

Health Research in Ireland

A study of activity from 2011
to 2015 using the Health Research
Classification System



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Executive summary

In late 2016, the Health Research Board (HRB) conducted a national classification exercise of health-relevant research investment across as many funding agencies as could provide appropriate award data. This report presents the outcomes of that analysis of Irish health-relevant research funding from 2011 to 2015 (five years). Data are presented on funds committed by seven Irish funding agencies and two Government Departments with research funding programmes in health, as well as on co-funding leveraged by these agencies. Where agencies supported Irish researchers to participate in larger international consortia, the amount allocated to partners outside of Ireland was not included in the analysis; that is, only funding for research that took place in Ireland is included.

The focus of research activity and disease areas was identified through classification of the entire funding portfolio of awards made during the study period using the United Kingdom (UK) Health Research Classification System (HRCS).

The rationale for this national HRCS project was twofold:

1. To provide specific evidence on national investment in health research as part of a broader move to classify national research investment across all disciplines, which is a specific action in the Irish Government's strategy for research and development, science and technology, *Innovation 2020*
2. To provide comparable data across national funding agencies in order to gain a better understanding of the distribution of national health-relevant research investment across the full spectrum of disease areas and research activities.

While the HRB has routinely classified its awards using the HRCS system since 2010, this is the first time such an analysis has been carried out for Ireland as a whole.

Summary findings

Profile of awards

- Seven national funding agencies (Enterprise Ireland (EI), the Environmental Protection Agency (EPA), the HRB, the Irish Research Council (IRC), the Marine Institute (MI), Science Foundation Ireland (SFI), and Teagasc) and two Government Departments (the Department of Agriculture, Food and the Marine (DAFM) and the Department of Children and Youth Affairs (DCYA)) that manage research programmes provided data for this analysis.
- The nine participating agencies reported funding commitments valued at just over €752 million for 1,513 health research awards between 2011 and 2015 (five years). The majority of this spending was for awards that directly funded research activity (1,439 awards with a value totalling €543,528,341). The remaining 74 awards (with a value totalling €208,893,471) were aimed at the development of resources and infrastructure to support research.
- The HRB made the greatest number of awards (n=568; 37.5%) between 2011 and 2015, while SFI awards (n=306; 20.2%) were of higher monetary value and accounted for 53% of total national investment in health-relevant research.
- While the monetary value of IRC health-relevant awards was only €31.3 million, the number of awards made by this agency (n=358) accounted for 23.7% of all awards made in the period from 2011 to 2015, reflecting the importance of scholarship and fellowship awards for this agency.
- Agencies used a variety of mechanisms to support research, including capacity building (scholarships, fellowships, and leadership awards); project and programme funding; support for

innovation development and commercialisation; support for infrastructure, networks, and platforms; and support for knowledge exchange and dissemination.

Co-funding

- In total, 411 out of 1,513 awards (27.2%) had a co-funded component, with a total value of almost €329 million, of which €101.2 million was contributed by co-funders. All agencies reported health-relevant research awards with a co-funding element; DAFM, DCYA, the EPA, and the MI reported a single co-funding partner, while the other agencies had more than one co-funding partner.
- Co-funding was most pronounced in the portfolios of EI (n=158), the IRC (n=91), the HRB (n=85), and SFI (n=58), which collectively made 94% of awards with a co-funded component. In terms of the monetary value of co-funded awards, SFI (€219.4 million), EI (€60.7 million), and the HRB (€31.9 million) accounted for 94.9% of funding with a co-funded component.
- Industry partnerships accounted for 62% of co-funded awards, but other national and international funding agencies, charities, and health bodies were also important sources of co-funding.
- Industry co-funded awards were particularly important for *Prevention of Disease and Conditions, and Promotion of Well-Being (Prevention)* (57.1%), *Development of Treatments and Therapeutic Interventions (Treatment Development)* (54.5%), and *Evaluation of Treatments and Therapeutic Interventions (Treatment Evaluation)* (48.2%), where they accounted for roughly half of the value of all awards in those research activities.
- Co-funding was important for awards classified within the *Generic Health Relevance* category and accounted for 64.3% of funding within that category. Co-funded awards also made a significant contribution to the total funding available for research on *Congenital Disorders* (42.3%), *Ear* (100%), *Injuries and Accidents* (53%), *Oral and Gastrointestinal* (49.8%), *Renal and Urogenital* (47.9%), and *Reproductive Health and Childbirth* (57.2%).

Resources and infrastructure investment

- Development of, and support for, the infrastructure, networks, and platforms that enable health research were key investments for Irish funding agencies, especially in support of research in *Aetiology* (21.7%), *Prevention* (32.1%), *Treatment Development* (34.4%), and *Treatment Evaluation* (60.5%).
- Across research activities associated with health categories, resources and infrastructure accounted for 27.8% of the total funding, but within the *Generic Health Relevance* health category, resources and infrastructure accounted for 70.5% of investment.

Funding distribution by research activity

- The IRC (17.2%), SFI (18.6%), and Teagasc (12.1%) were the main funders of *Underpinning Research (Underpinning)* activities. Policy-driven Government Departments and agencies (DAFM, DCYA, the EPA, and the MI) did not have expenditure in *Underpinning*, while EI (2.5%) and the HRB (1.6%) had very low expenditure in this research activity.
- With the exception of EI, all agencies invested in *Aetiology*, and for DCYA (99.5%) and the EPA (52.6%), this was their predominant focus. Most other agencies invested between 20% and 30% of their funding in this area.
- Research activities in *Prevention* accounted for 11.7% of total expenditure. *Prevention*-related research was particularly important for DAFM and Teagasc (nutritional and chemoprevention research), and SFI made significant infrastructure investment to support this research activity.

- Four agencies (EI, the HRB, the IRC and SFI) supported research activities in *Detection, Screening and Diagnosis (Detection)*, which accounted for 8.1% of total expenditure. Within this research activity, discovery and preclinical testing of markers and technologies dominated.
- *Treatment Development* accounted for 25% of total investment by all agencies, with the exception of DCYA and Teagasc. For EI, the IRC and SFI, *Treatment Development* was an important research activity (development of pharmaceuticals, cellular and gene therapies, medical devices, and supporting infrastructure).
- Research activities in *Treatment Evaluation* accounted for 13.3% of total expenditure, but 25.5% of total HRB expenditure. Within this category, evaluation of pharmaceutical products dominated and there was significant investment in the resources and infrastructure to support *Treatment Evaluation* by both the HRB and SFI.
- *Management of Diseases and Conditions (Disease Management)* and *Health and Social Care Services Research (Health Services)* together accounted for 8.4% of total research investment, and were focused on individual care and on improving health services. Investment in these activities was predominantly made by the HRB, although EI and the IRC also made some investments in these areas of research.

Funding distribution by health category

- The focus of investment in specific health categories varied by participating agency and was generally in line with their specific remits.
- EI, the HRB, the IRC and SFI support research and infrastructure across almost all health categories, while all other agencies support research in a more limited number of health categories linked to their specific remits.
- The *Generic Health Relevance* health category, used for studies that are applicable to all diseases and/or general health, accounted for 40.3% of the total investment across all participating agencies from 2011 to 2015.
- All research activities were represented within the *Generic Health Relevance* health category. *Treatment Development* (25%), *Underpinning* (19%), *Aetiology* (18%), and *Treatment Evaluation* (18%) accounted for 80% of research activity within this health category.
- *Cancer and Neoplasms* research received the greatest share of health-specific funding (€93.1 million; 20.7%), and funding was provided by all participating agencies except the MI. The HRB (€49.9 million) and SFI (€31.7 million) were the main funders of *Cancer and Neoplasms* research, including €13.3 million of investment in infrastructure, networks, and platforms to support cancer research and clinical trials.
- Other health-specific health categories in which significant funding was awarded included *Infection* (11.3%), *Neurological* (11.0%), *Oral and Gastrointestinal* (9.2%), *Cardiovascular and Stroke* (10.1%), *Mental Health* (6.6%), and *Reproductive Health and Childbirth* (5.7%). Investments of less than 5% were made in all remaining health categories.

International context

- When Irish health research investment over the period from 2011 to 2015 was compared to data from the 2014 UK HRCS analysis and the 2014 Norwegian HRCS pilot for both research activity and health category, it was found that the overall distribution pattern was broadly similar, although the relative proportion of funding within individual categories differed somewhat.
- The proportion of the UK's investment in *Underpinning* and *Aetiology* was significantly higher than either Ireland's or Norway's, while the proportion of Norwegian investment was highest,

and Ireland's lowest, in *Detection* and *Health Services*. The proportion of Ireland's investment in *Prevention, Treatment Development, and Treatment Evaluation* was significantly higher than both the UK's and Norway's. All three countries allocated an equivalent proportion of their total funding to *Disease Management* and to *Health Services*.

- *Cancer and Neoplasms* research accounted for the largest proportion of total funding in all jurisdictions. The UK invested proportionately more than either Ireland or Norway in the *Infection, Mental Health, and Neurological* health categories. Norway invested proportionately more than either Ireland or the UK in the *Cancer and Neoplasms, Injuries and Accidents, and Musculoskeletal* health categories. Ireland invested proportionately more than either the UK or Norway in *Generic Health Relevance* and *Oral and Gastrointestinal* research. In all other health categories, the proportion of spending was similar.

1 Introduction

This report presents an analysis of Irish health-relevant research funding from 2011 to 2015 (five years). Data are presented on research funding committed, and co-funding leveraged, by seven Irish funding agencies and two Government Departments with research funding programmes in health. The focus of research activity and disease areas was identified through classification of the entire funding portfolio of awards made during the study period using the United Kingdom (UK) Health Research Classification System (HRCS).¹

While the Health Research Board (HRB) has routinely classified its awards using the HRCS since 2010, this is the first time such an analysis has been carried out for Ireland as a whole.

The work reported here builds on the experience of the UK health research system. To date, the UK has undertaken three separate analyses of national health research funding using the HRCS system, spanning 2004/2005,² 2009/2010,³ and 2014.⁴ In addition, in 2007, the UK Clinical Research Collaboration published a report on the funding distribution by 26 UK medical research charities for the period 2004/2005.⁵

1.1 Purpose of analysis

The purpose of this report is to provide an analysis of national health-relevant research investment between 2011 and 2015 (five years) in order to gain a better understanding of the distribution of, and possible gaps in, this investment across the full spectrum of disease areas and research activities. It is hoped that this work can provide useful inputs to future strategic planning of individual agencies (including the HRB) by allowing them to view their research investments in a new way and to compare their research investments with those of other funders in Ireland. It may, highlight potential opportunities for collaboration as well as provide a better overall picture of the areas of activity in which health-relevant research funding is being invested in Ireland. This work sits within a broader move to classify national research investment across all disciplines, which is a specific action in the Irish Government's strategy for research and development, science and technology, *Innovation 2020*.⁶

1.1.1 Need for national data on health research investment

Ireland makes significant investments in health-relevant research annually across a number of funding agencies and Government Departments. These investments have the potential to bring about substantial societal and economic benefits, and can also attract additional private investment from global companies. For example, in 2016, an analysis was conducted of the economic impact of government and charity funding for medical research on private research and development (R&D) funding in the UK.⁷ This analysis found that there was a complementary relationship between public biomedical and health research expenditure and private pharmaceutical R&D expenditure, which in turn was associated with spill-over benefits. In another study that used the 2014 UK Research Excellence impact case study data, Haskel *et al.* (2014) analysed 11 impact case studies collected over a five-year period, and identified health gains worth GBP 2 billion.⁸

Health research is a complex activity that attracts funding from many different sources, be they public, private, charity, or governmental. This makes estimating the inputs to, and subsequent gains and benefits from, health research investment challenging. If strategies for the support of research across sectors are to improve, then better approaches to categorising research inputs are needed. Recognising this, Action 7.6 of *Innovation 2020*⁶ identifies the need to develop a standardised classification of public investment in research for Ireland. Work is ongoing to identify an appropriate system that is capable of capturing all areas of R&D investment nationally, allowing comparison with other countries' R&D systems at a macro level, and identifying where deficits and gaps may still exist in Ireland.

Given the many disciplines that will be covered by a national classification system, the level of granularity that can be achieved in individual areas of research will, out of necessity, be relatively low. Health-relevant research in particular – which encompasses a broad spectrum of activities ranging from basic biomedical research to the development and testing of diagnostics and clinical interventions to population health and health services research – is generally inadequately captured by broad research classification systems. Therefore, addressing this deficit by adopting an internationally accepted and stable classification system for that portion of the national portfolio that supports health-relevant research will significantly enrich the data and enhance their usefulness.

1.1.2 Benefits of comparative data on health research investment

Common classification supports coordination between funders, which helps to maximise the impact of investment in research and to avoid duplicate funding. The strength of the HRCS is that it facilitates the development of an overall picture of health research activity nationally by allowing comparison of the portfolio of different funding agencies. In the UK, the HRCS has been used to map national research investment across sectors (public, government, charities) and agencies that fund health-relevant research; to identify deficits in national investment; and to map areas of investment against burden of disease. This has prompted a realignment of expenditure and focus by a number of agencies across the UK.

The HRCS also allows Ireland to map its health-relevant research portfolio against those of other countries that are using the same system to classify their health-relevant portfolios. To date, the UK and Norway have published HRCS analysis data, but the author is aware of other international systems that are beginning to apply the HRCS to their health research investments; for example, Canada, Sweden, Singapore, and Hong Kong. In the future, the possibility of broader comparative analysis against health research systems of similar size will allow us to gain a better perspective on international trends and on national strengths and weaknesses.

1.2 The Health Research Classification System

The Health Research Classification System (HRCS) is a system for classifying and analysing biomedical and health research funding.⁹ The basic unit of analysis is research projects, which are classified in two dimensions: research activities and health categories. The HRCS was developed collaboratively in 2004 by 11 participating UK funding organisations, and 64 funders took part in the most recent UK HRCS analysis in 2014. The HRCS has now been widely adopted by UK research funders to inform research management and to undertake prospective analyses of their portfolios.

The HRCS is designed to answer strategic questions about investment across the broad spectrum of research activities as they apply to areas of health and disease. Use of this stable common classification system allows meaningful comparisons to be made within and between different research portfolios and allows funding trends to be monitored over time.

The philosophy of the HRCS is to capture the ‘centre of gravity’ or main objective of the research taking place within the lifetime of the award, as opposed to potential downstream outcomes, thereby linking funding to research objectives. Therefore, analysis of research classified by the HRCS provides an overview of the strategic focus of research investment.

1.2.1 Research activity classification

The HRCS classifies research activity across eight research activity groups. Each of the eight research activity groups is further stratified into subgroups to give a total of 48 research activity codes. Research activities represent the value chain of research, from underpinning to health system organisation, and also cover both healthy functioning and disease, as follows:

1. **Underpinning Research:** Research that underpins investigations into the cause, development, detection, treatment and management of diseases, conditions and ill health
2. **Aetiology:** Identification and characterisation of determinants that are involved in the cause, risk and development of diseases or conditions. This encompasses most epidemiological research, including studies aimed at understanding behaviours.
3. **Prevention of Disease and Conditions, and Promotion of Well-Being:** Research aimed at the promotion of health or primary prevention of diseases or conditions in healthy people or people without a pre-existing condition. These are frequently interventions.
4. **Detection, Screening and Diagnosis:** Discovery, development and evaluation of diagnostic, prognostic and predictive markers and technologies for clinical use
5. **Development of Treatments and Therapeutic Interventions:** Discovery and development of therapeutic interventions and testing in model systems and preclinical settings, and includes patient samples if they are being used in the treatment development phase
6. **Evaluation of Treatments and Therapeutic Interventions:** Testing and evaluation of therapeutic interventions in clinical, community or applied settings, with clinical trials in this category often involving an economic evaluation and quality of life component
7. **Management of Diseases and Conditions:** Research into individual care needs and management of disease, conditions or ill health from an individual perspective, and
8. **Health and Social Care Services Research:** Research into the provision and delivery of health and social care services, health policy and studies of research design, measurements and methodologies from a health service perspective.

In each of the eight research activity groups, one subgroup refers to investment in resources and infrastructure that benefit that activity. A single award can be assigned up to three research activity codes. For more details on research activity codes, see Appendix A.

1.2.2 Health category classification

The second dimension of the HRCS places awards into one of 21 health categories associated with systems in the body or with broader health-related research activities. These categories are aligned with the World Health Organization (WHO) International Classification of Diseases¹⁰ and a cancer-based system (the Common Scientific Outline¹¹), and are as follows:

- **Blood:** Haematological diseases, anaemia, clotting (including thromboses and venous embolisms) and normal development and function of platelets and erythrocytes.
- **Cancer and Neoplasms:** All types of neoplasms, including benign, potentially malignant, or malignant (cancer) cancer growths. This includes leukaemia and mesothelioma.
- **Cardiovascular:** Coronary heart disease, diseases of the vasculature and circulation, including the lymphatic system, and normal development and function of the cardiovascular system.
- **Congenital Disorders:** Physical abnormalities and syndromes that are not associated with a single type of disease or condition, including Down syndrome and cystic fibrosis.
- **Ear:** Deafness and normal ear development and function.
- **Eye:** Diseases of the eye and normal eye development and function.
- **Infection:** Diseases caused by pathogens, acquired immune deficiency syndrome, sexually transmitted infections, and studies of infection and infectious agents.

- **Inflammatory and Immune System:** Rheumatoid arthritis, connective tissue diseases, autoimmune diseases, allergies, and normal development and function of the immune system.
- **Injuries and Accidents:** Fractures, poisoning and burns.
- **Mental Health:** Depression, schizophrenia, psychosis and personality disorders, addiction, suicide, anxiety, eating disorders, learning disabilities, bipolar disorder, autism spectrum disorders, and studies of normal psychology, cognitive function and behaviour.
- **Metabolic and Endocrine:** Metabolic disorders (including diabetes), and normal metabolism and endocrine development and function. This includes all research on the pineal, thyroid, parathyroid, pituitary and adrenal glands.
- **Musculoskeletal:** Osteoporosis, osteoarthritis, muscular and skeletal disorders, and normal musculoskeletal and cartilage development and function.
- **Neurological:** Dementias, transmissible spongiform encephalopathies, Parkinson's disease, neurodegenerative diseases, Alzheimer's disease, epilepsy, multiple sclerosis, and studies of the normal brain and nervous system.
- **Oral and Gastrointestinal:** Inflammatory bowel disease, Crohn's disease, diseases of the mouth, teeth, oesophagus, digestive system including liver and colon, and normal oral and gastrointestinal development and function.
- **Renal and Urogenital:** Kidney disease, pelvic inflammatory disease, renal and genital disorders, and normal development and function of male and female renal and urogenital system.
- **Reproductive Health and Childbirth:** Fertility, contraception, abortion, *in vitro* fertilisation, pregnancy, mammary gland development, menstruation and menopause, breastfeeding, antenatal care, childbirth, postnatal care and complications of newborns.
- **Respiratory:** Asthma, chronic obstructive pulmonary disease, respiratory diseases, and normal development and function of the respiratory system.
- **Skin:** Dermatological conditions and normal skin development and function.
- **Stroke:** Includes both ischaemic stroke (caused by blood clots) and haemorrhagic stroke (caused by cerebral/intracranial haemorrhage).
- **Generic Health Relevance:** Research applicable to all diseases and conditions or to general health and well-being of individuals. Public health research, epidemiology and health services research that is not focused on specific conditions. Underpinning biological, psychosocial, economic, or methodological studies that are not specific to individual diseases or conditions.
- **Disputed Aetiology and Other:** Conditions of unknown or disputed aetiology (such as chronic fatigue syndrome/myalgic encephalomyelitis), or research that is not of *Generic Health Relevance* and not applicable to the 19 health categories with specific pathological/physiological determinants listed above.

Each award can be assigned to up to five health categories. If the research is applicable to more than five areas of health or is aimed at understanding or improving health in general, it will be classified as *Generic Health Relevance*. For more details on health categories, see Appendix B.

2 Scope of the analysis

2.1 Data criteria

In this study, we looked longitudinally at funding investment over the period from 2011 to 2015 (five years) in terms of investment made per award over its lifetime, as opposed to expenditure per award in a single year, as is used in the UK. Irish investment included both the portion provided by the participating agencies and the co-funding provided by other partners operating in the Irish system, such as industry, charities, philanthropy, and European programmes that provide funding within Ireland. Where Irish researchers were supported, through public funding, to participate in larger European consortia, only the research activity supported in Ireland is discussed. We chose this methodology because it can give us an overall picture of national health-relevant research investment over a five-year period, can quickly flag changes in the focus of this investment over that time, and is more straightforward for agencies to extract.

2.1.1 Definition of 'health-relevant research'

The definition of 'health-relevant research' used to identify awards for inclusion in this study was the one used by the HRB when collecting funding information for the annual reports on the *Implementation of the Action Plan for Health Research 2009–2013*,¹² coordinated by the Health Research Group:

Health-related research expenditure is defined broadly as 'research which benefits the health of an individual, group or population through the prevention, treatment and management of illness. Such direct interventions include the development of diagnostics, pharmaceuticals, vaccines and devices and the preservation of mental and physical well-being through the services offered by the medical, nursing, and allied health professions. Health-related research may also benefit health through improvement in understanding the mechanisms underlying ill health (either physical or mental) or the influences and impact of environment (physical, social, cultural or occupational) and behaviour on health status and outcomes.'

2.1.2 Inclusion/exclusion criteria

Awards that were included in this analysis were:

- Health-relevant research activity supported by publicly funded agencies in Ireland, although it is acknowledged that charities, the Health Service Executive (HSE), and the private sector also contribute to the research base for health
- The full value of co-funded awards whose research is taking place in Ireland, regardless of the source of co-funding (public, charity, private, philanthropic, etc.)
- For co-funded awards that form part of a larger international consortium, and whose research takes place both in Ireland and internationally, only the portion of the award representing Irish research
- All types of funding instruments, including fellowships, project and programme funding, infrastructure, networks, and so on, and
- All funding deemed eligible under these instruments, including salary support, dissemination, equipment and consumables, training, and so on.

Awards that were excluded from this analysis were:

- Awards that were not directly relevant to human health (e.g. veterinary but not zoonosis, environmental with no health component, robotics for manufacturing)
- Awards for which insufficient information could be provided to allow the award to be coded (e.g. no synopsis or description)
- Wholly industry-funded research
- Research funded wholly by not-for-profit organisations, and
- Higher Education Authority (HEA) core funding to universities.

2.1.3 Categorisation of funding mechanisms

Funding mechanisms (normally referred to as schemes) are approaches to disbursing research funding that are designed to address specific objectives. Examples of such objectives and mechanisms of funding are shown in Table 2.1.

Depending on its objective, the funding mechanism can also be targeted at one or more specific audiences who are best placed to deliver the desired outcomes; for example, postgraduate or postdoctoral researchers, senior researchers (either individually or collectively), healthcare professionals, industry-linked researchers, policy-makers and decision-makers, or clinicians.

Table 2.1: Objectives and mechanisms for awarding health-relevant research funding

Objectives	Type of funding mechanism
Increase capacity, capability, and expertise of Irish researchers in a particular area of health research, either in academia, the healthcare system, the enterprise sector, or in policy bodies.	<ul style="list-style-type: none"> • Clinical fellowship • Postdoctoral fellowship • Postdoctoral enterprise fellowship • Employment-based postgraduate scholarship • Postgraduate scholarship • Postgraduate enterprise scholarship • Healthcare fellowship • Industry fellowship • Senior fellowship • Leadership award
Expand and advance knowledge and understanding in a particular area of health or disease in academia, the healthcare system, the enterprise sector, or in policy bodies.	<ul style="list-style-type: none"> • Cohort study • Projects and programmes • Seed funding • Systematic review/desk study • Conference award • Knowledge exchange and dissemination award
Advance testing, uptake, or commercialisation of a technological innovation, product, or service that benefits people's health or healthcare delivery.	<ul style="list-style-type: none"> • Clinical trial • Proof of concept • Commercialisation support • Innovation development project
Provide the infrastructure, networks, and platforms required to underpin/support a particular area of health research.	<ul style="list-style-type: none"> • Infrastructure and resources investment • Research centre • Networks and platforms • Technology centre

2.2 Participating organisations

All major public funding agencies and Government Departments with a significant research funding portfolio which might include health-relevant research were contacted (n=11). Of these, nine funding agencies responded, namely:

1. Department of Agriculture, Food and the Marine (DAFM)
2. Department of Children and Youth Affairs (DCYA)
3. Enterprise Ireland (EI)
4. Environmental Protection Agency (EPA)
5. Health Research Board (HRB)
6. Irish Research Council (IRC)
7. Marine Institute (MI)
8. Science Foundation Ireland (SFI), and
9. Teagasc.

It is important to understand, when looking at the data in this report, that the remit of each of the participating funders is linked to different governmental strategic agendas. Therefore, a short description of the participating agencies is provided here.

2.2.1 Department of Agriculture, Food and the Marine (DAFM)

DAFM's mission is to lead the sustainable development of the agri-food, forestry, and marine sectors and to participate in the sustainable development of the circular bioeconomy sector. The Department, along with its staff and State agencies, play a vital leadership role in providing and encouraging an environment which can deliver on this mission and on the strategic objectives set out for the agri-food sector in *Food Wise 2025: A 10-year vision for the Irish agri-food industry*.¹³

DAFM's objectives are to:

- Progress the economic development of the agri-food, forestry, and marine sectors, including facilitating the achievement of the goals of *Food Wise 2025*
- Promote and enhance, including through regulation and enforcement, the already high standards of food safety, consumer protection, animal health and welfare, and plant health
- Promote economic, social, and environmentally sustainable farming, fishing, and forestry, and
- Deliver schemes and services effectively and efficiently.

The Department's role in the area of research is informed by the strategic research agendas for the agri-food, forestry, and marine sectors – namely *Sustainable Healthy Agri-Food Research Plan (SHARP)*;¹⁴ *Forest Research Ireland*;¹⁵ and *Harnessing Our Ocean Wealth*¹⁶ – which set out the research and innovation priorities and objectives as agreed by all relevant stakeholders. In pursuit of this, DAFM funds collaborative, national, pre-competitive-type research projects across the agri-food spectrum under its three competitive research funding programmes, namely the Food Institutional Research Measure (FIRM), the Research Stimulus Fund, and the Programme of Competitive Forestry Research for Development (CoFoRD).¹⁷ DAFM also uses these competitive funding programmes in order to enable Irish researchers to participate in transnationally conducted research under programmes such as European Research Area Networks (ERA-NETs), Joint Programming Initiatives (JPIs), the European Joint Programme (EJP), and the United States-Ireland (US-Ireland) R&D Partnership Programme.

2.2.2 Department of Children and Youth Affairs (DCYA)

The core function of DCYA is to put in place a unified framework for policy, legislation, and service provision across the Government for children and young people. In doing this, the Department focuses on harmonising policy issues that affect children and young people in a number of areas, including research on children and young people.

This function is informed by *Better Outcomes, Brighter Futures: The National Policy Framework for Children & Young People, 2014–2020*,¹⁸ which adopts an outcome-based approach to five nationally agreed indicators for children and young people, namely:

- Being active and healthy
- Achieving in all areas of learning
- Being safe and protected from harm
- Experiencing economic security and opportunity, and
- Being connected, respected, and contributing to the world.

Through its commitment to the first of these outcomes (being active and healthy) and its equivalent research domain (health and physical development), the Department's largest research project, *Growing Up in Ireland*,¹⁹ the national longitudinal study of children in Ireland, comes to feature in this report. This focus on health also informs other departmentally funded and commissioned research, including the annual IRC postgraduate scholarship, which replaced the DCYA Research Scholarship scheme.

2.2.3 Enterprise Ireland (EI)

EI is the Government organisation responsible for the development and growth of Irish companies in world markets. It works in partnership with Irish enterprises to help them start, grow, innovate, and win export sales in global markets. In this way, EI supports sustainable economic growth, regional development, and secure employment.

EI's primary goal for innovation is to drive the innovative capacity of Irish companies of all sizes and competencies by enabling in-company innovation, connecting Irish industry with the expertise in the Irish academic system, and leveraging international funding and opportunities to build capabilities at home.²⁰ Through a suite of support programmes, EI drives innovation in four key ways:

- Through the R&D Fund, which supports in-company R&D at all stages of a company's needs, from initial feasibility studies to developing a new product or process or service.
- Through collaboration programmes, such as Innovation Vouchers, Innovation Partnerships, the Technology Gateway Programme, and Technology Centres, which facilitate companies to access and use the expertise in the Irish research system and third-level colleges for the strategic development of their businesses.
- Through programmes such as Knowledge Transfer Ireland, the Commercialisation Fund, the Campus Incubation Programme, and BioInnovate Ireland, all of which foster licensing, entrepreneurship and new company spin-offs from research in the higher education sector.
- By maximising Ireland's success in winning European Union (EU) research funding through Horizon 2020 (H2020), and by optimising the economic benefits of membership of the European Space Agency.

EI also acts as national coordinator for the H2020 programme, supporting a network of National Contact Points and National Delegates across all of the H2020 thematic areas, including health.

2.2.4 Environmental Protection Agency (EPA)

The EPA is an independent public body established under the Environmental Protection Agency Act, 1992. The EPA has a wide range of functions to protect the environment, and its primary responsibilities include environmental licensing; enforcement of environmental law; environmental planning, education, and guidance; environmental research; monitoring, analysing, and reporting on the environment; regulating Ireland's greenhouse gas emissions; strategic environmental assessment; waste management; and radiological protection.

In 2014, the EPA published its *Strategy 2014–2020*,²¹ which is targeted at the needs of key governmental and non-governmental stakeholders. The Programme aims to:

- *Identify pressures*: Provide assessments of current environmental status and future trends in order to identify pressures on our environment
- *Inform policy*: Generate evidence, review practices, and build models in order to inform policy development and implementation, and
- *Develop solutions*: Use novel technologies and methods that address environmental challenges and provide green economic opportunities.

The EPA's current Research Programme 2014–2020 is a Government of Ireland initiative funded by the Department of Communications, Climate Action & Environment. It provides funding under three pillars – Sustainability, Climate, and Water – and is open to all types of organisations from Ireland and abroad. While EPA funding is principally top-down, following consultation with the research community, there is an Open Topic in its 2018 Calls. As well as providing funding under each of the three pillars, the EPA also provides funding for Green Enterprise, Scholarship Funding Opportunities, and Event Support.

Given that environmental challenges go beyond national frontiers and require a coordinated approach at European and global level, the EPA actively promotes, participates, and facilitates participation in several international programmes, e.g. H2020, the JPI on Water Challenges for a Changing World (Water JPI), the JPI on Connecting Climate Knowledge for Europe (Climate JPI), BiodivERSA, the ENV-Health network, and Fulbright awards.

2.2.5 Health Research Board (HRB)

The HRB is the statutory body with responsibility for facilitating, supporting, and funding health research in Ireland. The HRB acts under the auspices of the Department of Health.

Through its research and national health information systems, the HRB aims to improve the health and well-being of Irish citizens. Meeting Ireland's health and social care needs will require substantially increased innovation in clinical practice and in health service design and delivery. To support this, the HRB has, since the late 1990s, broadened its investments beyond biomedical research and placed more emphasis on patient-oriented and clinical research, population health sciences, and health services research, which is articulated in its *HRB Strategy 2016–2020: Research. Evidence. Action*.²²

The HRB supports its research objectives through a combination of project and programme grants, capacity building initiatives, and infrastructure investment, primarily through bottom-up, open competitive calls which are peer reviewed internationally in order to ensure their quality. This has resulted in a significantly enhanced landscape for clinical research in Ireland, much of it driven by the development, with HRB funding, of clinical research facilities (CRFs) on hospital campuses in order to support clinical trials and interventions, as well as coordination mechanisms and support for trial methodology enhancement.

HRB investments in enhancing Ireland's health research capacity are aimed at researchers at all career stages in both academic and healthcare settings. The objectives of these investments are to

enhance evidence-led and evidence-informed health policy and clinical practice, and to create a research-literate healthcare workforce. The HRB also collaborates nationally and internationally with Government Departments, funding agencies, charities, and philanthropic organisations in order to address global health questions, and it provides the National Delegate for Health and a National Contact Point for Health in order to help Irish health researchers become engaged in H2020 programmes.

2.2.6 Irish Research Council (IRC)

The IRC is an associated agency of the Department of Education and Skills and operates under the aegis of the Higher Education Authority.²³ The IRC was established and mandated to:

- Fund excellent research within, and between, all disciplines, and in doing so to enhance Ireland's international reputation as a centre for research and learning
- Support the education and skills development of excellent individual early-stage researchers and cultivate agile independent researchers and thinkers, while offering a range of opportunities which support diverse career paths
- Enrich the pool of knowledge and expertise available for addressing Ireland's current and future needs, whether societal, cultural, or economic, and deliver for citizens through collaboration and enabling knowledge exchange with Government Departments and agencies, enterprise, and civic society, and
- Provide policy advice on postgraduate education, and on more general research matters, to the Higher Education Authority and other national and international bodies. In giving the IRC this role, the then Minister for Research and Innovation requested that particular attention be given to the arts, humanities, and social sciences.

The value of the IRC's award portfolio is currently in the region of €130 million, and it supports more than 1,600 individual research projects across all disciplines and career stages. In particular, the IRC is the key national funder of basic research across all disciplines through its Starting, Consolidator, and Advanced Laureate Award programmes, and is the only Irish funder that supports basic research in the arts, humanities, and social sciences.

To best deliver for Ireland and its citizens, the IRC partners nationally and internationally with Government Departments and agencies, enterprise, and civic society. The objectives of international engagement are set out in the IRC's *International Engagement Strategy 2018–2021*.²⁴ The IRC also engages with Ireland's research community to inform its work and the future development of its activities.

2.2.7 Marine Institute (MI)

The MI is Ireland's national agency for marine research, technology, development, and innovation. It is responsible for promoting the sustainable development of Ireland's marine resources through coordinated and focused research, leading to sound and accurate management advice for the Government, industry, and the EU.²⁵

The MI carries out statutory and non-statutory monitoring and data collection to underpin the development of the marine sector and the sustainability of our ocean resources, specifically: 1) food safety monitoring, 2) managing fisheries resources, 3) monitoring the marine environment and climate change, 4) supporting environmental EU directives, and 5) auditing the impact of marine economic activity.

The MI provides advice to a range of national and international agencies and departments that supports policy decisions across all marine sectors. It works with national development agencies to maximise the economic potential of existing marine sectors (e.g. marine food, shipping/maritime transport) and emerging sectors (e.g. marine biotechnology, renewable ocean energy).

The MI is a research performer that undertakes research (applied and experimental development) through its operational programmes and by leading or participating in many national and EU/international research projects.

The MI is also a research funder, and manages the National Marine Research Programme that provides funding (circa €8 million per annum) to the Irish marine sector through competitive calls. Funding is provided for marine research that addresses national priorities as stated in *Harnessing Our Ocean Wealth*,¹⁶ the *National Marine Research & Innovation Strategy 2017–2021*,²⁶ and other national/EU strategies (*Innovation 2020*,¹² *Food Wise 2025*,¹³ and *Blue Growth*²⁷). The MI also co-funds research with other national partners (e.g. SFI, Geological Survey of Ireland, and the EPA) and international partners (e.g. ERA-NETs, the JPI for Healthy and Productive Seas and Oceans (JPI Oceans), and the Organisation for Economic Co-operation and Development (OECD)).

2.2.8 Science Foundation Ireland (SFI)

SFI is the statutory body with responsibility for funding basic and applied research in the areas of science, technology, engineering, and mathematics (STEM). The agency was established in 2003 under the Industrial Development (Science Foundation Ireland) Act 2003 and is run by a board appointed by the Minister for Business, Enterprise and Innovation. SFI is one of three sister State agencies of the Department of Business, Enterprise and Innovation, along with EI and the Industrial Development Agency. SFI's mission is to build and strengthen scientific and engineering research, along with its infrastructure in the areas of greatest strategic value to Ireland's long-term competitiveness and development.

SFI invests in academic researchers and research teams who are most likely to generate new knowledge, leading-edge technologies, and competitive enterprises in STEM. SFI also promotes and supports the study of, education in, and engagement with STEM and promotes an awareness and understanding of the value of STEM to society and, in particular, to the growth of the economy. SFI makes grants based on the merit review of distinguished scientists. SFI also facilitates cooperative efforts among education, government, and industry that support its fields of emphasis, and promotes Ireland's ensuing achievements around the world.

SFI's current strategic plan, *Agenda 2020*,²⁸ aims to position Ireland as a global knowledge leader and as a society with scientific and engineering research at its core, driving economic, social, and cultural development. SFI aims to create impacts from excellent research, to demonstrate clear value for money invested, and to build partnerships that help to drive that research out into the market and society. SFI also aims to nurture a highly engaged and scientifically informed public in scientific endeavours.

2.2.9 Teagasc

Teagasc – the Agriculture and Food Development Authority – was established under the Agriculture (Research, Training and Advice) Act, 1988 to provide integrated research, advisory, and training services to the agriculture and food industry and to rural communities in Ireland, making it unique internationally in having these three pillars of the innovation system within one organisation. This mandate gives Teagasc the responsibility of meeting the knowledge and technology needs of the entire food chain and the authority to integrate research, advice, and education services in order to deliver the innovation support necessary to add significant value to Ireland's agri-food sector.

Through its research activities, Teagasc ensures that its main focus is on the rapid delivery of results with potential for economic and social impact. This is achieved through the close coupling of research and knowledge transfer in four programme areas:

- Animal and Grassland Research and Innovation
- Crops, Environment and Land Use

- Food, and
- Rural Economy and Development.

Each of these programmes is composed of research, development, and knowledge-transfer/industry-development departments. Research is conducted at seven dedicated locations, while knowledge transfer professionals are located throughout the country.

Teagasc has an annual research portfolio of some 300 research projects undertaken by 500 scientific and technical staff, and supports more than 250 PhD and MSc students annually. Teagasc collaborates extensively with Irish institutes of higher education to deliver its research projects. In addition, Teagasc competes successfully in EU research programmes and has developed bilateral agreements with research organisations in Europe, the US, Canada, South America, New Zealand, and Africa, as well as with the Consortium for International Agricultural Research Centers (CGIAR).

3 Participating agency analysis

Irish health research benefits from funding provided by the public, charity, and private sectors and by European funding programmes. This report focuses on funding commitments made by public funding agencies and two Irish Government Departments, but also captures co-funding provided by other sectors to support health research taking place in Ireland. With the exception of the HRB, none of the participating agencies have a purely health-related research portfolio, so the submissions for this report constitute only that portion of funding that was health relevant.

Summary findings

- Seven national funding agencies (EI, the EPA, the HRB, the IRC, the MI, SFI, and Teagasc) and two Government Departments (DAFM and DCYA) that manage research programmes provided data for this analysis.
 - The nine participating agencies reported funding commitments valued at just over €752 million for 1,513 health research awards between 2011 and 2015 (five years). The majority of this spending was for awards that directly fund research activity (1,439 awards with a value totalling €543,528,341). The remaining 74 awards (with a value totalling €208,893,471) were aimed at the development of resources and infrastructure to support research.
 - The HRB made the greatest number of awards (n=568; 37.5%) between 2011 and 2015 while SFI awards (n=306; 20.2%) were of higher monetary value and accounted for 53% of total national investment in health-relevant research.
 - While the monetary value of IRC health-relevant awards was only €31.3 million, the number of awards made by this agency (n=358) accounted for 23.7% of all awards made in the period from 2011 to 2015, reflecting the importance of scholarship and fellowship awards for this agency.
 - Agencies used a variety of mechanisms to support research, including capacity building (scholarships, fellowships, and leadership awards); project and programme funding; support for innovation development and commercialisation; support for infrastructure, networks, and platforms; and support for knowledge exchange and dissemination.
 - In total, 411 out of the 1,513 awards (27.2%) were co-funded, with a total value of almost €329 million, of which €101,208,528 was contributed by co-funders. All agencies reported health-relevant research awards with a co-funding element; DAFM, DCYA, the EPA, and the MI reported a single co-funding partner, while the other agencies had more than one co-funding partner.
 - Co-funding was most pronounced in the portfolios of EI (n=158), the IRC (n=91), the HRB (n=85), and SFI (n=58), which collectively made 94% of awards with a co-funded component. In terms of the monetary value of co-funded awards, SFI (€219.4 million), EI (€60.7 million), and the HRB (€31.9 million) accounted for 94.9% of funding with a co-funded component.
 - Industry co-funding predominated (62% of co-funded awards), but other national and international funding agencies, charities, and health bodies were also important sources of co-funding.
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3.1 Participating agency profile

In total, seven national funding agencies and two Government Departments with substantial funding programmes in health research provided data on 1,513 awards. The nine participating agencies reported funding commitments valued at just over €752 million between 2011 and 2015 (five years). The totality of this dataset is shown in Table 3.1. The value column shows the funding commitment made by each agency and additional co-funding provided by partners over the period from 2011 to 2015. Where participating agencies supported Irish researchers to participate in a larger international consortium, the funding to international consortia members outside of Ireland is not included in the national total.

Unsurprisingly, given its remit in health research, the HRB made the greatest number of awards (n=568; 37.5% of total) from 2011 to 2015, with a total value of €206,926,733. However, SFI health-relevant research awards (n=306; 20.2% of total) were of higher monetary value (€399,137,831) and accounted for 53% of total national investment in health-relevant research. EI was also a significant funder of health-relevant research and, over the period of analysis, made 161 awards (10.6% of total) valued at €66,101,708. It should be noted that while the monetary value of IRC health-relevant research awards was only €31.3 million (4.2% of total), the number of awards made by this agency (n=358) accounted for 23.7% of all health-relevant research awards made during the period from 2011 to 2015. This reflects the predominant funding mechanisms (scholarships and fellowships) used by this agency to build research capacity in the Irish system.

Table 3.1: Total number, value to Ireland, and percentage of national health-relevant research investment across the nine agencies (2011–2015)

Participating agency	Number of awards	% of total number of awards	Value (agency and co-funding) (€)	% of value of all awards
DAFM	47	3.1	25,468,046	3.4
DCYA	11	0.7	14,865,881	2.0
EI	161	10.6	66,101,708	8.8
EPA	36	2.4	5,891,446	0.8
HRB	568	37.5	206,926,733	27.5
IRC	358	23.7	31,269,881	4.2
MI	9	0.6	1,357,000	0.2
SFI	306	20.2	399,137,831	53.0
Teagasc	17	1.1	1,403,285	0.2
Total amount	1,513		€752,421,812	

3.2 Co-funding of awards

In total, 411 out of the 1,513 awards (27.2%) had a co-funded component. The total value of co-funded research activity happening in Ireland was €328,857,868, and of that, the contribution from partners was worth €101,208,528 (Table 3.2). JPIs, ERA-NETs, and the US-Ireland R&D Partnership Programme, which allowed Irish researchers to participate in larger European and US research consortia, were valued at €61.8 million, but only the portion of the research activity happening within Ireland was included in the analysis presented here (€11.2 million).

The value of the contributions made by co-funding partners to the co-funded portion of the portfolios of the nine participating agencies was greatest for the HRB (37.2%), EI (32.2%), SFI (30.3%), and the IRC (29.2%), which collectively accounted for more than €100 million of the €101 million in contributions made by co-funding partners.

Co-funding also made an important contribution to the overall value of the co-funded awards made by the MI (15.8%) and DCYA (13.3%). When the contribution of co-funding to the overall portfolio of participating agencies was examined, it was noted that a slightly different picture emerged. In this instance, the co-funding contribution of partners as a proportion of the total value of each participating agency's awards was most significant for EI (29.5%), for whom European Structural and Investment Funds are an important source of co-funding. The contribution of co-funding partners was also important in the overall portfolio of SFI (16.6%), much of which was industry co-funding; the MI (14.4%); and the IRC (9%), which awarded 91 industry and employment co-funded fellowships and scholarships.

Table 3.2: Total number, value to Ireland, and percentage of national health-relevant research investment of co-funded awards across the nine agencies (2011–2015)

Participating agency	Number of co-funded awards	Value of co-funded component (€)	Total value of co-funded awards (€)	% of funding contributed by co-funding partners	Total value (agency and co-funder) (€)	% of total value accounted for by co-funder
DAFM	5	0*	2,222,068	0.0	25,468,046	0.0
DCYA	1	400,000	3,001,507	13.3	14,865,881	2.7
EI	158	19,531,489	60,731,253	32.2	66,101,708	29.5
EPA	3	0*	378,712	0.0	5,891,446	0.0
HRB	85	11,852,856	31,855,501	37.2	206,926,733	5.7
IRC	91	2,805,652	9,603,874	29.2	31,269,881	9.0
MI	7	196,000	1,242,000	15.8	1,357,000	14.4
SFI	53	66,422,530	219,406,847	30.3	399,137,831	16.6
Teagasc	8	0*	416,105	0.0	1,403,285	0.0
Grand total	411	101,208,528	328,857,868		752,421,812	

* The co-funding component of these awards supported research outside of Ireland.

Figure 3.1 shows the distribution of the types of co-funding partners, which together contributed more than €101 million to the Irish health research system. Industry co-funding was by far the most valuable source of co-funding for Irish health research (62% of the total co-funded component), but European funding programmes (18%), other Irish and international funding agencies and charities (6% each) were also important sources of co-funding.

A government agency, health bodies and philanthropy collectively accounted for 8% of co-funded awards. The government agency was the Northern Ireland Department of the Economy, which co-funded five Investigator Programmes with SFI, while philanthropic funding was provided by the Atlantic Philanthropies to the HRB to support a variety of awards in the area of dementia research, and to DCYA to support the *Growing Up in Ireland* cohort study. A variety of health bodies provided co-funding to the HRB and the IRC to support scholarships and fellowships.

Figure 3.1: Source of co-funding component by proportion of total co-funding amount (2011–2015)

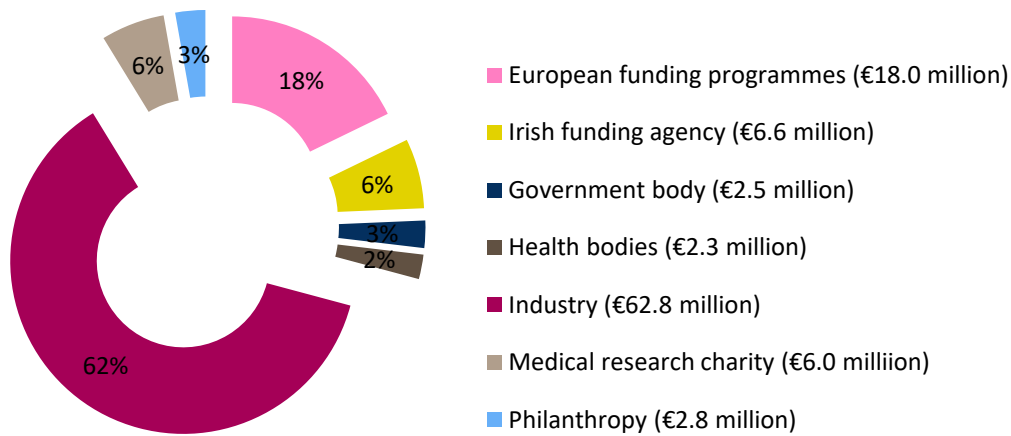
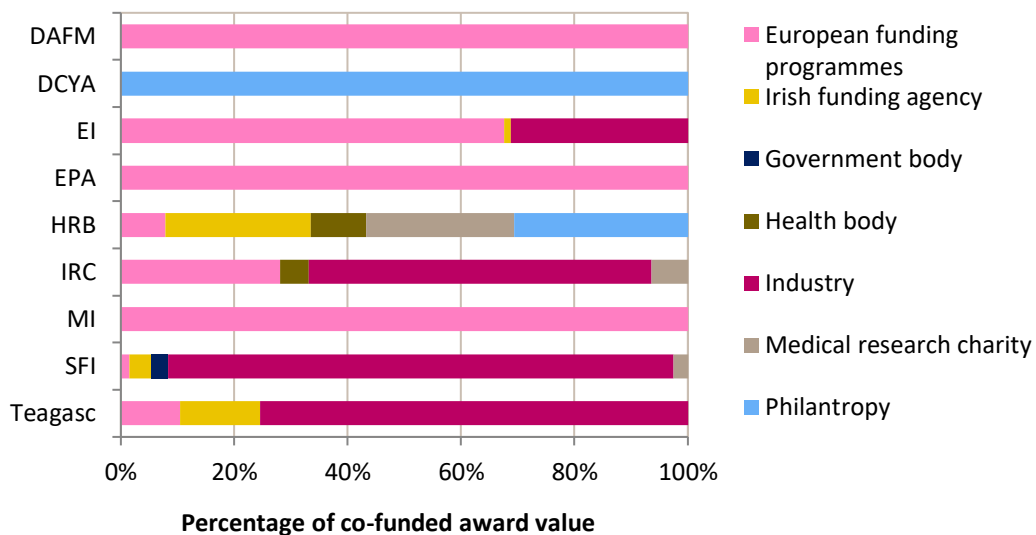


Figure 3.2 shows the distribution of co-funded awards (€328.9 million) within the portfolios of the nine participating agencies. From this, it can be seen that DAFM, DCYA, the EPA, and the MI reported a single co-funding partner, while the other participating agencies had more than one co-funding partner.

Figure 3.2: Distribution of co-funded awards (€328.9 million) within the health-relevant research portfolios of the nine participating agencies, by type of co-funding partner (2011–2015)



Four participating agencies reported industry co-funding, which provided an additional €62.8 million for Irish health research activity. Industry co-funding accounted for 89.2% of the co-funded portfolio of SFI, which included its Research Centres, Spokes calls, and Strategic Partnership Programme. Industry co-funding also accounted for 75.5% of Teagasc’s co-funded portfolio, and focused on its culture collections. The IRC’s industry co-funding accounted for 60% of its co-funded portfolio and was focused on Enterprise Partnerships and Employment-based scholarships and fellowships. Two EI Technology Centres accounted for 31.2% of that agency’s co-funded portfolio.

With the exception of DCYA, all agencies reported co-funding provided by European funding programmes, which provided an additional €18 million for Irish health research activity. For the policy- and regulatory-driven agencies (DAFM, the EPA, and the MI), this was the sole co-funding source, reflecting the cross-boundary nature of their remits. The European Regional Development Fund (ERDF) accounted for 67.5% of EI's co-funding and was focused on commercialisation support and innovation development. European co-funding accounted for 28% of the IRC's co-funded ELEVATE postdoctoral fellowships.

Three agencies (the HRB, the IRC and SFI) reported co-funding with medical research charities. This accounted for 26% of the HRB's co-funded awards (HRB-MRCG Joint Funding Scheme). The IRC co-funded its Enterprise Partnerships and Employment-based scholarships and fellowships with a variety of medical research charities (6.8% of co-funded awards), and SFI co-funded the Blood Cancer Network Ireland and an amyotrophic lateral sclerosis ALS genome-sequencing project with charity partners (2.5% of co-funded awards).

Co-funding with other national and international funding agencies accounted for 25.6% of the HRB's co-funded awards and 14.1% of Teagasc's co-funded awards. Philanthropic funding accounted for all of DCYA's co-funded awards (*Growing Up in Ireland* study) and for 30.7% of the HRB's co-funded awards (all of which were in dementia research).

3.3 Mechanism of funding

Table 3.3 looks at the distribution of investment by funding mechanism objective (using HRB categories) across all participating agencies, while Table 3.4 provides information on distribution of specific funding mechanisms across participating agencies.

Table 3.3: Number and value of health-relevant research awards broken down by main objectives of investment (2011–2015)

Objectives of funding mechanisms	Number of awards	% of total number	Value of awards (€)	% of total value
Capacity building in a particular area of health research, either in academia, the healthcare system, the enterprise sector, or in policy bodies	521	34.4	86,546,575	11.5
Expand and advance knowledge and understanding in a particular area of health or disease in academia, the healthcare system, the enterprise sector, or in policy bodies	679	44.9	305,273,476	40.6
Advance testing, uptake, or commercialisation of a technological innovation, product, or service that benefits people's health or healthcare delivery	208	13.7	121,485,171	16.1
Provide the infrastructure, networks, and platforms required to underpin/support a particular area of health research	105	6.9	239,116,290	31.8
Grand total	1,513		€752,421,512	

From Table 3.3, it can be seen that capacity building was an important objective for participating agencies, and funding mechanisms that facilitated this accounted for 34.4% of all awards, with a total value of €86.5 million. Mechanisms of funding that contributed to expanding and advancing

knowledge and understanding of a particular area of health or disease accounted for the largest share (44.9%) and value (€305.3 million) of awards. Advancing the application of research outputs in policy, clinical practice, or enterprise development accounted for 13.7% of all awards, with a total value of €121.5 million. Finally, investment in infrastructure, networks, and platforms was important for participating agencies in order to underpin and support other research activities, and while the number of awards in this area only accounted for 6.9% of total awards, the total value of these awards was significant (€239 million).

Table 3.4 shows the types of funding mechanisms used by participating agencies to deliver their specific objectives. For example, the predominant focus of the HRB is to support research that improves understanding of disease processes, prevention, diagnosis and treatment, and healthcare management. The HRB used a variety of funding mechanisms to achieve these goals, in particular through capacity building and project and programme funding to increase knowledge; many of these schemes are co-funded with a relevant medical research charity, health body, and funding agency partner.

For the IRC, its remit is to build capacity for research in Ireland, and therefore its focus has traditionally been the provision of funding to early-stage postgraduate and postdoctoral researchers, many of whom are co-funded by industry, policy, or health bodies.

The majority of awards made by EI, whose remit is industry focused, supported innovation development and commercialisation, which is of relevance for Irish small and medium-sized enterprises (SMEs), and the development of new start-up companies. SFI, whose remit is to provide funding oriented towards basic and applied research in STEM, uses a broad range of mechanisms to achieve its goals, and 17.3% of its awards are co-funded with industry, funding agency, and government partners.

DAFM, Teagasc, and the MI, whose remits are to lead the sustainable development of the agri-food, forestry, and marine sectors, support their objectives primarily through projects and programmes, networks and platforms, and scholarships. These agencies also emphasise support for Irish researchers to participate in larger European consortia.

The EPA, whose remit is to inform policy and develop solutions for environmental challenges, supports postgraduate scholarships as well as projects and programmes to build capacity and knowledge that contribute to environmental protection and enhancement. Like DAFM, Teagasc, and the MI, the EPA also supports Irish researchers to participate in larger European consortia.

DCYA's research activity focuses on longitudinal studies of children through the *Growing Up in Ireland* study, and on postgraduate scholarships that conduct secondary analysis of this rich dataset.

Table 3.4: Number of awards made by the nine agencies in health-relevant research, broken down by type of funding scheme (2011–2015)

Mechanism of funding distribution	DAFM	DCYA	EI	EPA	HRB	IRC	MI	SFI	Teagasc	Total
Clinical fellowship					7					7
Clinical trial					9					9
Cohort study	8	5			1					14
Commercialisation support			4							4
Conference award								1		1
Employment-based postgraduate scholarship						23				23
Healthcare fellowship					86					86
Industry fellowship								14		14
Infrastructure			3		13			9	1	26
Innovation development project			149					19		168
Knowledge exchange and dissemination					86					86
Leadership award					21					21
Networks and platforms	3		2		24			37		66
Postdoctoral enterprise fellowship						11				11
Postdoctoral fellowship					8	67				75
Postgraduate scholarship		6		11	1	208	2	1		229
Postgraduate enterprise scholarship						49				49
Projects and programmes	29			25	308		7	185	15	569
Proof of concept								27		27
Research centre								9	1	10
Seed funding					2					2
Senior fellowship					2			4		6
Systematic review/desk study	7									7
Technology centre			3							3
Grand total	47	11	161	36	568	358	9	306	17	1,513

4 Funding distribution by research activity

The Health Research Classification System (HRCS) has 48 research activity codes within eight overarching research activity groups that encompass all aspects of health-related research activity, ranging from basic research to health system improvement. It is important to note that many research projects span more than one research activity, and up to three codes can be applied to a single award.

Summary findings

- The IRC (17.2%), SFI (18.6%), and Teagasc (12.1%) were the main funders of *Underpinning* research activities. Policy-driven Government Departments and agencies (DAFM, DCYA, the EPA, and the MI) did not have expenditure in *Underpinning*, while EI (2.5%) and the HRB (1.6%) had very low expenditure in this research activity.
 - With the exception of EI, all agencies invested in *Aetiology*, and for DCYA (99.5%) and the EPA (52.6%), this was their predominant focus. Most other agencies invested between 20% and 30% of their funding in this area.
 - Research activities in *Prevention* accounted for 11.7% of total expenditure. *Prevention*-related research was particularly important for DAFM and Teagasc (nutritional and chemoprevention research), and SFI made significant infrastructure investment to support this research activity.
 - Four agencies (EI, the HRB, the IRC and SFI) supported research activities in *Detection*, which accounted for 8.1% of total expenditure. Within this research activity, discovery and preclinical testing of markers and technologies dominated.
 - *Treatment Development* accounted for 25% of total investment by all agencies, with the exception of DCYA and Teagasc. For EI, the IRC and SFI, *Treatment Development* was an important research activity (development of pharmaceuticals, cellular and gene therapies, medical devices, and supporting infrastructure).
 - Research activities in *Treatment Evaluation* accounted for 13.3% of total expenditure, but 25.5% of total HRB expenditure. Within this category, evaluation of pharmaceutical products dominated and there was significant investment in the resources and infrastructure to support *Treatment Evaluation* by both the HRB and SFI.
 - *Disease Management* and *Health Services* together accounted for 8.4% of total research investment, and were focused on individual care and on improving health services. Investment in these activities was predominantly made by the HRB, although EI and IRC made some investments in products and services to benefit these areas of research.
 - Development of, and support for, infrastructure, networks, and platforms that enable health research were key investments for Irish funding agencies, especially in support research in *Aetiology* (21.7%), *Prevention* (32.1%), *Treatment Development* (34.4%), and *Treatment Evaluation* (60.5%).
 - When the distribution of Irish research activity groups was compared to that of the UK and Norway, it was found that there was a broadly similar pattern of distribution for all three countries, although some differences were observed within individual research activities.
 - Industry co-funding was particularly important for *Prevention* (57.1%), *Treatment Development* (54.5%), and *Treatment Evaluation* (48.2%), where it accounted for roughly half of the value of all awards in those research activities.
-

4.1 Overall distribution of health research funding across research activities

The distribution of the collective research portfolio for all nine participating agencies across the eight major research activity groups in the period from 2011 to 2015 is shown in Figure 4.1 (distribution) and Figure 4.2 (proportion of total funding).

Overall, expenditure on *Treatment Development* (25.0%) was highest, followed by *Aetiology* (22.4%). There was similar expenditure in *Underpinning* (11.3%), *Treatment Evaluation* (13.3%), and *Prevention* (11.7%). The lowest shares of national expenditure were in *Disease Management* (4%) and *Health Services* (4.4%).

Figure 4.1: Distribution of health-relevant research investment (€752.4 million) across research activity groups for all nine agencies (2011–2015)

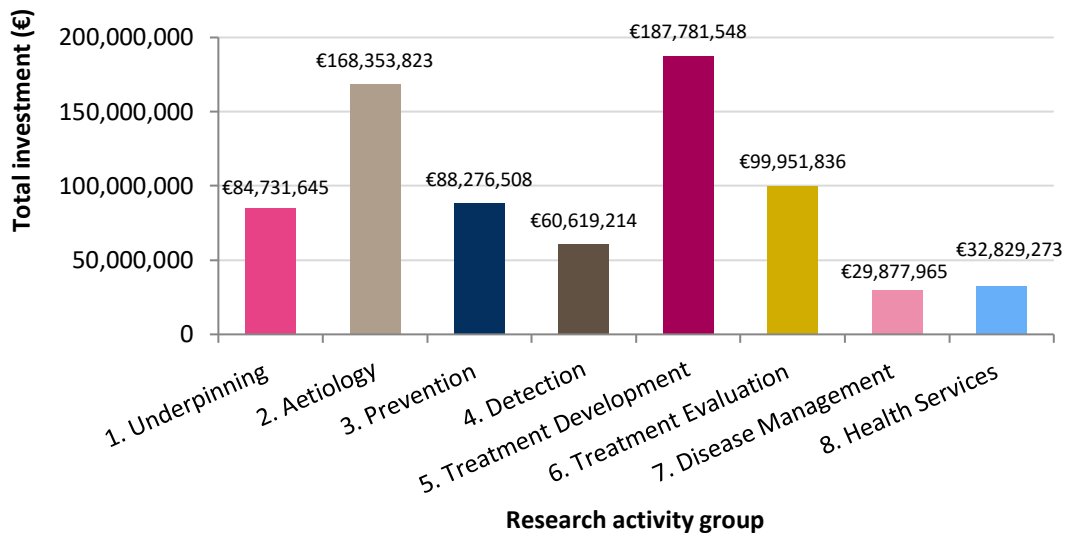
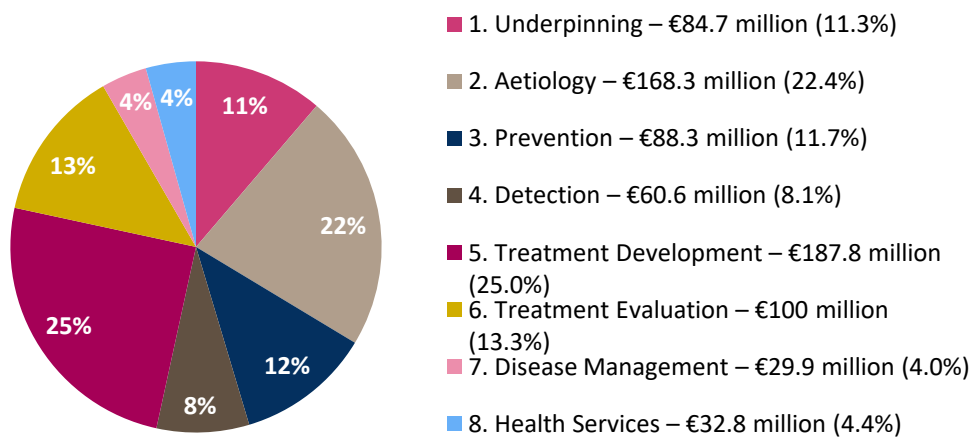


Figure 4.2: Percentage of total health-relevant investment (€752.4 million) by research activity group for all nine agencies (2011–2015)



4.1.1 Investment in resources, infrastructure, and networks

Each research activity group in the HRCS makes provision for investment in resources and infrastructure to support research activities within that activity. Within the Irish dataset, 74 awards were made in resources and infrastructure to support health-relevant research (worth a total of €208,893,471). The HRCS defines ‘resources’ as any research activity that benefits the whole research community, and includes the development of cell lines, tissue and DNA banks, genomic and proteomic sequence resources, informatics systems, datasets, and so on. Research activity is categorised as ‘infrastructure’ if it supports research networks and consortia, research-relevant platforms, and/or research centres and facilities.

Investment in resources and infrastructure accounted for 27.8% (€208,893,471) of all investment across the eight research activity groups. Table 4.1 presents a comparison of the distribution of all participating agencies’ investment in resources and infrastructure in each research activity group as a percentage of the total investment made collectively in the resources and infrastructure research activity. This demonstrates that the development of, and support for, the infrastructure, networks, and platforms that enable health research were key investments for Irish funding agencies, especially in support of research in *Aetiology* (11%), *Prevention* (17%), *Treatment Development* (18%), and *Treatment Evaluation* (31%).

Table 4.1: Distribution of resources and infrastructure investment in health-relevant research by all nine agencies across research activity groups (2011–2015)

Resources and infrastructure subcode	Investment in resources and infrastructure (€)	Total value of research activity group (€)	% of research activity group
1.5 Resources & infrastructure (Underpinning)	253,042	84,731,645	0.3
2.6 Resources and infrastructure (Aetiology)	36,612,254	168,353,823	21.7
3.5 Resources and Infrastructure (Prevention)	28,304,170	88,276,508	32.1
4.5 Resources and infrastructure (Detection)	9,624,204	60,619,214	15.9
5.9 Resources and infrastructure (Treatment Development)	64,510,154	187,781,548	34.4
6.9 Resources and infrastructure (Treatment Evaluation)	60,444,469	99,951,836	60.5
7.4 Resources and infrastructure (Disease Management)	3,729,863	29,877,965	12.5
8.5 Resources and infrastructure (Health Services)	5,415,315	32,829,273	16.5
Total	208,893,471	752,421,812	27.8

The research activity group with the largest proportion of resources and infrastructure investment was *Treatment Evaluation* (60.5% of total investment; €60.4 million). This included HRB capital investment in the Clinical Trials Facility at National University of Ireland, Galway, as well as support for networks and enabling platforms, which included core funding for clinical trials networks and the coordination (in partnership with EI) and methodology of clinical trials. This also included a portion of SFI Research Centres (CÚRAM, Advanced Materials and BioEngineering Research (AMBER), and the Synthesis and Solid State Pharmaceutical Centre (SSPC)).

Investment in resources and infrastructure within *Treatment Development* accounted for 34.4% (€64.5 million) of total investment in that research activity group. This included EI’s support for the

Healthcare Innovation Hub Ireland, a portion of the investment in a number of SFI Research Centres (CÚRAM, AMBER, and SSPC), support for the Blood Cancer Network Ireland, and a national transgenic and germ-free facility.

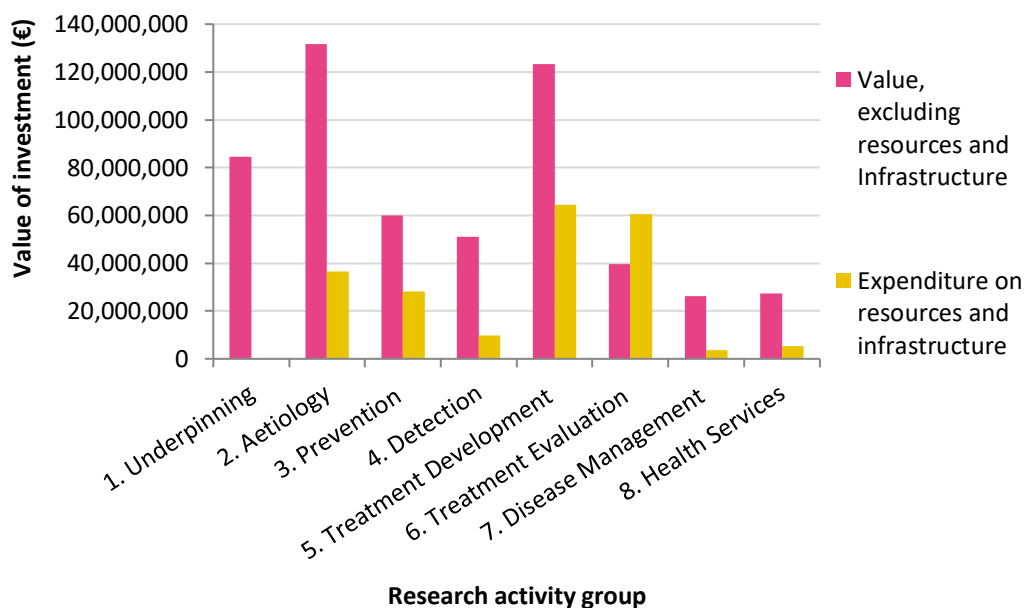
Investment in resources and infrastructure within *Prevention* accounted for 32.1% (€28.3 million) of total investment in this research activity group. This included a portion of HRB support its Centre for Health and Diet Research, a number of leadership awards, and knowledge exchange and dissemination awards. It also included a portion of SFI investment in APC Microbiome Ireland, a food database, and the Irish Centre for Foetal and Neonatal Translational Research (INFANT) Discovery Platform. Finally, this investment included Teagasc support for conservation of its Bacterial Culture Collection.

Aetiology resources and infrastructure investment accounted for 21.7% (€36.6 million) of total investment in this research activity group. This included a portion of HRB support for its Centres for Primary Care Research and for Health and Diet Research, the PhD Scholars Programme in Health Services Research, and two research consortia, one of which was co-funded with DAFM. It also included a portion of SFI investment in APC Microbiome Ireland; in the Blood Cancer Network Ireland, a national transgenic and term-free facility; in the INFANT Biobank; and in the INFANT Discovery Platform.

Figure 4.3 looks at the contribution to each research activity group of resources and infrastructure investment and all other investments, respectively.

When investment in specific research projects and in resources and infrastructure are considered separately, the pattern of distribution across research activities differs somewhat from the pattern seen in Figure 4.1. Development of, and support for, infrastructure, networks, and platforms that enable health research were key investments for Irish funding agencies, especially in support of research in *Prevention* (32.1%), *Treatment Development* (34.4%), and, in particular, *Treatment Evaluation* (60.5%). Investment in resources and infrastructure played less of a role in *Underpinning* (0.3%), *Detection* (15.9%), *Disease Management* (12.5%), and *Health Services* (16.5%).

Figure 4.3: Comparison of the value of resources and infrastructure investment (€208.9 million) with all other health-relevant research investments (€543.5 million), by research activity group (2011–2015)



4.1.2 Contribution of co-funding to research activities

In addition to the investment in co-funded awards made directly by the participating agencies, a variety of co-funding partners contributed an additional €101,208,528, bringing the total value of co-funded awards to €328,857,868.

Figure 4.4 shows where these 411 awards sat on the spectrum of research activities, in comparison to awards for each research activity that were not co-funded. From this, it can be seen that co-funded awards were particularly important for *Prevention* (57.1%), *Treatment Development* (54.5%), and *Treatment Evaluation* (48.2%), where they accounted for roughly half of the value of all awards in those research activities. Co-funded awards also contributed significantly to the total value of awards in *Aetiology* (36%) and *Detection* (42%).

In contrast, co-funded awards made less of a contribution to the total value of awards in *Underpinning* (30.2%), *Disease Management* (22.1%), and *Health Services* (28.6%).

Figure 4.4: Comparison of the value of co-funded awards (€329 million) with non-co-funded health-relevant research awards (€423.4 million) in each research activity group (2011–2015)

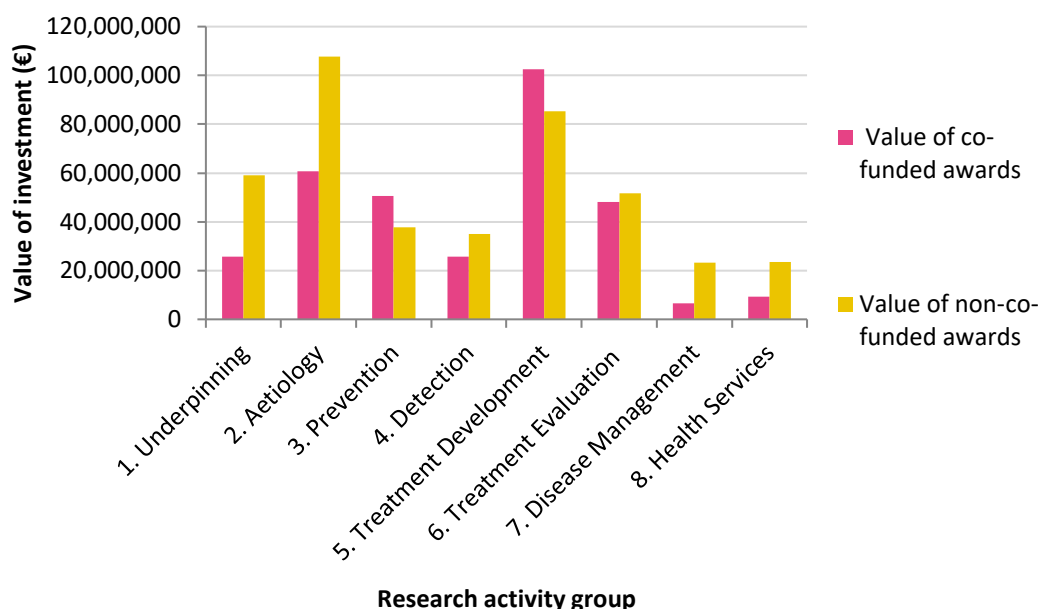


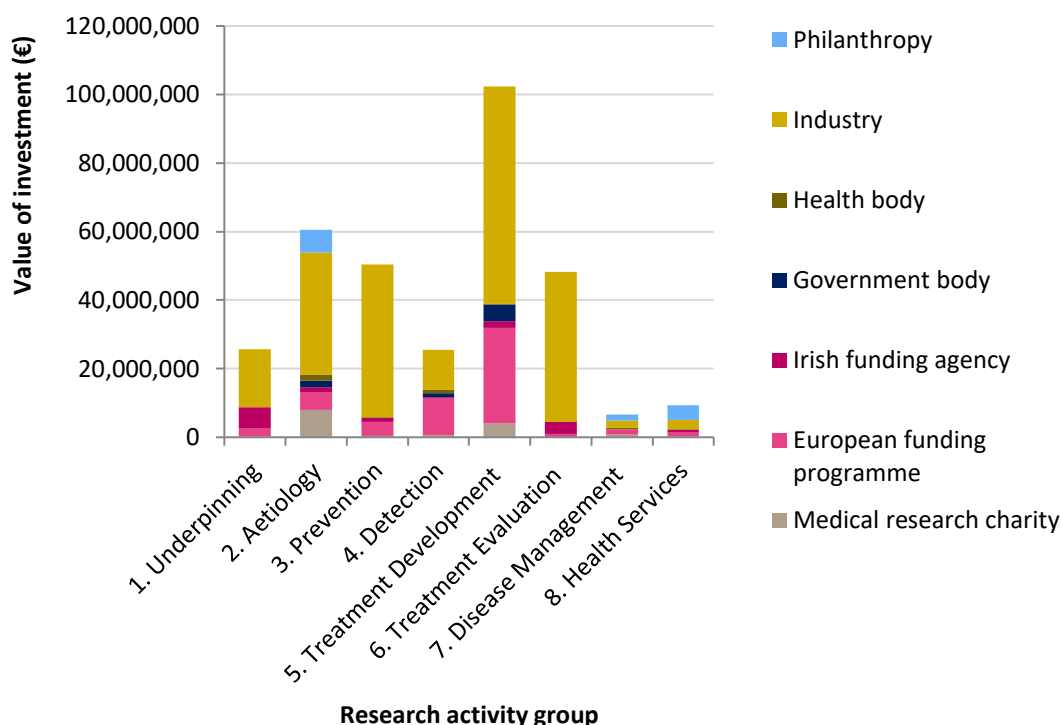
Figure 4.5 shows the sources of co-funding investment across the spectrum of research activities.

Industry co-funding contributed significantly across all research activities, in particular *Prevention* (88.5%) and *Treatment Evaluation* (90.8%), although it also accounted for more than 50% of co-funding in *Underpinning*, *Aetiology*, and *Treatment Development* and just under 50% of co-funding for *Detection*. Industry co-funding, while still significant, was less prominent for co-funding of *Disease Management* (33.1%) and *Health Services* (28.6%).

Awards that were co-funded through European funding programmes accounted for a significant proportion of co-funded awards in *Detection* (41.8%), *Treatment Development* (27.2%), and *Disease Management* (22.3%) – and, to a lesser extent, *Health Services* (12.4%).

Partnerships with other funding agencies accounted for 24.7% of the value of awards in *Underpinning*, while partnerships with medical research charities accounted for slightly more than 13% of the value of co-funded awards in both *Aetiology* and *Disease Management*. Philanthropic co-funding was particularly important for *Health Services* (46.3%), and also contributed to research in *Aetiology* (11.2%) and *Disease Management* (25.1%).

Figure 4.5: Distribution of co-funded health-relevant research awards by partner type across research activity groups (2011–2015)



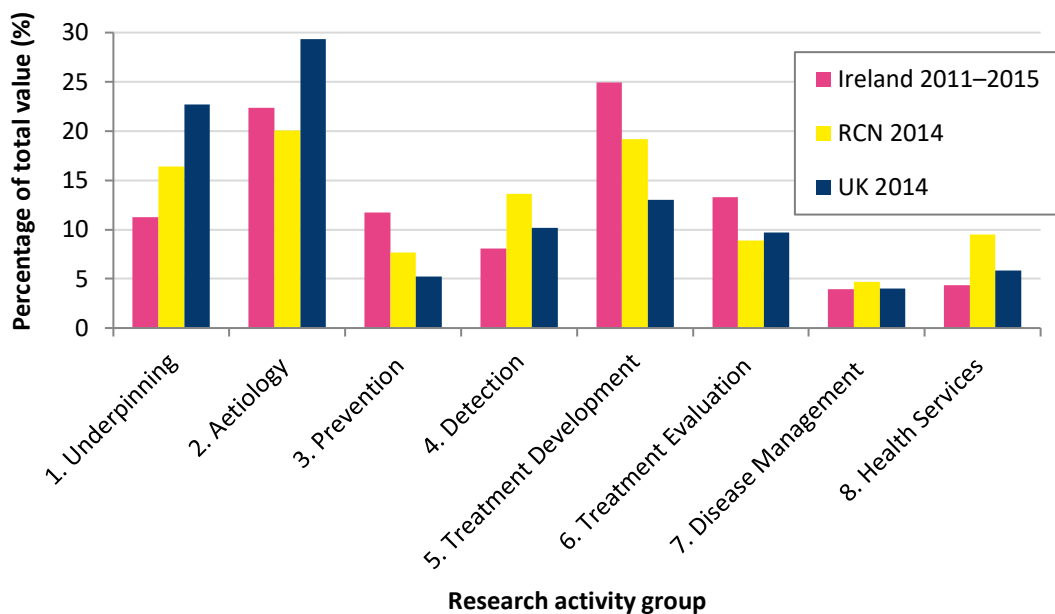
4.1.3 Comparison of Irish, UK, and Norwegian HRCS research activity

In order to place Ireland in a broader European context in terms of overall expenditure across research activities, Figure 4.6 compares Irish research activity to the latest available HRCS analysis of the UK's health research portfolio²⁹ and a pilot HRCS analysis conducted by the Research Council of Norway (RCN) in 2014 on a limited number of its large programmatic awards valued at approximately €100 million.³⁰ Data were not available from other international funding agencies.

The distribution of funding by research activity had a broadly similar pattern for all three comparators. There were also some differences observed between the comparators:

- The proportion of the UK's investment in *Underpinning* and *Aetiology* was considerably higher than either Ireland's or Norway's.
- The proportion of RCN investment was highest, and Ireland's lowest, in *Detection* and *Health Services*.
- The proportion of Ireland's investment in *Prevention*, *Treatment Development*, and *Treatment Evaluation* was higher than both the UK's and the RCN's studies.
- All agencies allocated an equivalent proportion of their total budget to *Disease Management* and *Health Services*.

Figure 4.6: Comparison of the proportion of health-relevant research investment in each research activity group for Ireland (2011–2015 commitment), the UK (2014 actual spend), and the RCN (2014 commitment)



4.2 Distribution of funding within research activities

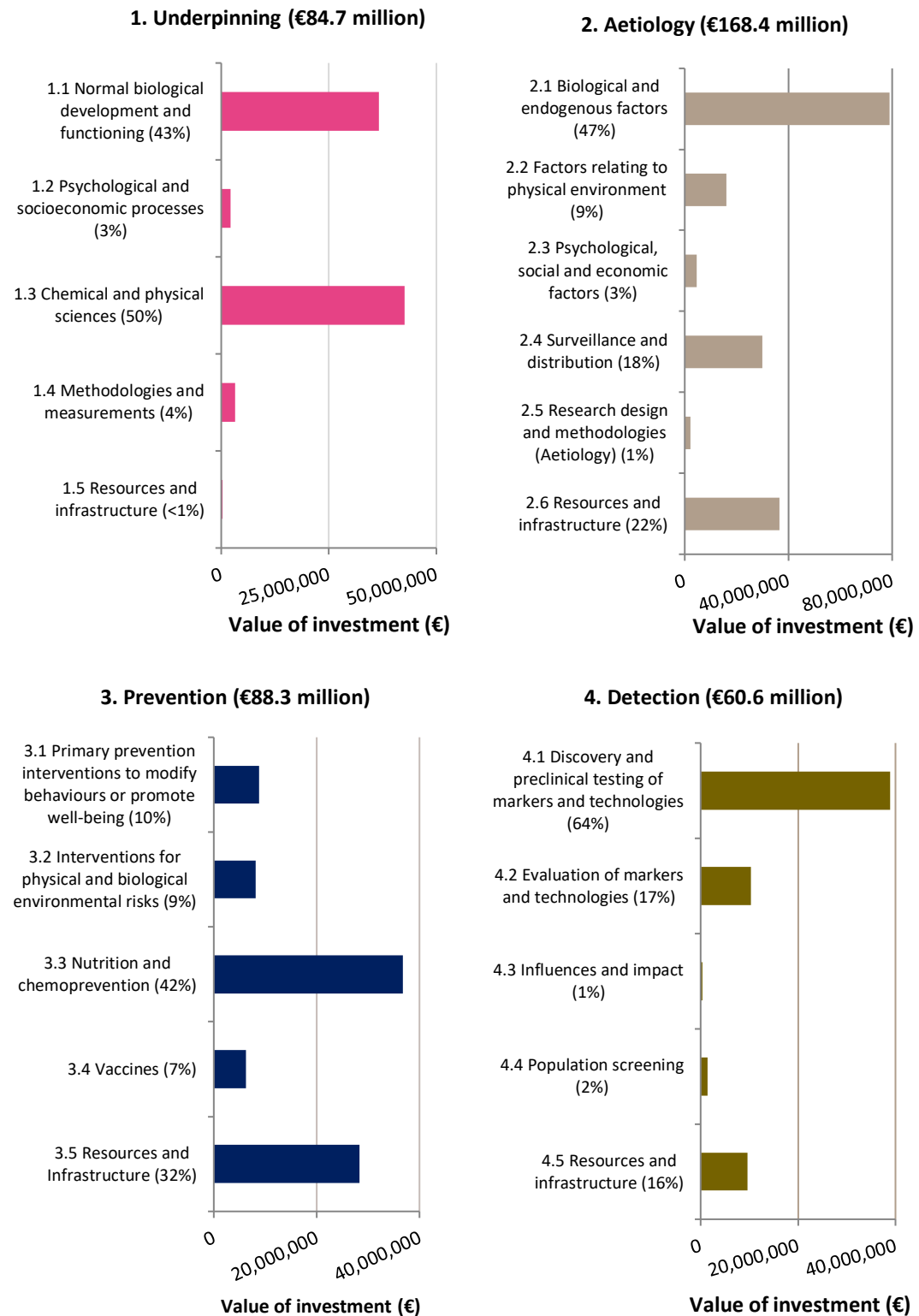
Each research activity group has a number of subcodes to reflect the range of activities that might occur within the overall research activity. Figure 4.8 presents overall investment in each major research activity, broken down by the subcodes for that research activity group.

From Figure 4.7, a number of observations can be made:

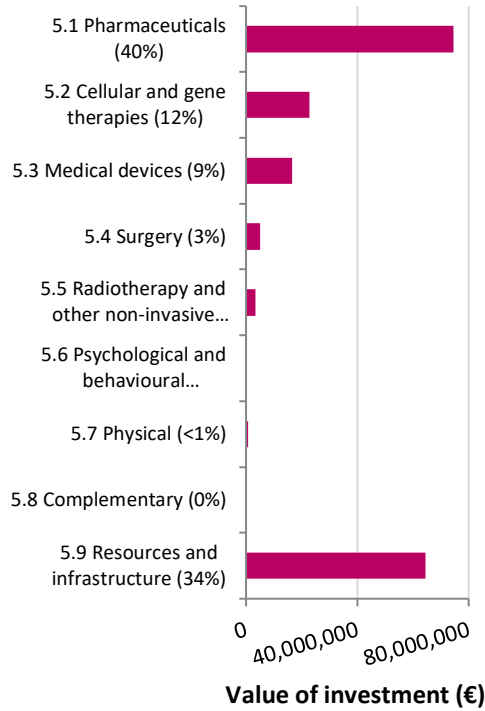
- Within *Underpinning*, the majority of investment is in research that focuses on normal biological functioning (this would include health promotion) and on chemical and physical sciences.
- Investment in research classified as *Aetiology* covered a range of activities, but a significant proportion was focused on biological and endogenous factors in health and disease, on surveillance and distribution of disease, and on the infrastructure to support such research.
- Research activity classified as *Prevention* covered a range of preventative approaches, although the largest proportion of investment went towards nutrition and chemoprevention and towards the resources and infrastructure to support research in this area.
- Detection research activities focused predominantly on discovery and preclinical testing of markers and technologies.
- *Treatment Development* and *Treatment Evaluation* were similar in focusing primarily on pharmaceuticals, although there was some work being done on other treatment types. Both research activities also had significant investment in the resources and infrastructure required to support this type of work.
- *Disease Management* research activities focused primarily on research exploring individual care needs and on health management decisions around individual care.

- The focus within the *Health Services* research activity was on improvements in the organisation and delivery of services.

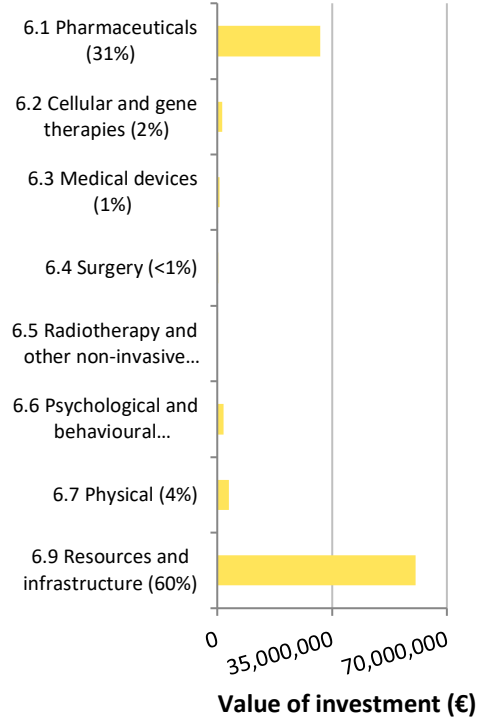
Figure 4.7: Distribution of health-relevant research investment in the subcodes within each research activity group, for each of the nine agencies (2011–2015)



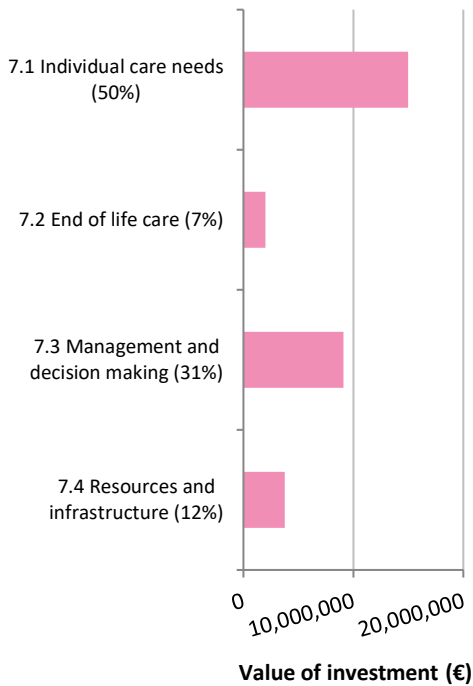
5. Treatment Development (€187.8 million)



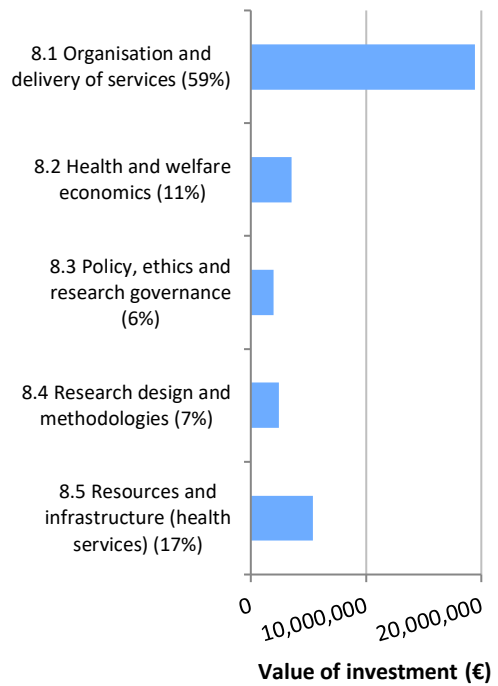
6. Treatment Evaluation (€100 million)



7. Disease Management (€29.9 million)



8. Health Services (€32.8 million)



4.3 Distribution of funding across research activities by individual agency

Figure 4.8 examines the distribution of expenditure by research activity across all nine participating agencies and departments. Figure 4.9 examines the distribution of each agency's investment in research activities as a percentage of its total investment, and Figure 4.10 examines the distribution of each agency's investment across research activities by the value of the agency's investment in each activity. Combining the analysis provided in Figures 4.8, 4.9 and 4.10 a number of observations can be made.

The HRB, SFI, and the IRC funded research across the full range of research activities, from *Underpinning* to *Health Services*, although the relative focus differed between agencies, reflecting their differing remits. EI funded research in all areas with the exception of *Aetiology*, but again its main investments reflected its enterprise remit. Overall, DAFM, DCYA, the EPA, the MI, and Teagasc funded research in a narrower range of research activities, which reflects their remits as supports to policy and regulation in their respective sectors.

In monetary terms, SFI was the main funder of *Underpinning* and *Aetiology* research (Figure 4.8). However, as a proportion of each agency's investment, *Aetiology* was a particularly important focus for DCYA (99.5%) and the EPA (52.5%) (Figure 4.9). A number of other agencies invested between 20% and 30% of their funding in *Aetiology* (SFI, the MI, the IRC, the HRB, and DAFM).

As a proportion of their overall portfolio, investment in research on *Prevention* was significant for the policy-driven agencies: DAFM (58.6%), the EPA (41.8%), the MI (44.8%), and Teagasc (74.5%).

In monetary terms, EI, the HRB and SFI accounted for almost all investment in *Detection*. However, as a proportion of their individual funding portfolios, investment was similar for the HRB (8.7%), the IRC (7.8%), and SFI (7.0%).

Figure 4.8: Distribution of health-relevant research investment (€752.4 million) across research activity group and participating agency (2011–2015)

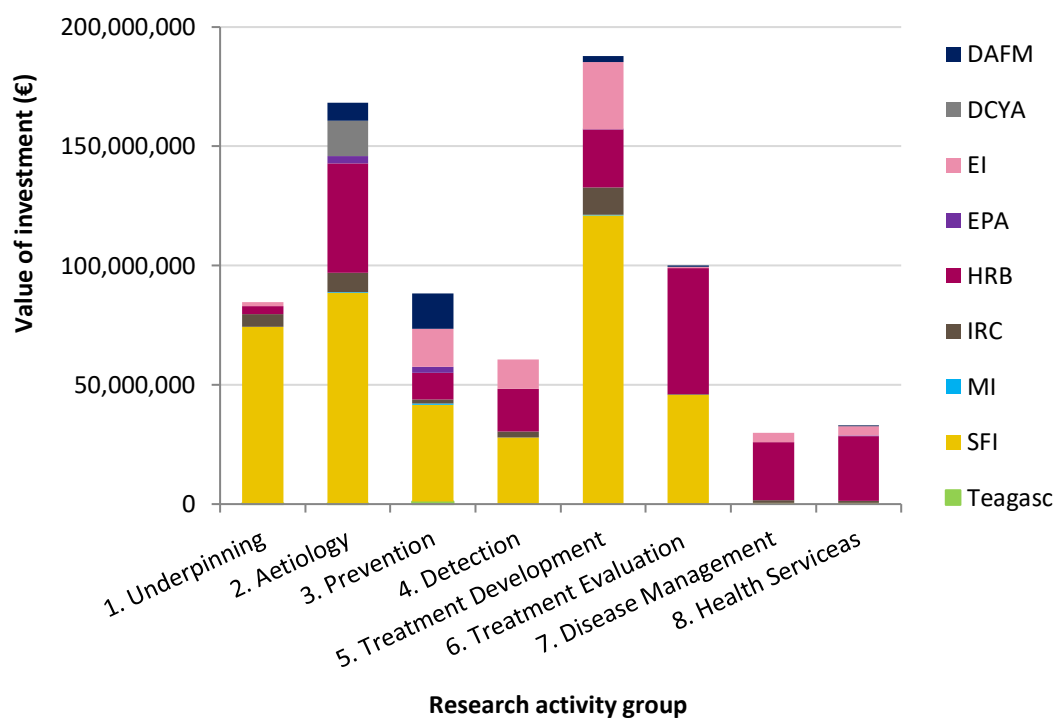
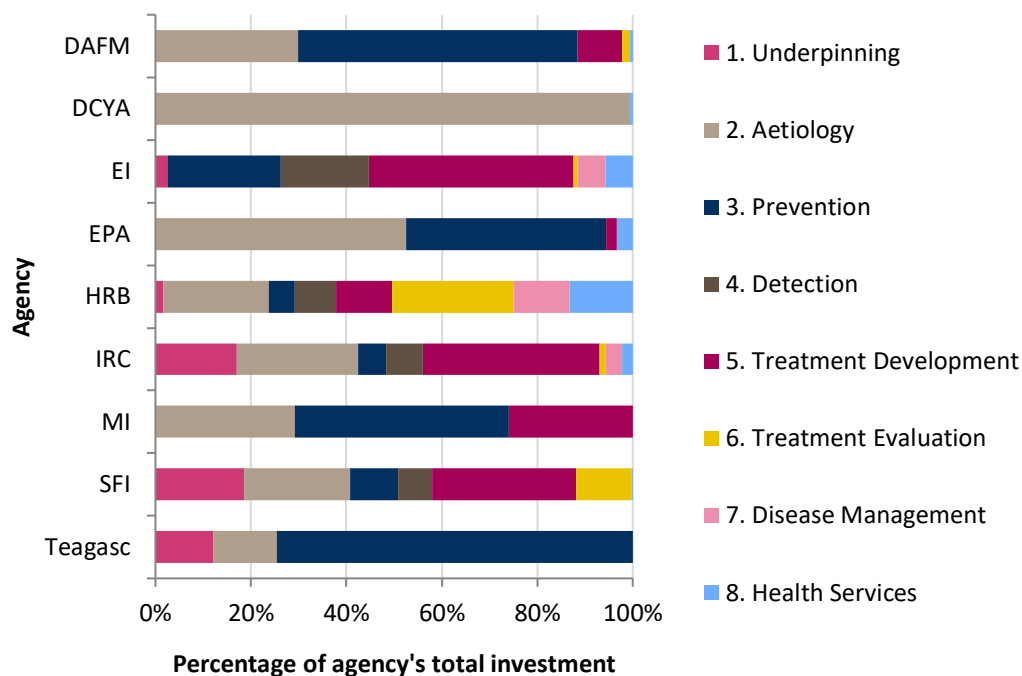


Figure 4.9: Distribution of investment in research activity groups in each of the nine agencies, as a percentage of their overall health-relevant research investment (2011–2015)

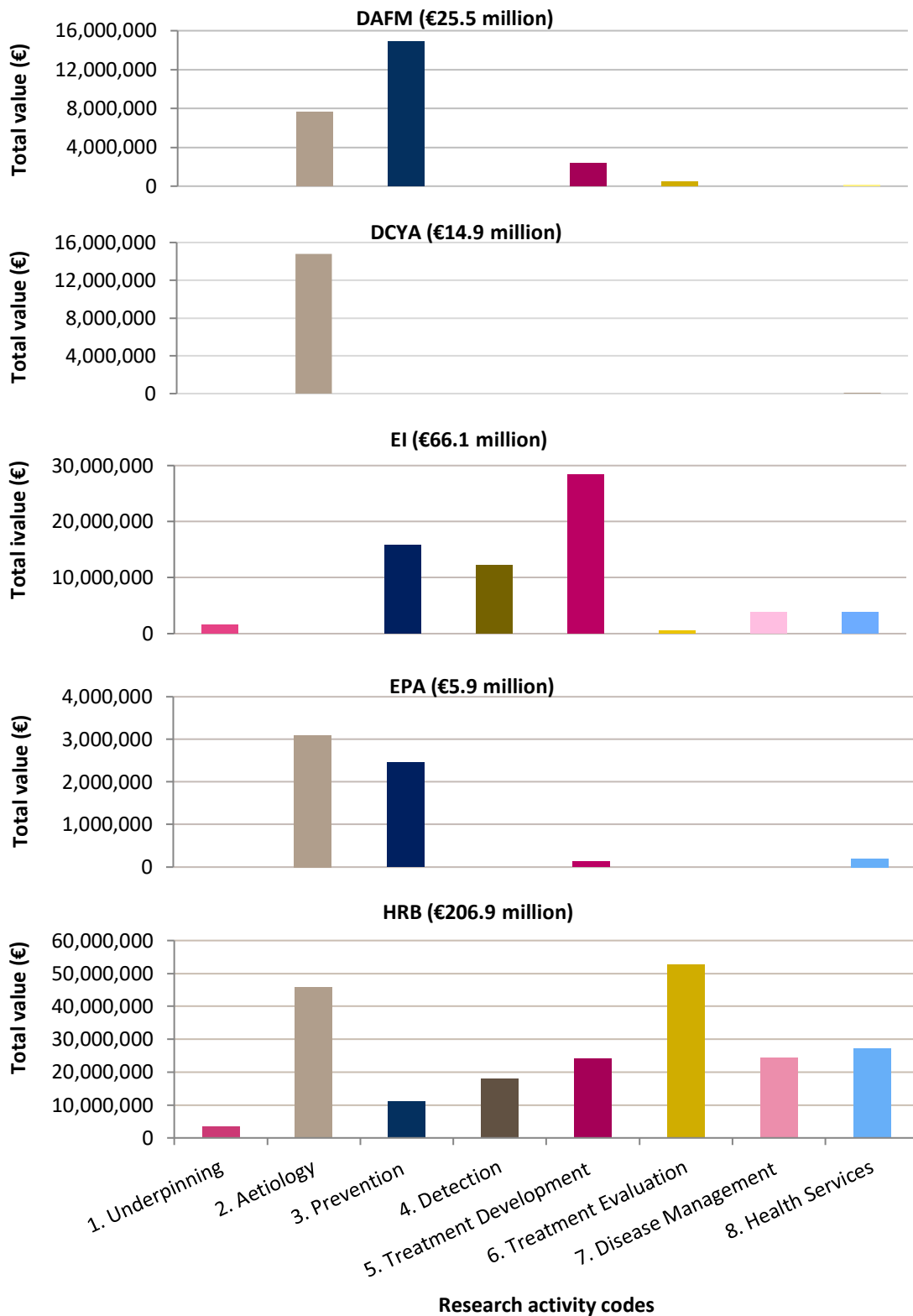


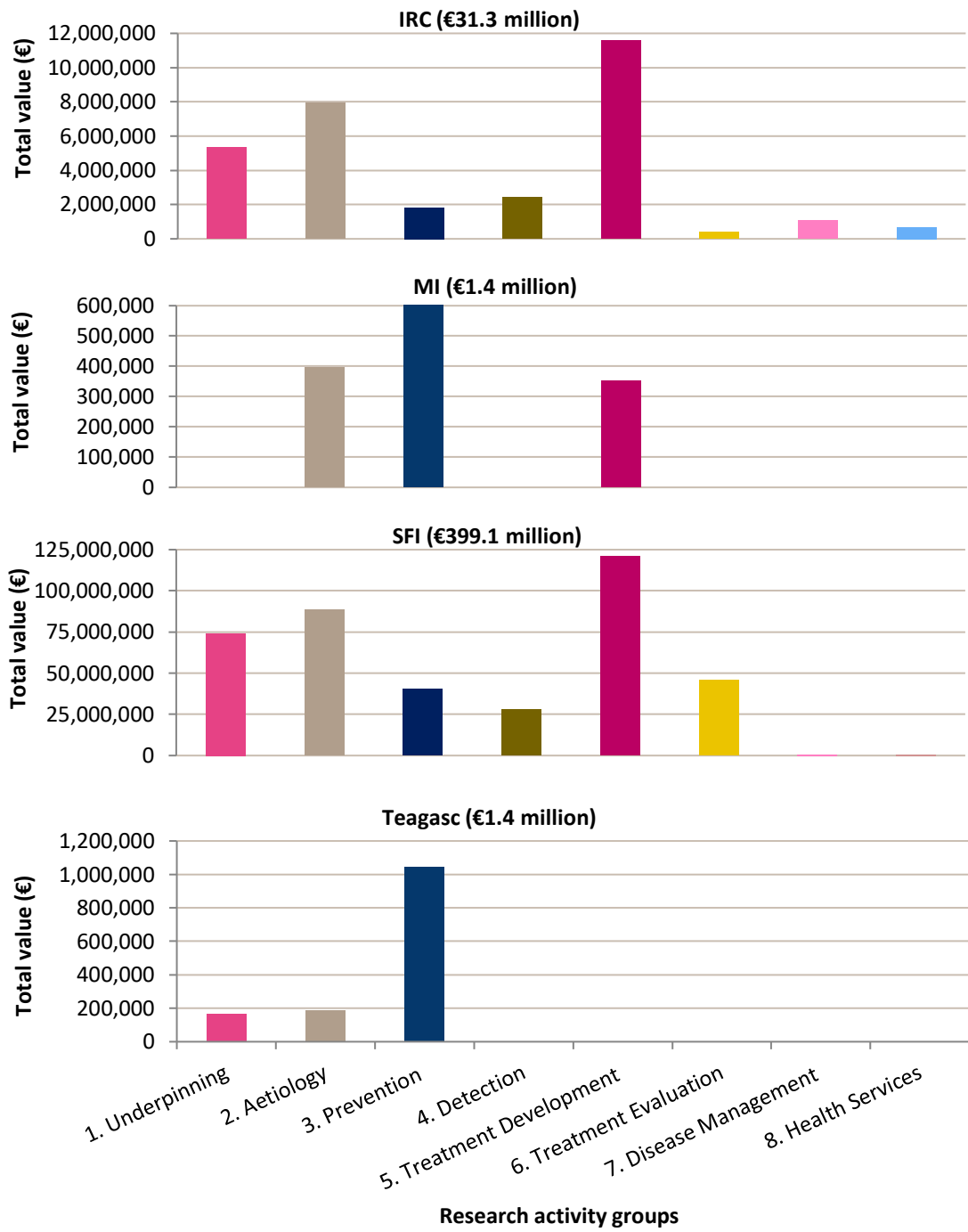
Investment in *Treatment Development* accounted for a significant proportion of the portfolio of SFI (30.3%), the MI (26%), the IRC (37.1%), and EI (42.8%), although in monetary terms SFI invested by far the most in this area (€121 million), while EI's and the HRB's investments were similar (€28.3 million and €24.1 million, respectively).

Two agencies (the HRB and SFI) accounted for almost all investment in *Treatment Evaluation* (€52.8 million and 45.8 million, respectively). For the HRB, this research activity represented 25.5% of its total portfolio, while for SFI, this research activity accounted for 11.5% of its total awards.

Overall, the HRB was the main investor in *Disease Management* and *Health Services*, which collectively represented 25% of its portfolio of awards (€51.6 million). EI also made some investments in these research activities (€7.6 million), which accounted for 11.5% of its portfolio of awards, as did the IRC (€1.8 million; 5.6% of its awards portfolio).

Figure 4.10: Distribution of health-relevant research investment in research activity groups across each participating agency (2011–2015)





5 Distribution of awards by health category

There are 21 distinct health categories used in the HRCS, of which 19 relate to a specific area of health or disease, since health categories cover both normal functioning and disease states. Many research projects span a range of health categories, and multiple codes can be applied to an award (to a maximum of five). For example, studies relating to diet will be split across *Cardiovascular*, *Metabolic and Endocrine*, *Oral and Gastrointestinal*, and *Stroke*.

The last two health categories are used slightly differently. *Generic Health Relevance* is used for studies that are applicable to more than five diseases and/or to general health or disease states. *Disputed Aetiology and Other* refers to conditions of disputed or unknown aetiology (there were no Irish awards assigned to this category).

Summary findings

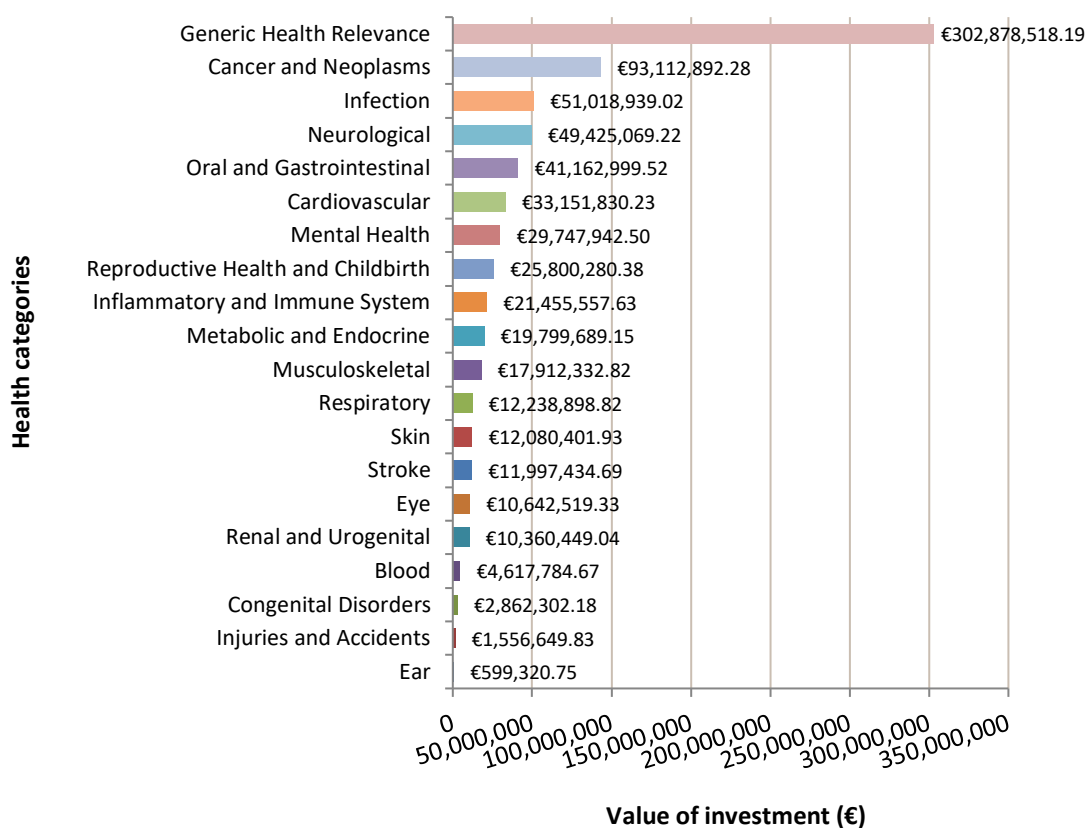
- The focus of investment in specific health categories varied by participating agency and was generally in line with their specific remits. EI, the HRB, the IRC and SFI support research and infrastructure across almost all health categories, while all other agencies support research in a more limited number of health categories linked to their specific remits.
- The *Generic Health Relevance* health category, used for studies that are applicable to all diseases and/or general health, accounted for 40.3% of the total investment across all participating agencies from 2011 to 2015.
- All research activities were represented within the *Generic Health Relevance* health category. *Treatment Development* (25%), *Underpinning* (19%), *Aetiology* (18%), and *Treatment Evaluation* (18%) accounted for 80% of research activity within this health category.
- *Cancer and Neoplasms* research received the greatest share of health-specific funding (€93.1 million; 20.7%), and funding was provided by all participating agencies except the MI. The HRB (€49.9 million) and SFI (€31.7 million) were the main funders of *Cancer and Neoplasms* research, including €13.3 million of investment in infrastructure, networks, and platforms to support cancer research and clinical trials.
- Other health-specific health categories in which significant funding was awarded included *Infection* (11.3%), *Neurological* (11.0%), *Oral and Gastrointestinal* (9.2%), *Cardiovascular and Stroke* (10.1%), *Mental Health* (6.6%), and *Reproductive Health and Childbirth* (5.7%). Investments of less than 5% were made in all remaining health categories.
- Across research activities associated with health categories, resources and infrastructure accounted for 27.8% of the total funding, but within the *Generic Health Relevance* health category, resources and infrastructure accounted for 70.5% of investment.
- When Irish health category investment over the period from 2011 to 2015 was compared to data from the 2014 UK HRCS analysis and the 2014 Norwegian HRCS pilot, it was found that overall distribution was broadly similar, although the relative proportion of funding within some individual health categories varied.
- *Cancer and Neoplasms* research accounted for the largest proportion of total funding in all jurisdictions. The UK invested proportionately more than either Ireland or Norway in the *Infection*, *Mental Health*, and *Neurological* health categories. Norway invested proportionately more than either Ireland or the UK in the *Cancer and Neoplasms*, *Injuries and Accidents*, and *Musculoskeletal* health categories. Ireland invested proportionately more than either the UK or Norway in *Generic Health Relevance* and *Oral and Gastrointestinal* research. In all other health categories, the proportion of spending was similar.

5.1 Overall distribution of health research funding across health categories

The distribution of the collective Irish health-relevant research portfolio for the nine participating agencies across 20 HRCS health categories (there was no Irish funding within the *Disputed Aetiology and Other* category) over the period from 2011 to 2015 is shown in Figure 5.1.

The *Generic Health Relevance* health category accounted for 40% of the total combined investment across the participating agencies from 2011 to 2015. The *Generic Health Relevance* category covers a wide range of research activities, from basic cell and molecular biology to geographical evaluation of health services, and is often used in coding for large programme awards with a broad research remit. This category is further analysed in Section 5.1.1.

Figure 5.1: Distribution of Irish health-relevant research funding across 20 HRCS health categories, including *Generic Health Relevance* (2011–2015)



In order to better visualise national expenditure in specific disease areas as classified by health categories, Figure 5.2 presents the distribution of national investment across the 19 specific areas of health and disease, while Figure 5.3 looks at the research activities within which investment in each health-specific health category was disbursed.

From Figure 5.2 and Figure 5.3, it can be seen that investment in cancer-related research accounted for 20.7% of the total investment from participating agencies. This included research that attempted to understand the mechanisms and risk factors for development of cancer; the development and testing of screening, diagnostics, and therapeutic interventions; and the management of the disease at the patient and health system levels. This health category includes

€13.3 million of investment in infrastructure, networks, and platforms to support cancer research and clinical trials.

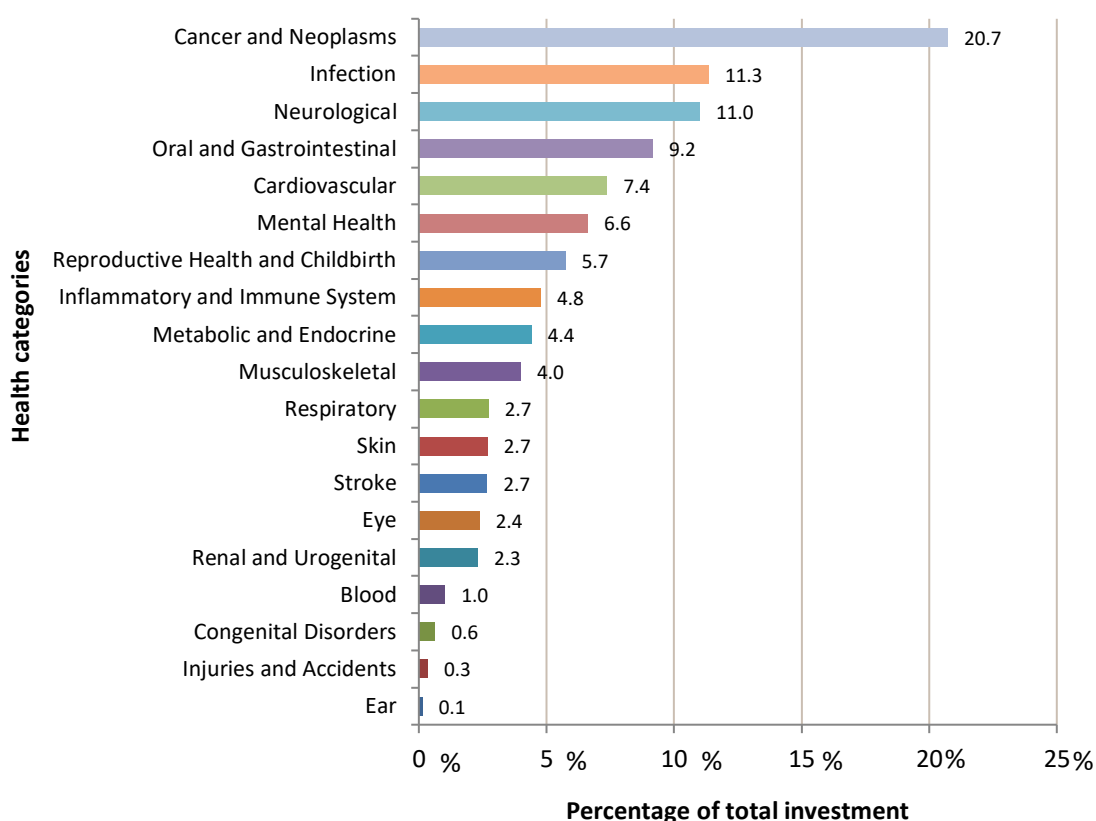
Investment in research associated with *Infection*, which accounted for 11.3% of total investment, was focused on *Aetiology* (35.3%), *Prevention* (24%), and *Treatment Development* (26.6%).

Neurological research, which accounted for 11% of total investment, also focused on *Aetiology* (26.7%) and *Treatment Development* (23.9%), and to a lesser extent on *Underpinning* (12.2%) and *Detection* (9.8%). *Disease Management* and *Health Services* collectively accounted for 23.4% of investment in the *Neurological* health category.

Oral and Gastrointestinal research accounted for 9.2% of total investment and was focused on *Aetiology* (28.6%), *Prevention* (28.6%), and *Treatment Development* (21.9%).

Overall investment in *Cardiovascular* research (7.4%) and *Stroke* research (2.7%) was focused on *Aetiology*, *Prevention*, *Treatment Development*, and *Treatment Evaluation*, with these health categories accounting for 20% or greater of the investment in each research activity.

Figure 5.2: Distribution of Irish health-relevant research funding across the 19 health-specific health categories (excluding the *Generic Health Relevance* health category) as a percentage of total investment (2011–2015)



Research on *Mental Health*, which accounted for 6.6% of total investment, was focused in particular on *Aetiology* (38.9%) and, to a lesser extent, on *Underpinning* (12.1%), *Disease Management* (11.4%), and *Health Services* (10.3%).

Investment in research on *Reproductive Health and Childbirth* accounted for 5.7% of total investment, and 58.5% of this investment was in *Detection*, with *Aetiology* and *Prevention* accounting collectively for 24.6% of investment.

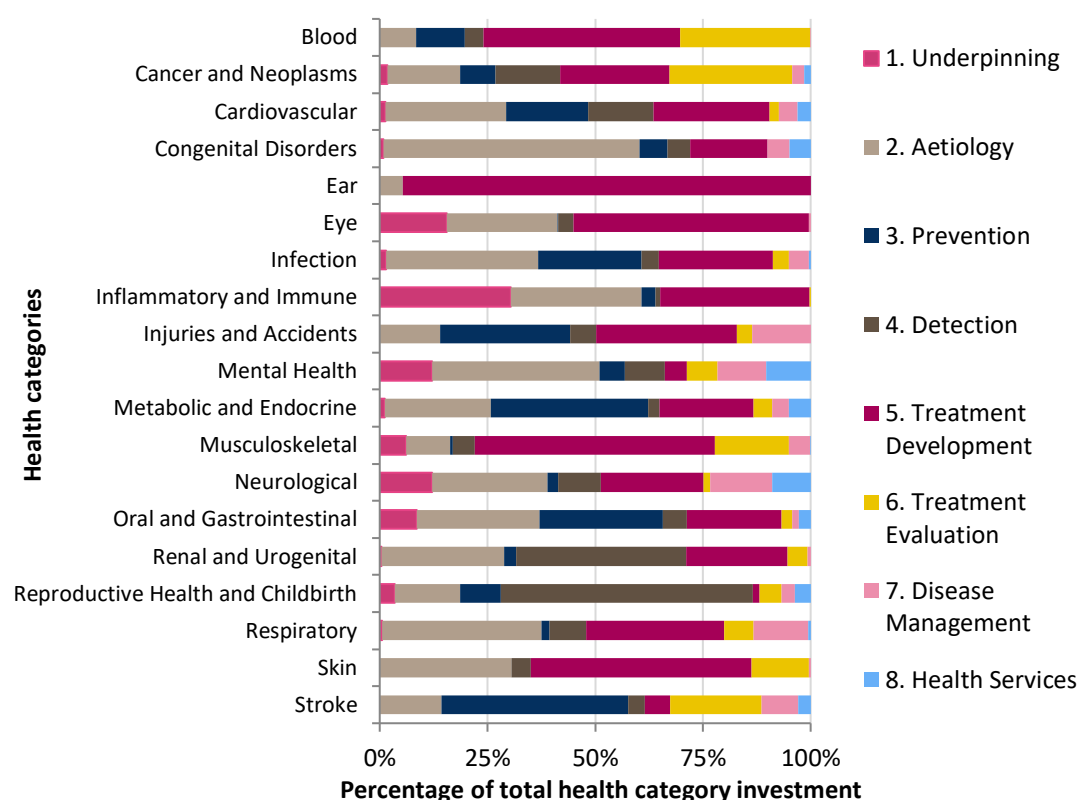
Inflammatory and Immune System research, in which Ireland is ranked in the top 2% of highly cited publications globally, accounted for 4.8% of total investment, and was almost exclusively focused on *Underpinning* (30.4%), *Aetiology* (30.3%), and *Treatment Development* (34.7%).

Investment in research on diseases associated with *Metabolic and Endocrine* accounted for 4.4% of total investment and was primarily focused on *Aetiology* (24.6%), *Prevention* (36.4%), and *Treatment Development* (21.8%).

Musculoskeletal research accounted for 4% of total investment, and its primary focus was *Treatment Development* (55.8%) and *Treatment Evaluation* (17.1%).

Investment in all other health categories was below 3% per category, so they will not be considered separately here. However, from Figure 5.3 it can be seen that the focus of research in these areas tended to be across a number of research activities.

Figure 5.3: Distribution of research activity groups across the 19 health-specific health categories (excluding the *Generic Health Relevance* health category) as a percentage of total investment in that health category (2011–2015)



5.1.1 *Generic Health Relevance* health category

The HRCS defines *Generic Health Relevance* research as “research applicable to all diseases and conditions or to the general health and well-being of individuals”.¹ Public health research, epidemiology, population health, and health services research that is not focused on specific conditions is included in this category. So too are underpinning biological, psychosocial, economic, or methodological studies that are not specific to individual diseases or conditions.

Figure 5.4 shows a breakdown of the research activities that were captured within the *Generic Health Relevance* health category and also looks at the broader objectives of the research. All

research activities were represented within the *Generic Health Relevance* health category. *Treatment Development* (25%), *Underpinning* (19%), *Aetiology* (18%), and *Treatment Evaluation* (18%) accounted for 80% of research activity within this health category.

The purpose of research activities undertaken within the *Generic Health Relevance* health category varied.

- Investment in infrastructure, networks and platforms was particularly important for *Treatment Development* and *Treatment Evaluation*.
- Foundational research on the development and testing of products featured most obviously in *Underpinning*, *Prevention*, *Detection*, and *Treatment Development*.
- Research aimed at improving the provision of care, and the health system more broadly, were the main objectives of *Disease Management* and *Health Services*.
- Research that examined population-wide issues was associated mainly with *Aetiology*, *Prevention*, and *Health Services*.

Figure 5.4: Breakdown of the *Generic Health Relevance* health category by research activity group and broad focus of the research (2011–2015)

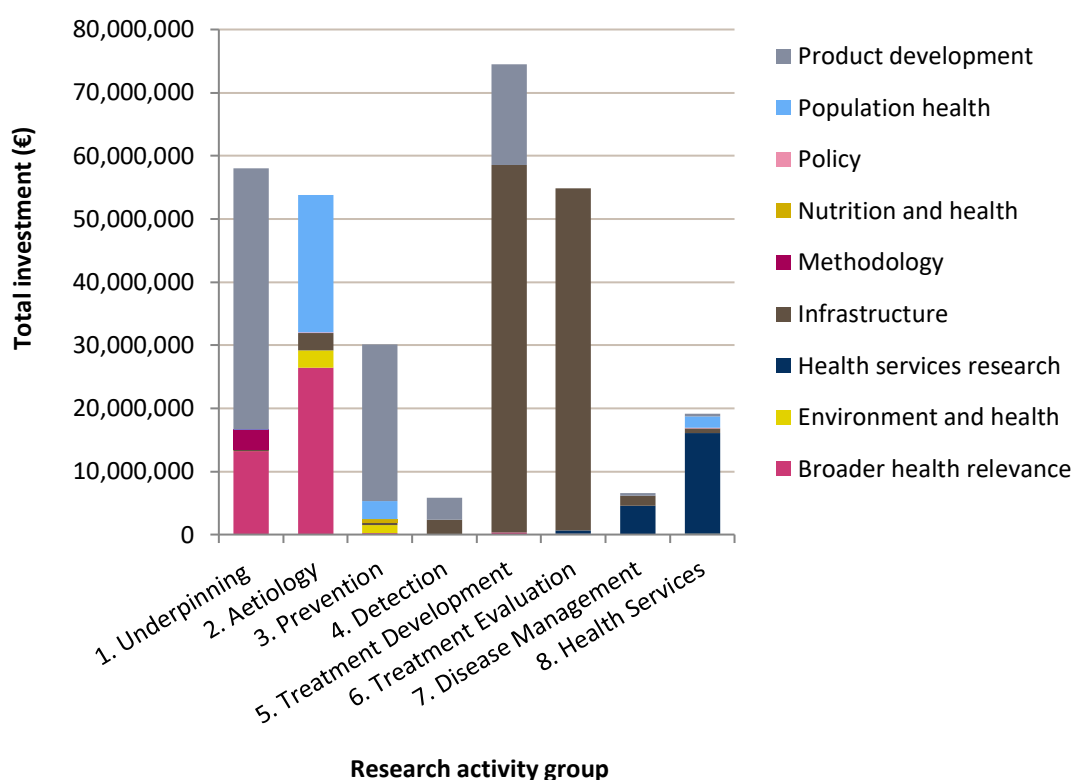


Table 5.1 provides a breakdown of spending as (a) the proportion that each agency contributed towards the total funding captured in the *Generic Health Relevance* health category (€302,878,518), and (b) the proportion of the total investment of each agency accounted for by *Generic Health Relevance* research.

From this table, it can be seen that the *Generic Health Relevance* health category accounted for 99.8% of research investment by DCYA (*Growing Up in Ireland* cohort study), as well as by the EPA (52.9%) and the MI (70.6%), whose activities in this health category focused on research on all aspects of environment and health. *Generic Health Relevance* research accounted for 55.2% of SFI funding, which reflects its significant investments in research centres, networks, and platforms.

For EI (22% of the agency's total spend), *Generic Health Relevance* investment was in infrastructure and innovation development projects, while for the HRB (20.4% of the agency's total spend), this health category accounted for investment in infrastructure, population health, and health services research.

Generic Health Relevance research accounted for 17.1% of all IRC funding and was primarily focused on research into product development or with broad relevance for health improvement.

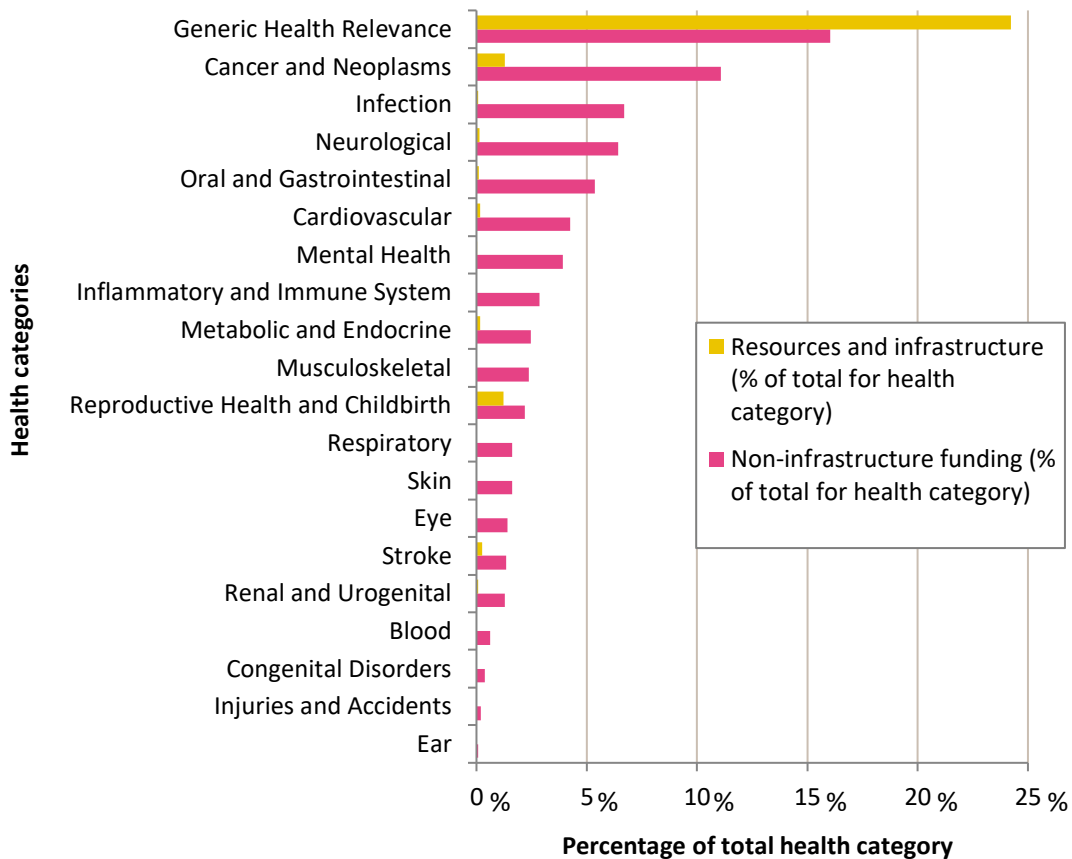
Table 5.1: Breakdown of investment in *Generic Health Relevance* research by each of the nine agencies, as a proportion of their total health-relevant research investment (2011–2015)

Participating agency	Total <i>Generic Health Relevance</i> investment (€)	% of total <i>Generic Health Relevance</i> investment	Total agency funding (€)	% of total agency spend on <i>Generic Health Relevance</i> research
DAFM	1,519,810	0.5	25,468,046	6.0
DCYA	14,839,481	4.9	14,865,881	99.8
EI	14,537,280	4.8	66,101,708	22.0
EPA	3,118,787	1.0	5,891,446	52.9
HRB	42,126,540	13.9	206,926,733	20.4
IRC	5,354,731	1.8	31,269,881	17.1
MI	958,500	0.3	1,357,000	70.6
SFI	220,184,791	72.7	399,137,831	55.2
Teagasc	238,599	0.1	1,403,285	17.0
Grand total	302,878,518		752,421,812	

5.1.2 Contribution of resources and infrastructure funding to spending across health categories

Figure 5.5 examines the proportion of funding within each of the health categories that was allocated to resources and infrastructure (as categorised by the resources and infrastructure research activity subcode). This figure shows that most resources and infrastructure funding is associated with the *Generic Health Relevance* health category, although *Cancer and Neoplasms* and *Reproductive Health and Childbirth* also benefited significantly from investment in resources and infrastructure.

Figure 5.5: Comparison of the proportion of resources and infrastructure investment (€208.9 million) with all other health-relevant research investment (€543.5 million) by health category (2011–2015)



5.1.3 Contribution of co-funding to spending across health categories

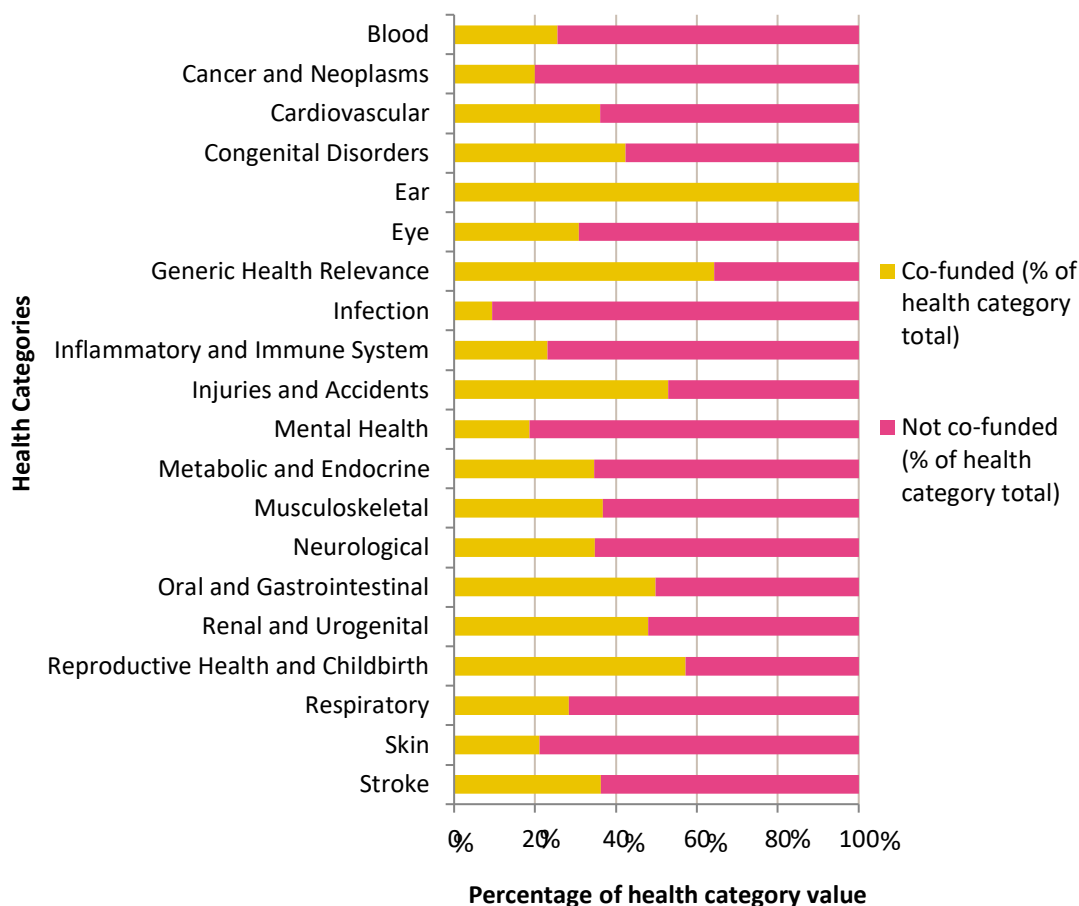
Figure 5.6 explores the contribution of co-funding to the overall distribution of funding across all health categories.

From Figure 5.6, it can be seen that co-funding was particularly important for awards classified within the *Generic Health Relevance* health category, accounting for 64.3% of funding within that category. Co-funded awards also made a significant contribution to the total funding available for research on *Congenital Disorders* (42.3%), *Ear* (100%), *Injuries and Accidents* (53%), *Oral and Gastrointestinal* (49.8%), *Renal and Urogenital* (47.9%), and *Reproductive Health and Childbirth* (57.2%).

Co-funding accounted for between 30% and 40% of the total funding provided for research in the health categories of *Cardiovascular* (36.1%), *Eye* (30.9%), *Metabolic and Endocrine* (34.6%), *Musculoskeletal* (36.8%), *Neurological* (34.8%), and *Stroke* (36.3%).

Co-funding accounted for less than 30% of total funding for research on *Blood* (25.5%), *Cancer and Neoplasms* (20%), *Infection* (9.3%), *Inflammatory and Immune System* (23.1%), *Mental Health* (18.7%), *Respiratory* (28.3%), and *Skin* (21%).

Figure 5.6: Comparison of the percentage of co-funded (€329 million) and non-co-funded (€423.4 million) awards in each health category (2011–2015)



5.1.4 Comparison of Irish health categories with the UK and Norway

The distribution of health categories across the combined Irish health research investment over the period from 2011 to 2015 was compared to data from the 2014 UK HRCS analysis and the 2014 HRCS pilot analysis conducted by the Research Council of Norway (RCN). Figure 5.7 presents this comparison and shows that the overall distribution pattern across health categories was broadly similar, although the relative proportion of funding within individual health categories varied.

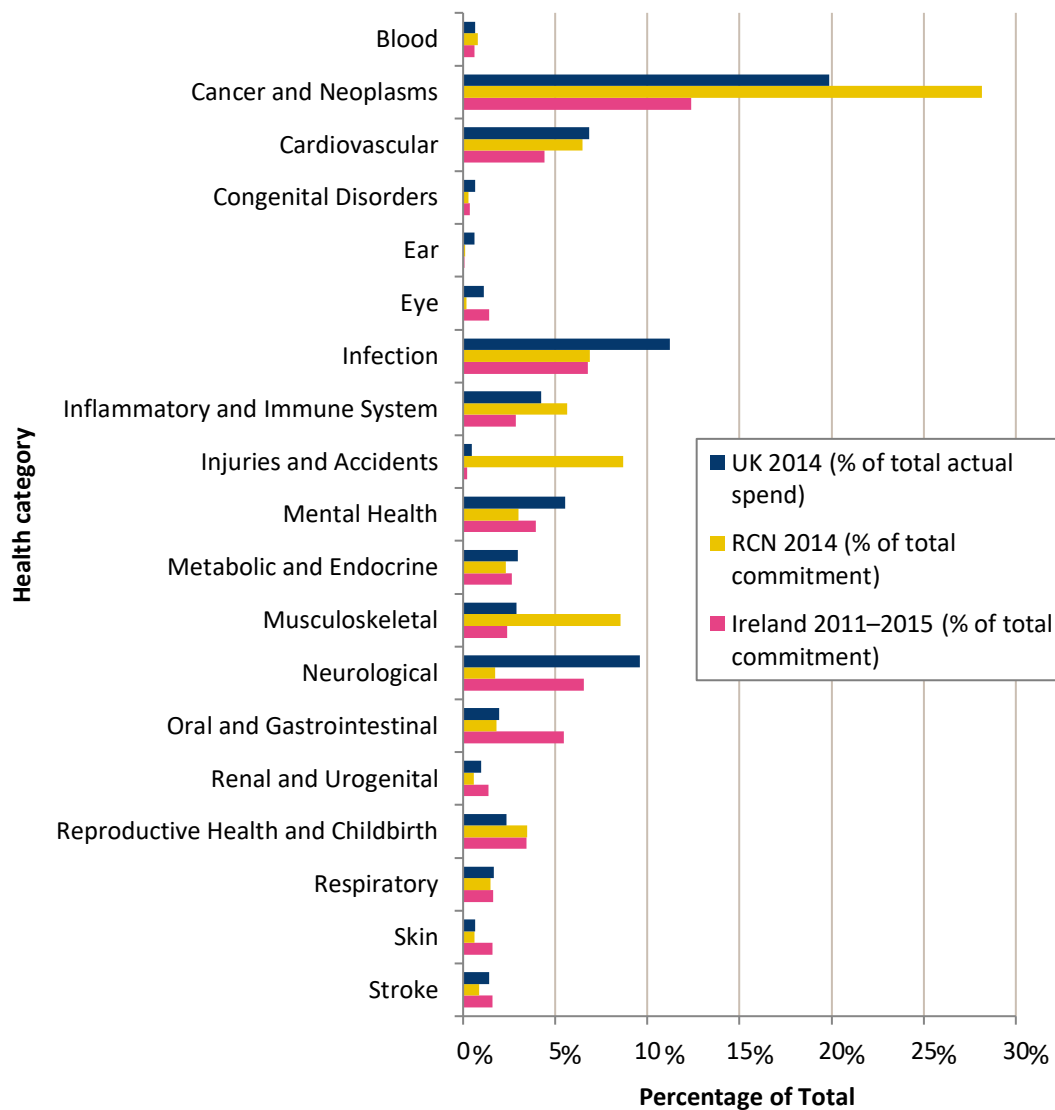
Cancer and Neoplasms research accounted for the largest proportion of total funding in all jurisdictions. The UK invested significantly more than either Ireland or Norway in *Infection*, *Mental Health*, and *Neurological*. Norway invested significantly more than either Ireland or the UK in *Cancer and Neoplasms*, *Injuries and Accidents*, and *Musculoskeletal*. Ireland invested significantly more than the UK or Norway in *Oral and Gastrointestinal* research. In all other health categories, the proportion of spending was similar in all three countries.

The *Generic Health Relevance* health category, while not included in Figure 5.7, also represented a significant proportion of investment in all three countries, although the share of investment was considerably higher in Ireland (40.3%) in comparison to the UK (23.6%) and Norway (18%).

However, in considering a comparison, it must be borne in mind that the funding landscape and structure are very different in the three comparator countries, and the datasets are of different scales. The UK dataset is based on more than 17,000 records from 64 funding agencies and

charities, corresponding to an annual spend of GBP 3 billion in 2014. The Norwegian dataset is based on a pilot of the HRCS conducted by the RCN on 135 large-scale awards with a total value of approximately €100 million. These differences will naturally introduce bias into the datasets.

Figure 5.7: Comparison of the proportion of health-relevant research investment in each health category for Ireland (2011–2015 commitment), the UK (2014 actual spend), and RCN (2014 commitment)

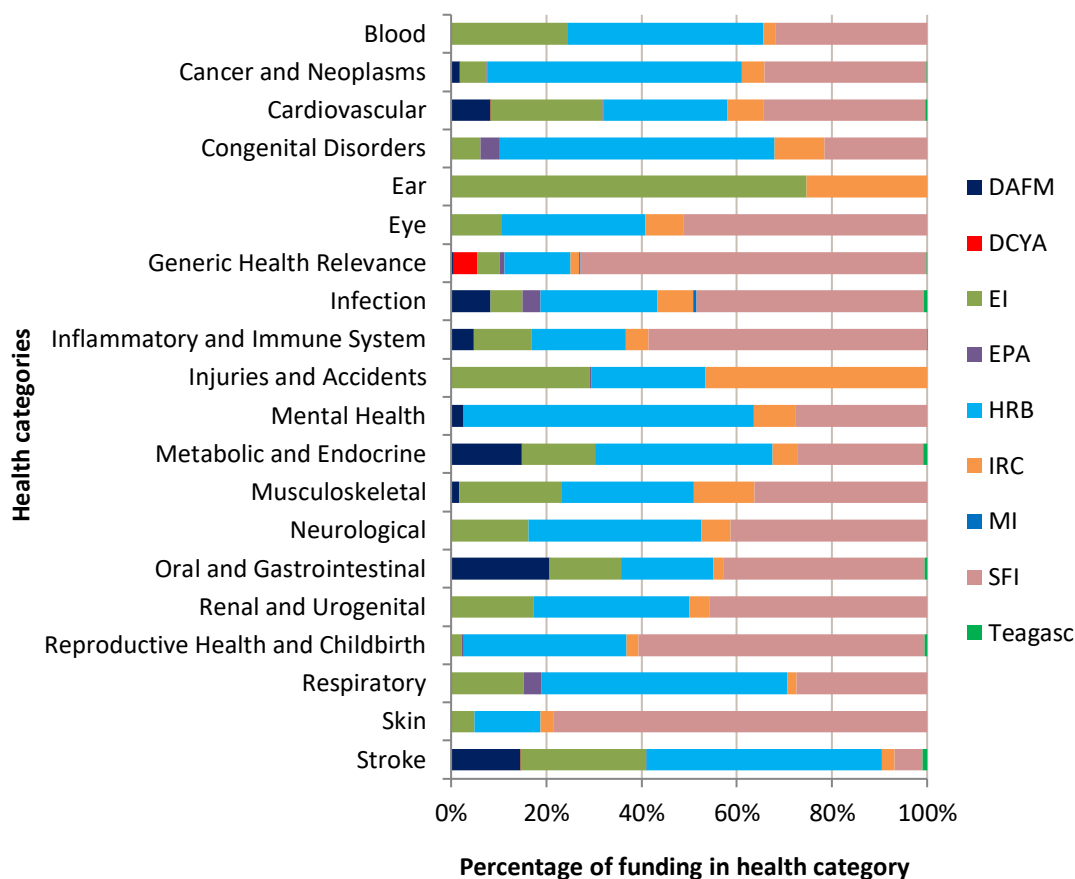


5.2 Distribution of funding across health categories by agency

In order to get an overview of investment in research on specific areas of health and diseases, Figure 5.8 presents investment by all participating agencies in all health categories, including *Generic Health Relevance* research.

Figure 5.9 shows investment across health categories as a percentage of total investment per agency. As would be expected, the focus of investment in specific health categories varies by participating agency and reflects their various remits.

Figure 5.8: Distribution of Irish health-relevant research investment from 2011 to 2015 by the nine Irish agencies for each health category



This analysis shows that that:

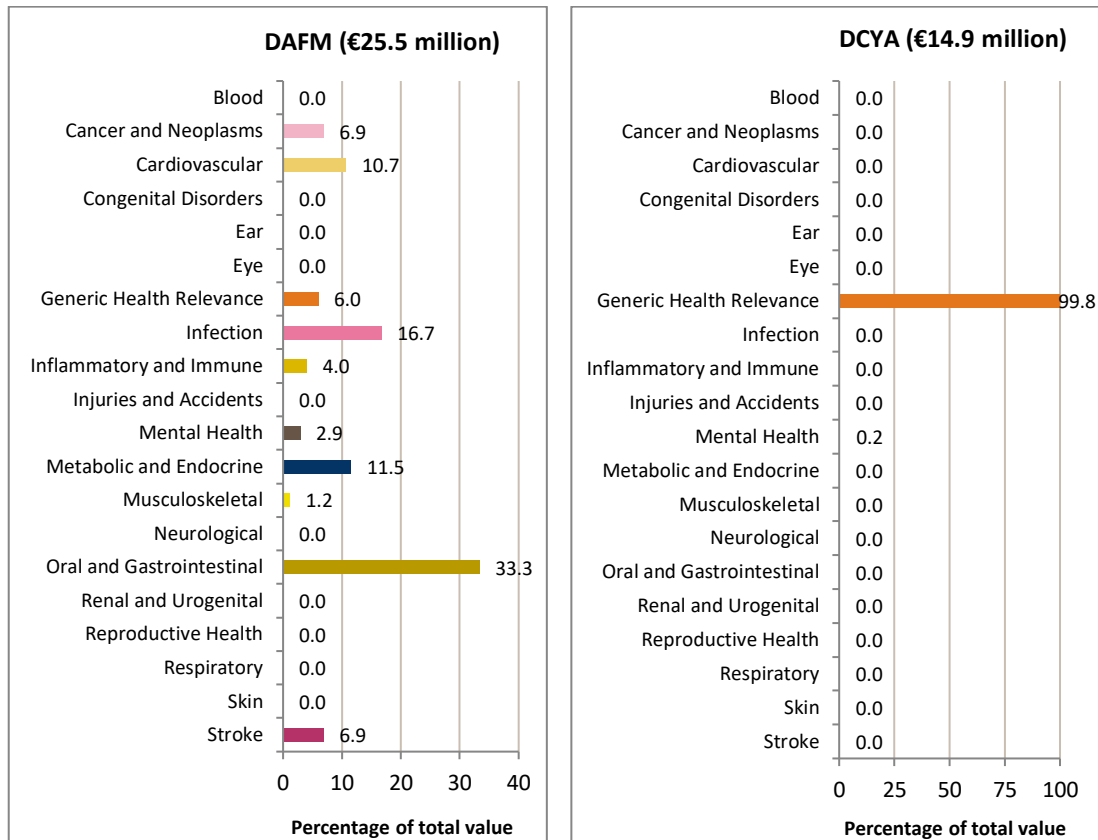
- EI, the HRB, the IRC and SFI support both research and infrastructure investment across almost all health categories, while all other agencies support research in a more limited number of health categories linked to their specific remits.
- *Cancer and Neoplasms* research received 12.4% of total funding (€93.1 million), and funding was allocated via a variety of funding mechanisms and by all participating agencies except the MI. The HRB (€49.8 million) and SFI (€31.7 million) were the main funders of *Cancer and Neoplasms* research, much of this through infrastructure and network funding.
- Research into bacteria, fungi, and viruses (*Infection*) for clinical, pharmaceutical, environmental, and agricultural applications accounted for 6.8% of total funding (€51 million) and all agencies except DCYA provided research funding in this health category. SFI and the HRB were the main funders of *Infection* over the study period.
- *Neurological* research accounted for 6.6% of total funding expenditure (€49.4 million). SFI (€20.4 million) and the HRB (€17.9 million) were the main funders in this health category, although EI (€8.1 million) and the IRC (€3 million) also made significant investments.
- *Oral and Gastrointestinal* research received 5.5% of total funding (€41.2 million). This was an area of particular interest to DAFM and represents its largest investment (€8.5 million), with research exploring the health benefits of nutrition and functional foods, preservation of

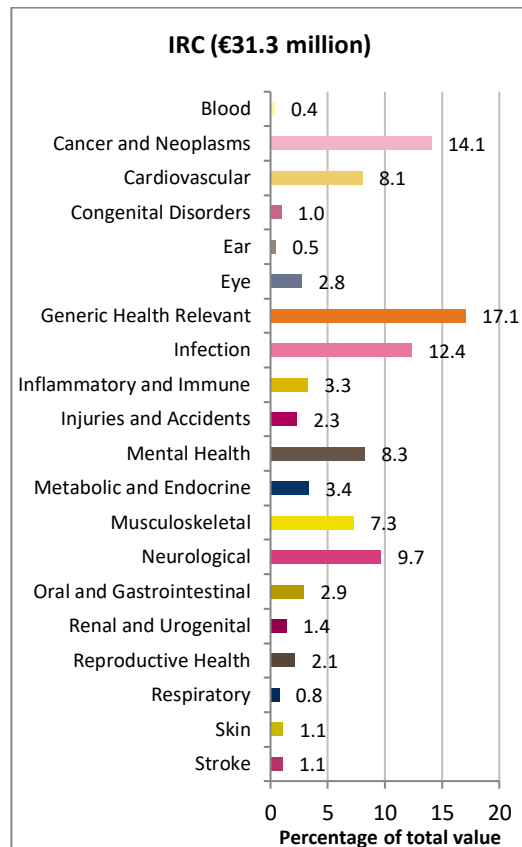
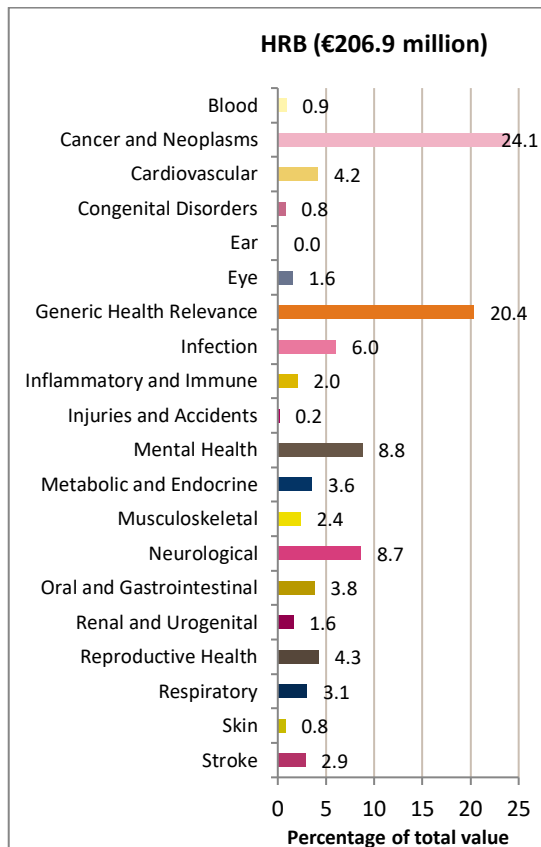
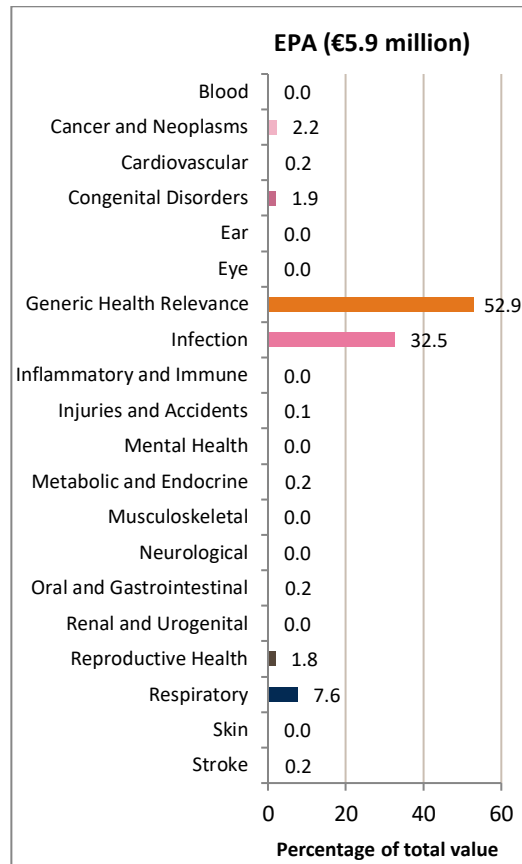
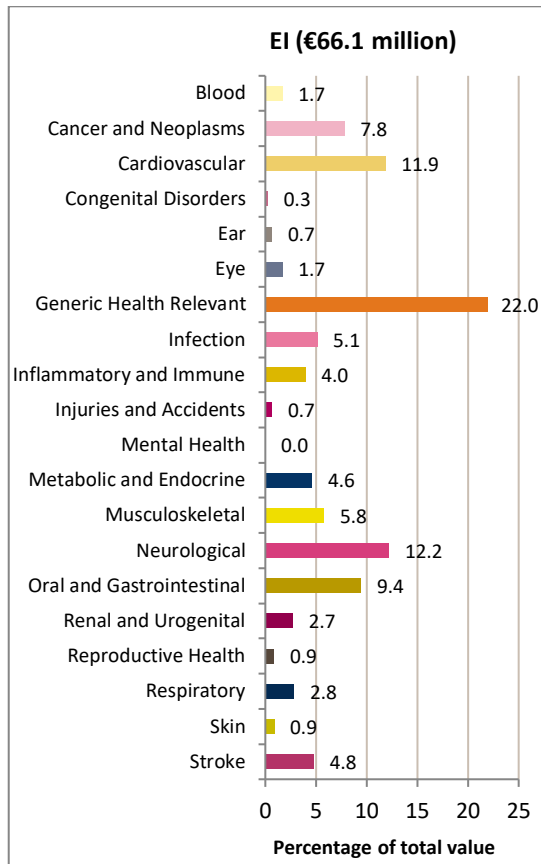
foodstuffs, and so on. SFI (€17.4 million), the HRB (€7.9 million), and EI (€6.2 million) also made significant investments in this health category.

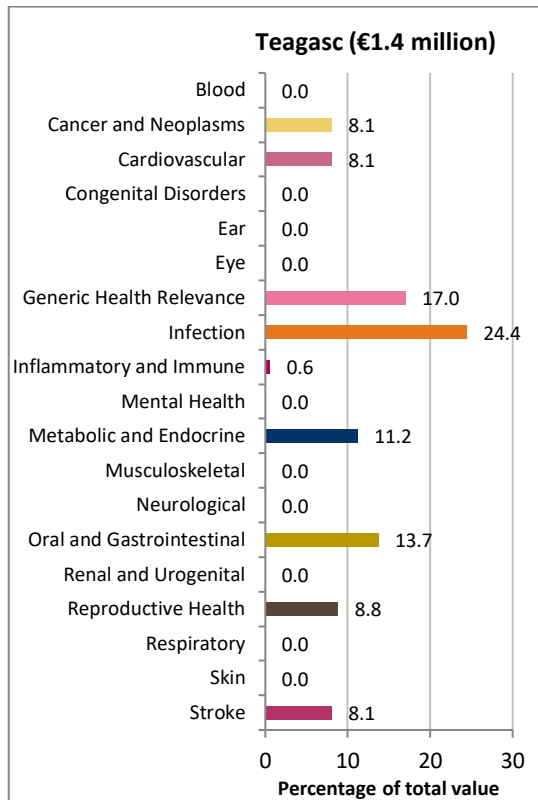
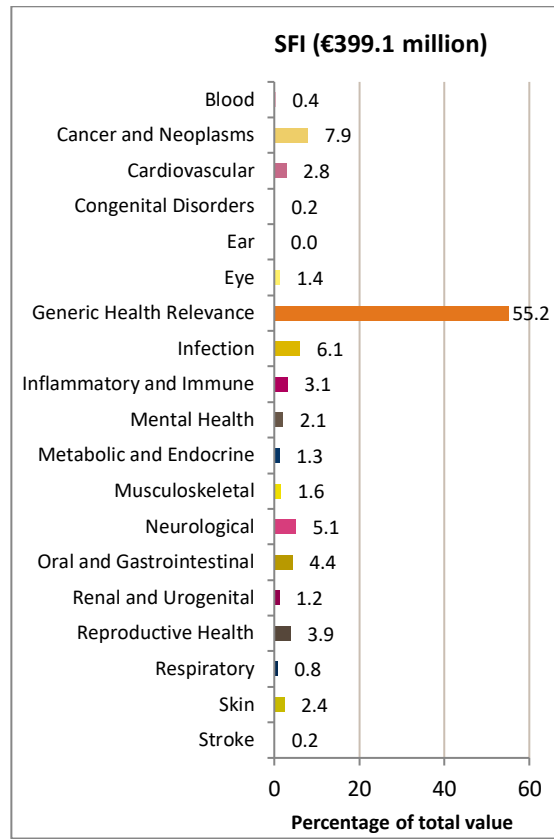
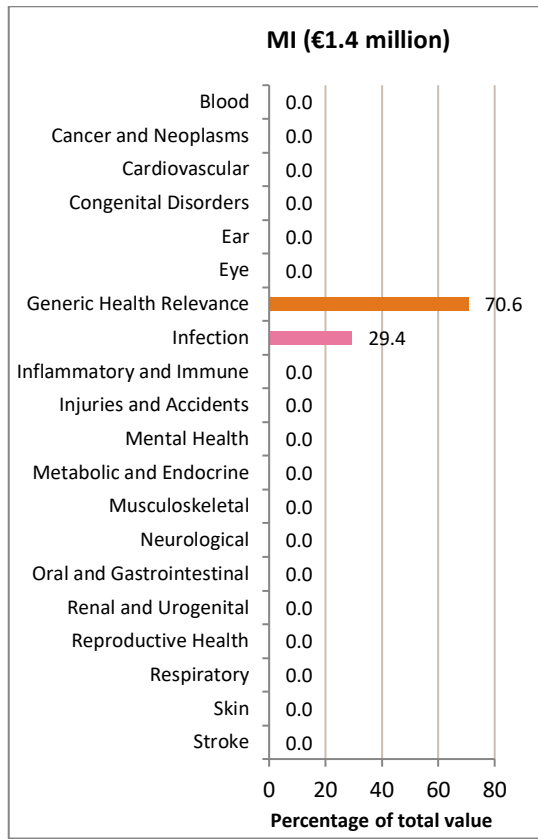
- *Cardiovascular* and *Stroke* together accounted for 6% of total investment (€45.1 million), and all agencies, except for the MI, supported some research in these health categories.
- *Mental Health* accounted for 4% of total expenditure (€29.7 million). All other health categories accounted for less than 4% of total funding each, but together received a total value of €139.9 million in funding.

When *Generic Health Relevance* research as a proportion of investment is considered by agency, it can be seen that this health category is important for almost all participating agencies. Section 5.1.1 provides a more detailed analysis of this health category.

Figure 5.9: Distribution of health-relevant research investment in health categories across each participating agency (2011–2015)







6 Conclusion

This report presented an analysis of a national dataset of health-relevant research awards made by nine Irish funding agencies over the period from 2011 to 2015. The analysis explored both research activity and the areas of health and disease on which these activities focused. The report examined the contribution of co-funding by a variety of partners to overall national health-relevant research, as well as the importance of the resources, infrastructure, and networks that support research.

The analysis provides a national overview of where research funding is being invested across the full spectrum of research activity, from fundamental to health system improvement research, and as this research relates to a range of specific health and disease areas. The results show that the research activities supported by the nine funding agencies reflect the different remits and interests of these agencies.

Comparison of the Irish dataset with HRCS analyses conducted in the UK and Norway revealed many similarities, as well as some variation across funding portfolios. Given the very different research systems in operation in Ireland, the UK, and Norway, and the differing scales of the datasets, greater divergence in both research activity and health categories might have been anticipated.

The real value of this exercise will be its repetition in the future, allowing trend analysis of Irish health-relevant research funding over time. It is hoped that this first report will spark the interest of agencies and Government Departments that did not participate on this occasion. In further analyses it will also be valuable to include HSE research data, when this becomes available, and the totality of Irish medical research charity funding (co-funding was captured in the current analysis).

Having a national dataset of internationally comparable health-relevant data may also point to areas of opportunity for collaboration in the future by providing a common language with which potential partners can discuss their objectives and focus.

Appendix A Overview of research activity codes

The table below presents an overview of the HRCS research activity classifications, and is taken directly from the HRCS website (<https://hrcsonline.net/research-activities/>). Each research activity code is linked to additional information via a hyperlink to the HRCS website.

Code	Inclusion criteria	Subcodes
1 Underpinning research	Research that underpins investigations into the cause, development, detection, treatment and management of diseases, conditions and ill health.	Summary of codes in 1 Underpinning
2 Aetiology	Identification of determinants that are involved in the cause, risk or development of disease, conditions and ill health.	Summary of codes in 2 Aetiology
3 Prevention of Disease and Conditions, and Promotion of Well-Being	Research aimed at the primary prevention of disease, conditions or ill health, or promotion of well-being.	Summary of codes in 3 Prevention
4 Detection, Screening and Diagnosis	Discovery, development and evaluation of diagnostic, prognostic and predictive markers and technologies.	Summary of codes in 4 Detection
5 Development of Treatments and Therapeutic Interventions	Discovery and development of therapeutic interventions and testing in model systems and preclinical settings.	Summary of codes in 5 Treatment Development
6 Evaluation of Treatments and Therapeutic Interventions	Testing and evaluation of therapeutic interventions in clinical, community or applied settings.	Summary of codes in 6 Treatment Evaluation
7 Management of Diseases and Conditions	Research into individual care needs and management of disease, conditions or ill health.	Summary of codes in 7 Disease Management
8 Health and Social Care Services Research	Research into the provision and delivery of health and social care services, health policy and studies of research design, measurements and methodologies.	Summary of codes in 8 Health Services

Appendix B Overview of health categories

The table below presents an overview of the HRCS health category classifications, and is taken directly from the HRCS website (<https://hrcsonline.net/health-categories/>). Each health category is linked to additional information via a hyperlink to the HRCS website.

Category	Inclusion criteria
Blood	Haematological diseases, anaemia, clotting (including thromboses and venous embolisms) and normal development and function of platelets and erythrocytes.
Cancer and Neoplasms	All types of neoplasms, including benign, potentially malignant, malignant (cancer) and cancerous growths. This includes leukaemia and mesothelioma.
Cardiovascular	Coronary heart disease, diseases of the vasculature and circulation including the lymphatic system, and normal development and function of the cardiovascular system.
Congenital Disorders	Physical abnormalities and syndromes that are not associated with a single type of disease or condition including Down syndrome and cystic fibrosis.
Ear	Deafness and normal ear development and function.
Eye	Diseases of the eye and normal eye development and function.
Infection	Diseases caused by pathogens, acquired immune deficiency syndrome, sexually transmitted infections, and studies of infection and infectious agents.
Inflammatory and Immune System	Rheumatoid arthritis, connective tissue diseases, autoimmune diseases, allergies, and normal development and function of the immune system.
Injuries and Accidents	Fractures, poisoning and burns.
Mental Health	Depression, schizophrenia, psychosis and personality disorders, addiction, suicide, anxiety, eating disorders, learning disabilities, bipolar disorder, autism spectrum disorders and studies of normal psychology, cognitive function and behaviour.
Metabolic and Endocrine	Metabolic disorders (including diabetes) and normal metabolism and endocrine development and function. This includes all research on the pineal, thyroid, parathyroid, pituitary and adrenal glands.
Musculoskeletal	Osteoporosis, osteoarthritis, muscular and skeletal disorders, and normal musculoskeletal and cartilage development and function.
Neurological	Dementias, transmissible spongiform encephalopathies, Parkinson's disease, neurodegenerative diseases, Alzheimer's disease, epilepsy, multiple sclerosis, and studies of the normal brain and nervous system.
Oral and Gastrointestinal	Inflammatory bowel disease, Crohn's disease, diseases of the mouth, teeth, oesophagus, digestive system including liver and colon, and normal oral and gastrointestinal development and function.
Renal and Urogenital	Kidney disease, pelvic inflammatory disease, renal and genital disorders, and normal development and function of male and female renal and urogenital system.

Category	Inclusion criteria
Reproductive Health and Childbirth	Fertility, contraception, abortion, <i>in vitro</i> fertilisation, pregnancy, mammary gland development, menstruation and menopause, breastfeeding, antenatal care, childbirth, postnatal care and complications of newborns.
Respiratory	Asthma, chronic obstructive pulmonary disease, respiratory diseases, and normal development and function of the respiratory system.
Skin	Dermatological conditions and normal skin development and function.
Stroke	Includes both ischaemic stroke (caused by blood clots) and haemorrhagic stroke (caused by cerebral/intercranial haemorrhage).
Generic Health Relevance	Research applicable to all diseases and conditions or to general health and well-being of individuals. Public health research, epidemiology and health services research that is not focused on specific conditions. Underpinning biological, psychosocial, economic or methodological studies that are not specific to individual diseases or conditions.
Disputed Aetiology and Other	Conditions of unknown or disputed aetiology (such as chronic fatigue syndrome/myalgic encephalomyelitis), or research that is not of <i>Generic Health Relevance</i> and not applicable to the top 19 health categories with specific pathological/physiological determinants.

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