a deeper understanding of the key routes through which new knowledge can deliver social and economic benefits by influencing UK, European and wider international policy.**

By revealing the roles of nutrition, physical activity and other factors in maintaining health and wellness under biological or environmental stress, *Bioscience for Health* research can inform strategies to promote healthy development and ageing. We will particularly explore strategic linkages with key policy stakeholders in health (including *Department of Health* agencies), nutrition and food standards (including the *Food Standards Agency*) and biological standards underpinning healthcare applications (including the *National Institute of Biological Standards and Control*) to ensure that research outputs feed effectively into evidence-based policy.

Knowledge generated by *One Health* research can inform policies and practices which will mitigate the threats posed by zoonotic disease. We will engage with policy partners including the *Animal and Plant Health Agency*, *Department of Environment*

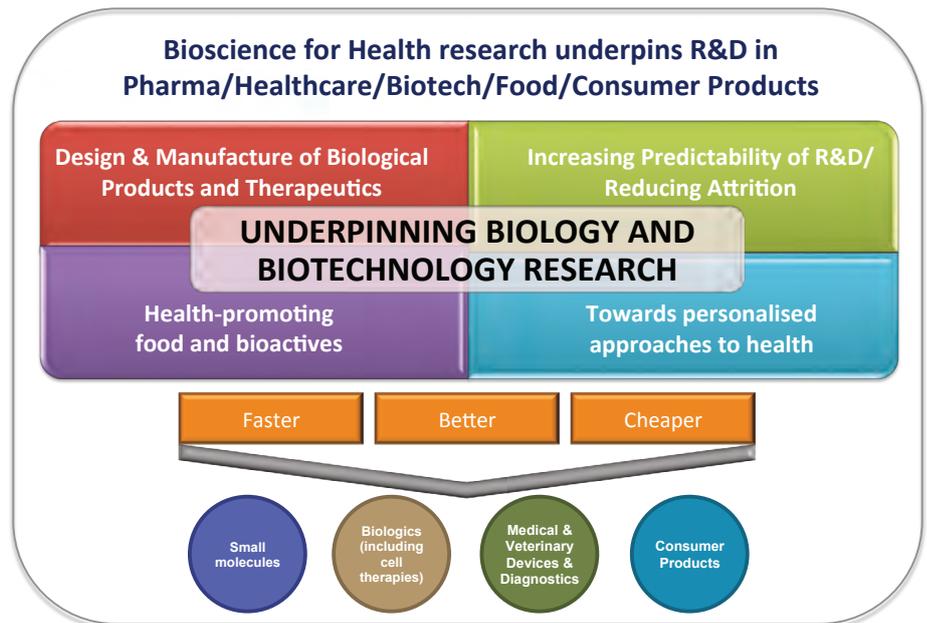


Fig. 3: Opportunities for industrial research collaboration in the *Bioscience for Health* area

and Rural Affairs and National Centre of Replacement, Refinement and Reduction of Animals in Research to ensure that research outcomes feed effectively into policy decisions, and inform new approaches to animal research where relevant.

## Infrastructure for research and innovation

**We will proactively capitalise on recent and ongoing key infrastructural investments to support the development of *Bioscience for Health* research capabilities and effective translation.**

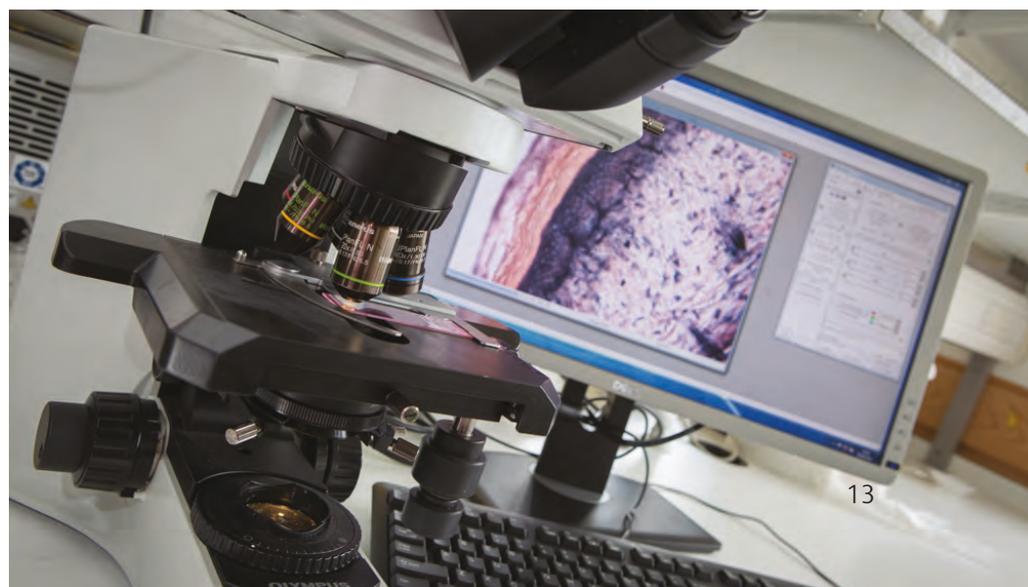
Notable examples of such investments include:

- Research and Innovation Campuses (including recent £70M investments at

the Babraham Institute and Norwich Research Park, funded by the *Department of Business, Innovation & Skills*)<sup>37</sup>

- Multidisciplinary research centres in synthetic biology (with EPSRC)<sup>38</sup>
- UK Regenerative Medicine Platform (with MRC and EPSRC)<sup>39</sup>
- Major underpinning research infrastructure initiatives such as ELIXIR<sup>40</sup>

We will seek to understand key future infrastructure needs and to capitalise on emerging opportunities to continue to grow world-class infrastructure in support of *Bioscience for Health* research and innovation.



# vi. Effective Partnerships and Communication

**BBSRC cannot deliver its *Bioscience for Health* vision in isolation. Partnerships with other research funders and research users will be essential to meet BBSRC's ambition of promoting effective integration and translation of basic bioscience to meet the key societal grand challenges of enabling people to live healthier lives for longer.**

**We will seek ways to build on established partnerships, and develop new ones, in strategic priority areas where clear value can be added. Figure 4** highlights important stakeholders and existing and potential collaborators in BBSRC *Bioscience for Health* research.

**We aim to collaborate and communicate effectively with UK and international research funders, industry, charities, policy makers and the public.** This interaction will inform *Bioscience for Health* research priorities and approaches, and ensure that the impact of relevant investments is effectively realised.

Key aims include:

- fostering integration of bioscience with relevant health, medical, engineering, environmental and social science research supported by other Research Councils and international funders
- facilitating effective exchange of people, new knowledge and tools between research disciplines and between academia, policy making and industry
- encouraging translation of new evidence and services stemming from research into health policy and public awareness, to underpin adoption of health-promoting choices and practices
- building on previous public dialogue activities<sup>41</sup> to develop better understanding

between BBSRC, sponsored researchers and the public about areas of interest and concern.

In particular, we recognise and will seek to capitalise on current opportunities for increased research impetus and impact through collaborative cross-funder approaches in the areas of *Nutrition for Health* (including food production science aims) and *Combatting Antimicrobial Resistance*.

## International coordination and collaboration in *Bioscience for Health* challenge areas

**We recognise that UK researchers, and BBSRC as a funder, cannot do everything. We will seek to foster working across international boundaries, developing strategic agendas and collaborative approaches with countries that have research strengths and aims complementary to BBSRC's.**

The challenges which drive research and innovation in *Bioscience for Health*, including population ageing, changing lifestyles and zoonotic disease, are global. Responses must

also be global, developing scales of research and resource coordination that will enhance impact and add value to UK research.

BBSRC will work with UK and overseas stakeholders, including the *Science and Innovation Network*, *UK Trade & Investment* and other funders, to identify hotspots of excellence in *Bioscience for Health* research and innovation and foster a strategic approach to international coordination. We will ensure that internal mechanisms, such as cofunding or lead agency agreements, allow researchers to fully exploit the benefits of international collaboration.

In seeking to develop international activities, we will build on established partnerships with the US (including the *National Institute on Aging* and *National Science Foundation*) and the EU. We will engage proactively with Horizon 2020<sup>42</sup> and allied EU programmes for the benefit of UK bioscientists, working to ensure that emerging work programmes are relevant to BBSRC's research community and *Bioscience for Health* aims. In particular, we will work with partners to exploit opportunities offered by the Newton Fund<sup>43</sup> in fostering strategic *Bioscience for Health* research linkages with developing nations.



Fig. 4: Exemplars of key *Bioscience for Health* research stakeholders and potential collaborators

# Annex 1

Note on relationship between *Bioscience for Health* Challenge Areas and the BBSRC responsive mode priority areas

The BBSRC Strategic Plan outlines three Strategic Research Priorities: *Agriculture and Food Security*, *Industrial Biotechnology and Bioenergy*, and *Bioscience for Health*. In addition to these, BBSRC also has a number of responsive mode priorities<sup>44</sup> that represent topics or activities within the broader Strategic Research Priorities that we particularly wish to encourage and promote.

The *Bioscience for Health* challenge areas developed in this strategic research framework map to the existing responsive mode priorities to varying degrees. As we move forward with implementation of the *Bioscience for Health Strategic Framework*, we will evolve the responsive mode priorities as appropriate to ensure this mechanism appropriately develops the identified *Bioscience for Health* challenge areas.

**Lifelong Health challenge area:**

substantively maps to the current *Healthy ageing across the lifecourse* responsive mode priority<sup>45</sup>. In addition, there are research linkages with the *Food, nutrition and health responsive mode priority*<sup>46</sup>.

**Nutrition for Health challenge area:**

closely aligned with, and represents a subset of, the *Food, nutrition and health responsive mode priority*. This priority additionally captures aspects of food safety and production science that are aligned more closely to BBSRC's overarching *Agriculture and Food Security* Strategic Research Priority. The *Food, nutrition and health responsive mode priority* aims to recognise and promote the value of joined up research approaches that will contribute to both *Bioscience for Health* and *Agriculture and Food Security* strategic aims.

**One Health challenge area:**

captured currently as part of the *Animal Health responsive mode priority*<sup>47</sup>.

**Biotechnology for Health challenge area:**

not explicitly linked to current responsive mode priorities, but aspects of this challenge area fall within the *Combatting antimicrobial resistance*, *Healthy ageing across the lifecourse* and *Food, nutrition and health responsive mode priorities*. In addition, there are linkages to the underpinning *New strategic approaches to industrial biotechnology* priority<sup>48</sup> in the support of new bioprocessing technologies.



## Footnotes

<sup>1</sup> <http://www.bbsrc.ac.uk/news/planning/strategy/>

<sup>2</sup> Including in non-bacterial pathogens; particularly helminths

<sup>3</sup> <http://www.bbsrc.ac.uk/funding/priorities/priorities-index.aspx>

<sup>4</sup> undertaken by a working group of the *Bioscience for Health Strategic Advisory Panel* (unpublished report)

<sup>5</sup> <http://www.bbsrc.ac.uk/institutes>

<sup>6</sup> <http://www.bbsrc.ac.uk/funding/grants/>

### **lola/**

<sup>7</sup> Examples include: *RNA processing mechanisms control lymphocyte development and activation* (BB/J00152X/1); *Systems Cognitive Neuroscience of Healthy Ageing: Population-Representative Studies of Functional Plasticity and Neural Change* (BB/H008217/1).

<sup>8</sup> <http://www.mrc.ac.uk/research/>

### **initiatives/lifelong-health-wellbeing/**

<sup>9</sup> Key co-sponsored investments include the Centre for Ageing and Vitality - Prof. D. Turnbull, Univ. Newcastle; Centre for Cognitive Ageing and Cognitive Epidemiology – Prof. I. Deary, Univ. Edinburgh, and; CRUCIBLE – Prof. N. Tyler, UCL

<sup>10</sup> [https://interact.innovateuk.org/competition-display-page/-/asset\\_publisher/RqEt2AKmEBhi/content/nutrition-for-life-providing-safe-and-healthy-foods-crd-](https://interact.innovateuk.org/competition-display-page/-/asset_publisher/RqEt2AKmEBhi/content/nutrition-for-life-providing-safe-and-healthy-foods-crd-)

<sup>11</sup> <http://www.bbsrc.ac.uk/funding/opportunities/2014/nia-co-funding-2014.aspx>

<sup>12</sup> e.g. [Reference/webpage no longer available – January 2017]

<sup>13</sup> [Reference/webpage no longer available – December 2016] MRC/EP SRC/ BBSRC funded

<sup>14</sup> [Reference/webpage no longer available – January 2017]

<sup>15</sup> <http://www.bbsrc.ac.uk/funding/opportunities/2014/lifecourse-of-auditory-system.aspx>

<sup>16</sup> <http://www.bbsrc.ac.uk/research/international/zels/>

<sup>17</sup> Including innovative bioscience tools and approaches

<sup>18</sup> Whilst BBSRC does not fund research focussed on human diseases, we also recognise the important impacts of basic bioscience supported by BBSRC in underpinning the clinical research aims of other funders

<sup>19</sup> Studies focused on understanding and reducing the incidence of harmful organisms/ substances within the food chain are supported, but research focused on pathogenicity or toxicology in humans is not within BBSRC's science remit

<sup>20</sup> This definition of *one health* has been adopted by BBSRC, as set out in the Strategic Plan, to highlight the Council's key priorities in this area. *One health* links into the broader concept of using comparative biology to understand biological systems, and broader definitions may be adopted by other organisations

<sup>21</sup> NB. Research into the specific mechanisms/ interactions and epidemiology of human infectious diseases is outside of BBSRC's scientific remit. However, research into underpinning human, animal and microbial physiology (e.g. normal functioning of the human immune system) is within BBSRC remit

<sup>22</sup> <http://www.bbsrc.ac.uk/publications/planning/strategy/priority-one.aspx>

<sup>23</sup> <http://www.foodsecurity.ac.uk/about/>

<sup>24</sup> For example, via STAR-IDAZ global network for animal disease research

<sup>25</sup> For example, *Zoonoses and Emerging Livestock Systems (ZELS): reducing the risk to livestock and people* (<http://www.bbsrc.ac.uk/research/international/zels/>) and *Ecology and Evolution of Infectious Diseases* (EEID)

<sup>26</sup> <http://www.bbsrc.ac.uk/news/planning/strategy/priority-two.aspx>

<sup>27</sup> <http://www.bbsrc.ac.uk/funding/priorities/combating-antimicrobial-resistance.aspx>

<sup>28</sup> <http://www.bbsrc.ac.uk/funding/priorities/3rs-research-animals.aspx>

<sup>29</sup> <http://www.bbsrc.ac.uk/about/policies/policy-foi/policy/animal-research-policy/>

<sup>30</sup> [Reference/webpage no longer available – November 2018]

<sup>31</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/277942/bis-14-589-working-to-reduce-the-use-of\\_animals-in-research.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277942/bis-14-589-working-to-reduce-the-use-of_animals-in-research.pdf)

<sup>32</sup> <http://www.bbsrc.ac.uk/funding/studentships/case.aspx>

<sup>33</sup> <http://www.bbsrc.ac.uk/business/people-information/flexible-interchange-programme.aspx>

<sup>34</sup> <http://www.bbsrc.ac.uk/business/collaborative-research/industrial-partnership-awards.aspx>

<sup>35</sup> <http://www.bbsrc.ac.uk/business/collaborative-research/stand-alone-link.aspx>

<sup>36</sup> <http://www.bbsrc.ac.uk/business/collaborative-research/industry-clubs/drinc/drinc-index.aspx>

<sup>37</sup> <http://www.bbsrc.ac.uk/organisation/research-innovation-campuses/campuses-index.aspx>

<sup>38</sup> [Reference/webpage no longer available – January 2017]

<sup>39</sup> [Reference/webpage no longer available – December 2016]

<sup>40</sup> <http://www.elixir-europe.org/about>

<sup>41</sup> <http://www.bbsrc.ac.uk/society/dialogue/activities/bbuh-public-workshop.aspx>

<sup>42</sup> Particularly the *Health, Demographic Change and Wellbeing* Societal Challenge area <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/health-demographic-change-and-wellbeing>

<sup>43</sup> <https://www.gov.uk/government/publications/newton-fund-building-science-and-innovation-capacity-in-developing-countries/newton-fund-building-science-and-innovation-capacity-in-developing-countries>

<sup>44</sup> <http://bbsrc.ac.uk/funding/priorities/priorities-index.aspx>

<sup>45</sup> <http://www.bbsrc.ac.uk/funding/priorities/healthy-ageing.aspx>

<sup>46</sup> <http://www.bbsrc.ac.uk/funding/priorities/food-nutrition-and-health.aspx>

<sup>47</sup> <http://www.bbsrc.ac.uk/funding/priorities/animal-health.aspx>

<sup>48</sup> <http://www.bbsrc.ac.uk/funding/priorities/ibb-industrial-biotechnology.aspx>