Outputs, outcomes, and emerging impacts

Results from HRB-funded awards that completed in 2018–19

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December 2021

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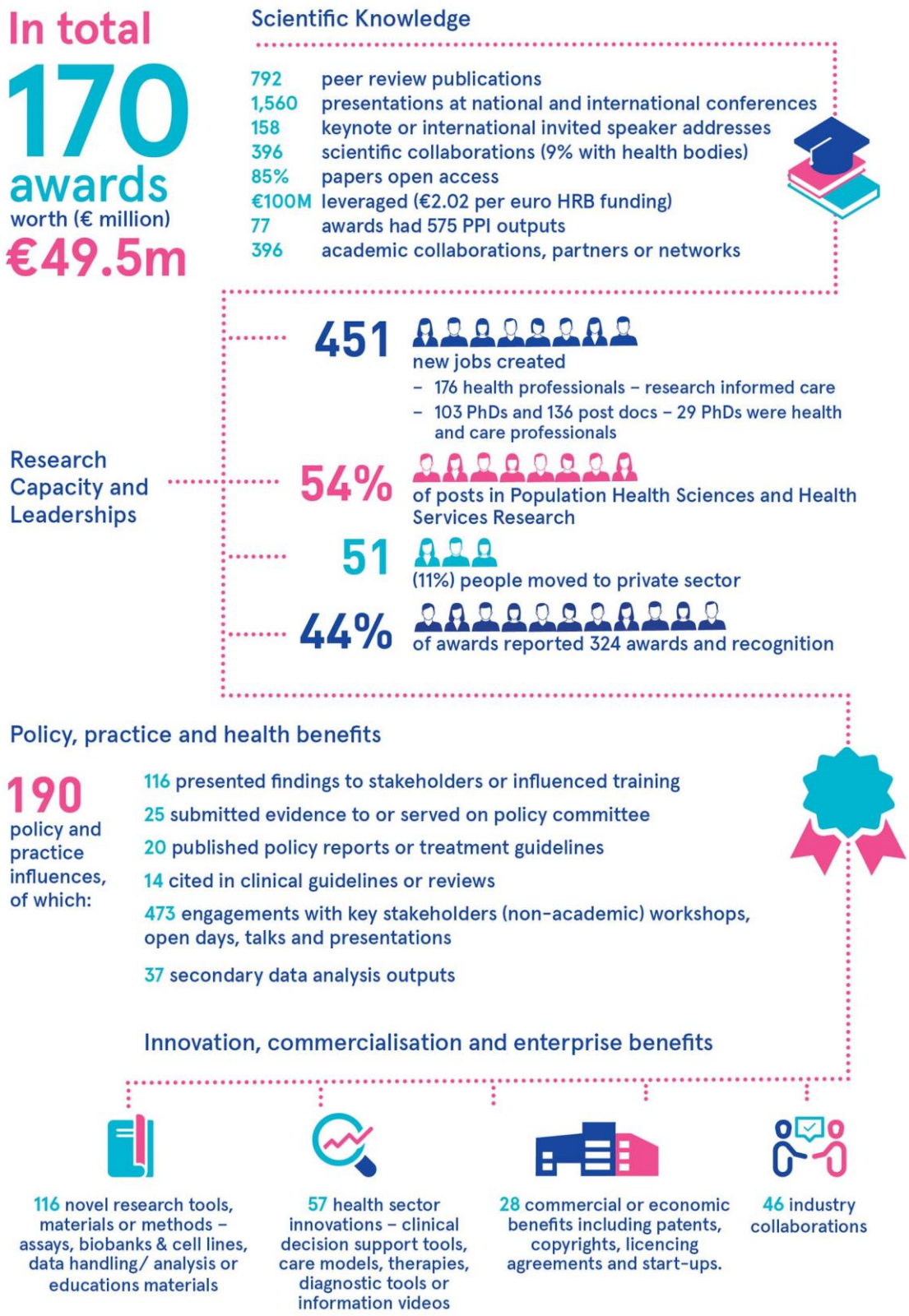
Table of acronyms/abbreviations

Acronym/abbreviation	Definition
ABR	Applied Biomedical Research
ALS	Amyotrophic Lateral Sclerosis
CR	Clinical Research
EI	Enterprise Ireland
EOG	End of Grant
EU	European Union
FAIR	Findable, accessible, interoperable, and reusable
HPV	Human papillomavirus
HRB	Health Research Board
HRCDC	Health Research Consent Declaration Committee
HRCI	Health Research Charities Ireland
HSE	Health Services Executive
HSR	Health Services Research
ICT	Information and communications technology
HIS	Irish Haemophilia Society
KEDS	Knowledge Exchange and Dissemination Scheme
MRC	Medical Research Council (UK)
MRCG	Medical Research Charities Group
MSc	Master of Science
N/A	Not applicable
PhD	Doctor of Philosophy
PHS	Population Health Sciences
PPI	Public, patient and carer involvement
PI	Principal Investigator
SpR	Specialist Registrar
TTO	Technology Transfer Office

Key findings



Executive summary

Introduction

This report presents a snapshot of the outputs, outcomes, and some emerging impacts arising from 170 Health Research Board (HRB) awards (with a combined value of €49.5 million) that completed in 2018 and 2019. Further outputs, outcomes, and impacts can be expected to occur in the years following the completion of these awards. The outputs and outcomes reported in 2018 and 2019, combined with those from past reporting periods, provide 12 years of evaluation data from completed HRB awards and, where possible, trend analysis of these data is provided.

This report demonstrates that HRB-funded award holders are highly productive across the full range of Payback categories, with increases in many output metrics since 2008. For example, the 2018–19 reporting period showed the highest ever average number of new research materials and methods, and number of healthcare innovations, per award.

Given the HRB's strategic objective as part of its mission statement to "generate relevant knowledge and promote its application in policy and practice", it was positive to see a significant increase in reported engagement outputs with policymakers, healthcare providers, and decision-makers, with the highest ever number of policy and practice outputs reported from awards that completed in 2018–19. The number of award holders publishing in open access compliant journals or on open publishing platforms has also increased steadily since becoming a mandatory requirement, from 56% in 2014–15 to 85% in 2018–19.

The HRB's increased emphasis on supporting Population Health Sciences (PHS) and Health Services Research (HSR) within a multidisciplinary collaborative funding model, along with the importance that international peer review panels place on methodological rigour, is reflected in the observed upward trend in research within these broad research areas since 2008, with the number of HSR publications tripling since 2016–17. Importantly from a capacity building perspective, one-half of all positions supported by HRB awards were associated with awards within the HSR and PHS broad research areas. Staff with a health and care background accounted for 39% of the total number of staff supported.

The success of the HRB's implementation of public, patient and carer involvement (PPI) supports since 2017 and the requirement to integrate PPI into many schemes is reflected in the high level of PPI reported in 2018–19. Growing numbers of award holders are including meaningful engagement with the public and patients at all stages of the research process, and a better understanding of what PPI means is developing in the research community.

HRB award holders collaborated extensively with international partners in 20 countries. For the second time since 2008, the amount of additional research funding leveraged by HRB award holders exceeded the original HRB investment in their awards, with €2.02 leveraged for every €1.00 invested by the HRB in awards ending during the 2018–19 reporting period. Thirty per cent of the leveraged funding came from non-exchequer sources in Ireland and overseas. This finding reflects Irish health researchers' increased success in winning funding from the European Union (EU) Framework and other programmes.

Finally, for the first time, this report presents an analysis of secondary data usage by HRB researchers, which is a growing area of interest for the HRB.

Summary of outputs and outcomes

The analysis reported here demonstrates a wide variety of outputs and outcomes produced by HRB-funded research in terms of scientific dissemination, capacity building, policy and clinical practice influences, and health sector and economic benefits (see Summary Table below). A more detailed

summary of outputs, broken down by award type, is provided in Appendix B and by broad research area in Appendix C

Summary Table: Key output and outcome statistics for awards ending in 2018–19, compared to previous reporting periods

PAYBACK CATEGORY	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Value of investment	**€49.5 million**	**€47.2 million**	**€55.0 million**	**€44.0 million**	**€54.5 million**	**€45.0 million**
Knowledge creation outputs						
Total number of peer-reviewed journal publications	792	849	693	584	470	526
Average number of peer-reviewed papers per award	4.6	4.5	3.5	4.5	2.4	2.5
Percentage of papers in open access journals and/or on open publishing platforms	85%	70%	56%	N/A	N/A	N/A
Average number of publications per €1 million spend	16.0	17.8	12.6	13.3	8.6	11.6
Number of scientific presentations	1,560	1,524	1,414	940	1,427	1,118
Percentage of award holders reporting at least one other dissemination activity	81%	68%	72%	96%	87%	92%
Number of keynote presentations internationally	20	23	21	35	35	51
Research capacity building and leadership outputs						
Total number of research-related posts created	451	329	385	422	280	296
Number of PhD students trained	103	77	93	133	72	88
Number of postdoctoral researchers supported	136	124	154	130	92	112
Percentage of cohort from health background	39.0%	40.1%	43.6%	32.2%	29.0%	N/A
Average number of posts per award	2.7	1.8	1.9	3.1	1.4	1.4
Percentage of awards reporting indicators of peer recognition	44%	77%	43%	70%	75%	N/A
Collaboration and leveraged funding outputs						
Total number of academic collaborations, partnerships, or networks	396	399	413	278	415	384
Percentage of academic collaborations with health bodies	9%	16%	19%	14%	10%	N/A
Average number of academic collaborations, partnerships, or networks per €1 million spend	8.0	8.5	7.5	6.3	7.6	8.5
Number of additional research awards leveraged	174	200	180	149	113	117
Total value of leveraged funding	€100.4 million	€57.6 million	€41.8 million	€39.5 million	€34.8 million	N/A
Amount of leveraged funding per €1 spend	€2.02	€1.20	€0.76	€0.89	€0.64	N/A

PAYBACK CATEGORY	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Value of investment	**€49.5 million**	**€47.2 million**	**€55.0 million**	**€44.0 million**	**€54.5 million**	**€45.0 million**
Informing policy and practice outputs						
Total number of policy and practice outputs	190	187	105	127	99	84
Percentage of awards reporting policy and practice outputs	43%	45%	27%	38%	24%	20%
Average number of policy or practice outputs per €1 million spend	3.8	3.8	1.9	2.9	1.8	0.9
Engagement/involvement with patients and the public						
Total number of non-academic engagement activities	473	531	258	188	122	N/A
Percentage of award holders reporting non-academic engagement	60%	71%	48%	50%	35%	N/A
Average number of non-academic engagement activities per award	2.8	2.8	1.3	1.4	0.6	N/A
Average number of non-academic engagement outputs per €1 million spend	9.5	11.2	4.7	4.6	2.2	N/A
Percentage of awards reporting PPI activities	45%	22%	N/A	N/A	N/A	N/A
Number of PPI activities reported	575	354	N/A	N/A	N/A	N/A
Research tools, materials, and methods						
Total number of new tools, materials or methods developed	116	113	96	112	85 (2011)	N/A
Average number of outputs per €1 million spend	2.3	2.4	1.8	2.9	1.6	0.6
Healthcare innovations						
Total number of healthcare innovations	57	57	54	43	48	32
Percentage of awards reporting healthcareinnovations	24%	22%	21%	25%	21%	15%
Average number of healthcare innovations per €1 million spend	1.24	1.21	0.98	0.98	0.88	0.71
Commercialisation and economic benefits						
Number of filed invention disclosures or disclosures in discussions with Technology Transfer Office	11	25	5	20	9	9
Number of patents, copyrights or trademarks filed	7	10	24	16	11	12
Number of licensed technologies developed	2	5	2	5	3	3
Number of start-ups or spin-outs established	2	2	4	2	2	2
Number of academic-industry collaborations established	46	59	58	88	25	10
Number of commercialisation awards secured from Enterprise Ireland	6	2	9	5	4	6

* N/A = not applicable as data on this metric was not collected during the reporting period

1 Introduction and methods

1.1 Introduction

This report presents an analysis of the outputs, outcomes, and some emerging impacts across a range of research metrics and indicators arising from 170 Health Research Board (HRB) awards (with a combined value of €49.5 million) that completed in 2018 and 2019. The outputs and outcomes reported in 2018–19, combined with those from past reporting periods, provide 12 years of evaluation data from completed HRB awards and, where possible, trend analysis of these data is provided.

The purpose of this report is to understand whether the award schemes in which the HRB invests are meeting their scientific objectives and are productive across a range of evaluation metrics. This can provide evidence to inform the HRB's funding strategy and decisions relating to new or existing funding initiatives. It is also important that the HRB is transparent about the outputs, outcomes, and emerging impacts from its research investments. The value of the HRB's current funding commitment is in the region of €245 million. As this is public money, there is an onus on the HRB to account to Government and other stakeholders, including the public, for the funds it allocates and the returns on this investment.

In order to understand how well HRB award holders are doing in comparison to their peers internationally, the United Kingdom's Medical Research Council (MRC) *10 years of outcomes reported by MRC projects* [1] is used as a comparator for the data contained in this report. The MRC collects and reports on a similar evaluation dataset to the HRB based on the Buxton and Hanney Payback Framework, for health research (Buxton and Hanney, 1994, 1996, 1997; Donovan and Hanney, 2011 [2-5]), although the MRC's outputs and outcomes are not always reported in a manner that allows direct comparison with HRB data. In addition, this comparison should be cautiously interpreted since the MRC operates in a different context; has different strategic objectives, structures, funding instruments, and expected outcomes; and operates on a far greater scale than the HRB. Nonetheless, some useful comparisons have been included in this report.

An important caveat in considering the findings in this report is that the analysis presented is not a complete picture of all outputs and outcomes of HRB-funded research. There can be a considerable time lag (>5 years) before research outputs manifest in outcomes and their ultimate impacts on society and the economy become clear, depending on the research area in question. Therefore, evaluation data collected at the point of end of grant (EOG) can only provide a snapshot in time. Further outputs, outcomes, and impacts would be expected to occur in the years following the completion of an award.

1.2 The Payback Framework

HRB evaluation data collection is guided by the Buxton and Hanney Payback Framework for Health Research originally developed to examine the 'payback' of health services research. This framework groups evaluation metrics into five payback categories that span short- to medium-term outputs and outcomes (knowledge production, research capacity building, informing policy and the public) and longer-term impacts effected through policy and clinical practice changes, healthcare innovations, and economic and commercial activity. The full HRB framework, adapted from Wooding *et al.* (2004) [6], is presented in Appendix A

For the purposes of this report, data on a substantial subset of quantitative metrics set out in the Payback Framework were collected using a bespoke online survey tool called Outcome Tracker, allowing the HRB to get a comprehensive overview of how its funding schemes are performing against their original objectives.

2 Number, type, and value of awards

In order to achieve outputs and outcomes of benefit to health and well-being, the HRB supports Projects and Programmes, Infrastructure and Networks, and Capacity Building and Leadership Enhancement awards across a broad spectrum of research areas relevant to health. This chapter examines these inputs and their distribution across different funding mechanisms, broad research areas, and host institutions.

Key findings

- The 170 HRB awards that reported on evaluation metrics in 2018–19, with a combined value of €49.5 million, represented 95.5% coverage of all HRB awards that completed in this reporting period.
- The HRB awards reported on spanned two different strategies: 48% of awards granted between 2011 and 2015 fell within the remit of the *HRB Strategic Business Plan 2010-2014* [7], and 52% of awards granted between 2016 and 2018 fell under the *HRB Strategic Business Plan 2016-2020* [8].
- Projects and Programmes awards accounted for 75% of all HRB awards and 65% of total funding; Capacity Building and Leadership Enhancement awards accounted for 24% of all HRB awards and 34% of total funding; and Infrastructure and Networks awards accounted for 1% of all HRB awards and 2% of total funding.
- Spend on Basic Biomedical Research has been in steady decline since 2008, with no HRB investment recorded in either the 2016–17 or 2018–19 reporting periods. Spend on awards categorised as Clinical Research has risen sharply since 2008, and trend analysis shows that this pattern has remained relatively stable since 2014–15. Applied Biomedical Research remained relatively constant from 2008–09 to 2014–15 but decreased in the two most recent reporting periods of 2016–17 and 2018–19.
- Investment in Health Services Research has increased since 2016–17, and Population Health Sciences investment has remained stable compared to 2016–17.
- Trinity College Dublin; University College Cork; the National University of Ireland, Galway; and the Royal College of Surgeons in Ireland, respectively, held the highest proportion of HRB awards by value in 2018–19. This same order of awards was also reported in 2016–17.

2.1 Number, value, and distribution of awards

In total, 170 HRB awards that completed in 2018 and 2019 are analysed in this report. These awards had a combined value of €49.5 million. The equivalent statistics for awards that completed in 2016–17, 2014–15, 2012–13, 2010–11, and 2008–09 were: 187 awards (€47.2 million value), 198 awards (€55.0 million value), 134 awards (€44.0 million value), 196 awards (€54.5 million value), and 204 awards (€45 million value), respectively. This report does not contain complete information on all awards that finished in 2018–19, as a small number of award holders did not provide evaluation data. However, this report covers 95.5% of awards ending in 2018–19 across all schemes. The year of award for all awards included in this report is shown in Figure 2.1.

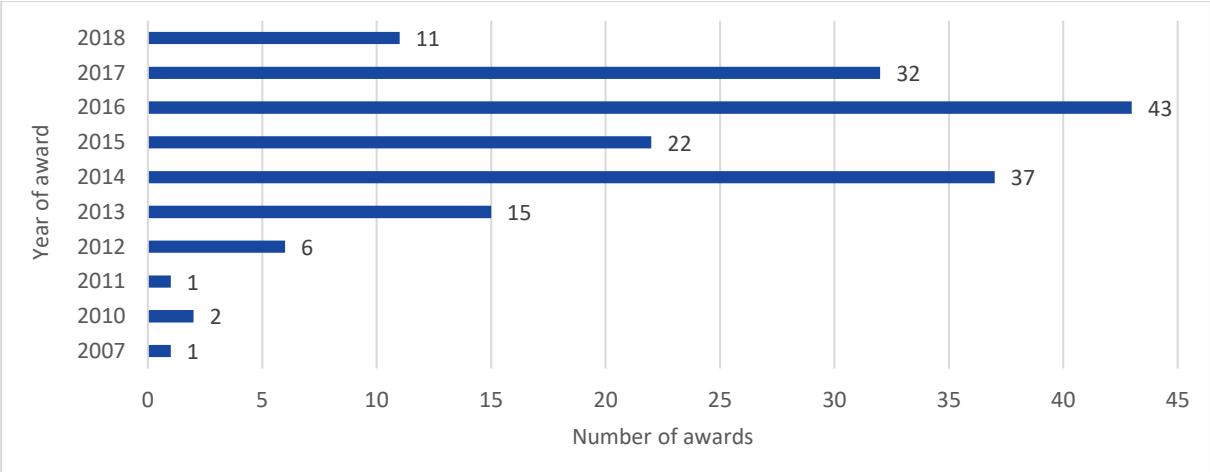


Figure 2.1: Breakdown of number of awards ending in 2018–19, by start date of awards

Figure 2.1 shows that of the awards that completed in 2018–19, a similar proportion of awards was granted between 2011 and 2015 (48%, n=81) (within the remit of the *HRB Strategic Business Plan 2010-2014*) and from 2016 onwards (51%, n=86) (within the remit of the *HRB Strategic Business Plan 2016-2020*). Most of the awards were project grants and fellowships of 2–4 years' duration, apart from the 38 Knowledge Exchange and Dissemination Scheme (KEDS) awards made in 2007, 2015, 2017, and 2018, which were of shorter duration (6–12 months).

A breakdown of awards by scheme and year of award is shown in Table 2.1. Notably, some grants included in this report were awarded pre-2011 and finished during this reporting period: one PhD Scholars Programmes award that ran for 9 years, graduating 45 PhD students in Health Services Research; two Translational Research Awards; and one Research Training Fellowships for Healthcare Professionals award.

Table 2.1: Breakdown of awards ending in 2018–19, per scheme and year of award

Scheme	2007	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Applied Partnership Awards								1	1		**2**
Applied Research Projects in Dementia							2				**2**
Cancer Prevention Fellowship Programme				1					1		**2**
Clinician Scientist Awards				1							**1**
Cochrane Training Fellowships						3	4	8			**15**
Collaborative Applied Research Grants				1	3						**4**
Health Research Awards				1	7	25	5	23			**61**
HRB Trials Methodology Research Network						1					**1**
Interdisciplinary Capacity				1			1				**2**

Scheme	2007	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Enhancement Awards											
Investigator Led Projects									2		**2**
Joint Programme in Neurodegenerative Diseases					1	1					**2**
Knowledge Exchange and Dissemination Scheme		1					1		25	11	**38**
Medical Education Research Grants						2					**2**
MRCG-HRB Joint Funding Scheme						1	1	5	2		**9**
National SpR* Academic Fellowship Programme					1	1					**2**
PhD Scholars Programmes	1										**1**
Project Development Grant							1	2			**3**
Research Collaborative in Quality and Patient Safety							2				**2**
Research Leader Awards					1						**1**
Research Training Fellowships for Healthcare Professionals				1	2	2	5	4	1		**15**
Translational Research Awards		1	1			1					**3**
Total	**1**	**2**	**1**	**6**	**15**	**37**	**22**	**43**	**32**	**11**	**170**

*SpR = Specialist Registrar

2.1.1 Distribution of spend, by award type

Figure 2.2 shows the distribution of awards by award type, and Figure 2.3 shows the breakdown of the number and value of awards by award type. Table 2.2 shows the breakdown of number of awards, total value of awards, and average value of awards.

Projects and Programmes awards accounted for the largest number of awards (n=128, 75%) and received the largest proportion of total funding (65%, €32.1 million). This award type included 3-year projects such as the Health Research Awards (average award value: €314,336; n=61) and Collaborative Applied Research Grants (average award value: €1,199,042; n=4), and relatively small 1-year projects such as the KEDS awards (average award value: €39,060; n=38). Translational Research Awards (average award value: €774,573; n=3) and Health Research Charities Ireland (formerly the Medical Research Charities Group) jointly funded projects (average award value: €202,673; n=9) were also included in this award type.

Capacity Building and Leadership Enhancement awards accounted for 24% (n=41) of all awards that completed in 2018–19 and 34% (€16.7 million) of the total value of awards. This award type included high-value awards such as the PhD Scholars Programmes (award value: €6,870,967; n=1) and Clinician Scientist Awards (award value: €1,475,168; n=1), and lower-value awards such as the Interdisciplinary Capacity Enhancement Awards (average award value: €658,094; n=2), the Research Training Fellowships for Healthcare Professionals (average award value: €229,868; n=15), and the Cochrane Training Fellowships (average award value: €57,926; n=15).

There was one award categorised as an Infrastructure and Networks award that ended during 2018–19.

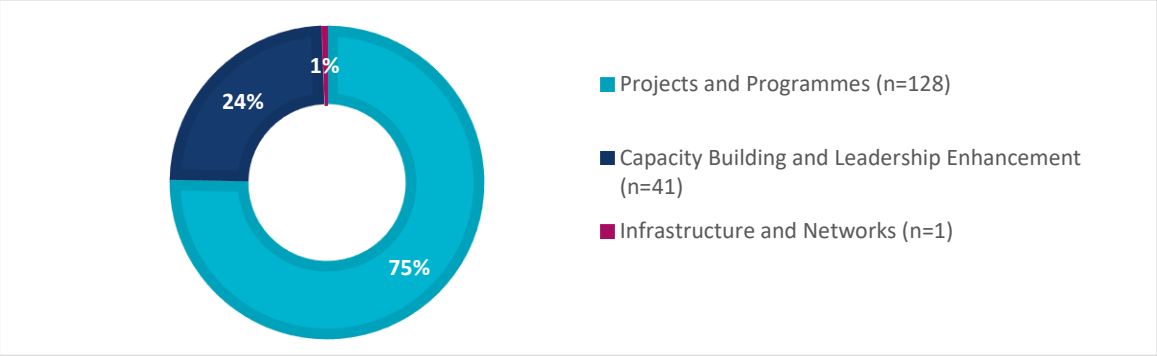


Figure 2.2: Distribution of number of awards ending in 2018–19, per award type

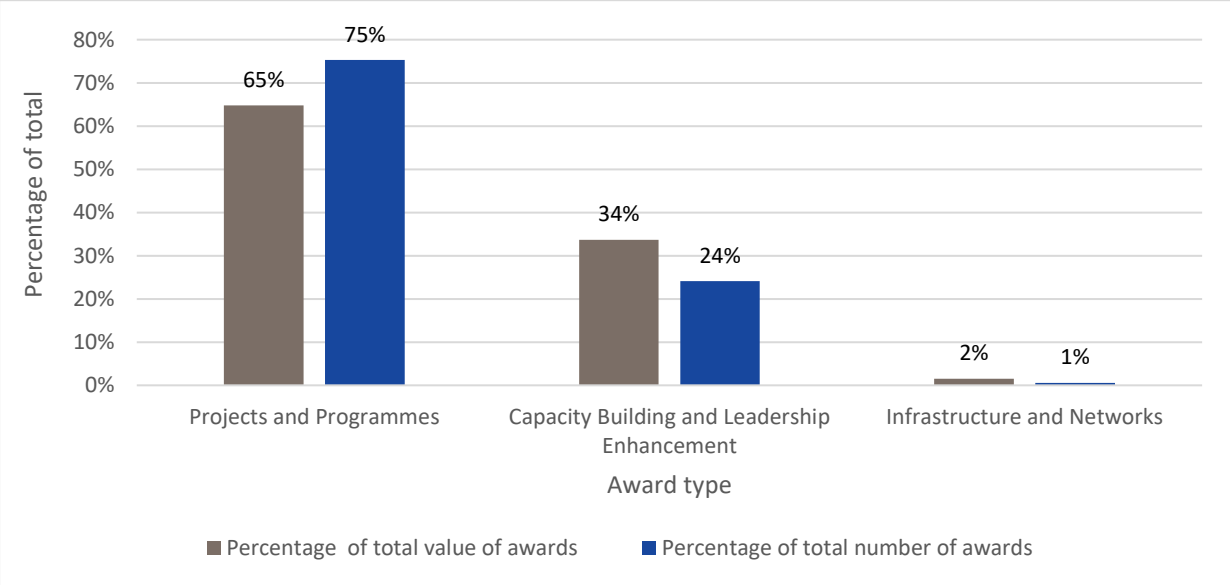


Figure 2.3: Comparison of number and value of awards ending in 2018–19, per award type

Table 2.2: Breakdown of number of awards, total value of awards, and average value of awards, 2018–19

	No. of awards	Total value of awards	Average value per award
Projects and Programmes	**128**	**€32,051,601**	**€250,403**
Applied Partnership Awards	2	€358,799	€179,400
Applied Research Projects in Dementia	2	€548,596	€274,298
Project Development Grant	3	€26,284	€8,761
Collaborative Applied Research Grants	4	€4,796,167	€1,199,042
Health Research Awards	61	€19,174,498	€314,336
Investigator Led Projects	2	€516,123	€258,062
Joint Programming Initiative in Neurodegenerative Diseases	2	€439,572	€219,786
Knowledge Exchange and Dissemination Scheme	38	€1,484,288	€39,060
MRCG-HRB Joint Funding Scheme	9	€1,824,058	€202,673
Research Collaborative in Quality and Patient Safety	2	€559,498	€279,749
Translational Research Awards	3	€2,323,718	€774,573
Capacity Building and Leadership Enhancement	**41**	**€16,669,831**	**€406,581**
Cancer Prevention Fellowship Programme Reintegration Grant	2	€203,398	€101,699
Clinician Scientist Awards	1	€1,475,168	€1,475,168
Cochrane Training Fellowships	15	€868,888	€57,926
Interdisciplinary Capacity Enhancement Awards	2	€1,316,187	€658,094
Medical Education Research Grants	2	€326,034	€163,017
National SpR/SR Academic Fellowship Programme	2	€743,789	€371,895
PhD Scholars Programmes	1	€6,870,967	€6,870,967
Research Leader Awards	1	€1,417,386	€1,417,386
Research Training Fellowships for Healthcare Professionals	15	€3,448,014	€229,868
Infrastructure and Networks	**1**	**€761,835**	**€761,835**
HRB Trials Methodology Research Network	1	€761,835	€761,835
Total number and value	**170**	**€49,483,267**	

2.1.2 Distribution of spend, by broad research area

Distribution of the HRB's €49.5 million investment in awards that completed in 2018–19 across four broad research areas is shown in Figures 2.4, 2.5 and 2.6 The breakdown of awards that were originally classified as spanning two broad research areas is shown in Figure 2.4. For ease of analysis in this report, each award was allocated to a single broad research area that represented the predominant focus of the award. In the cases where research spanned two broad research areas, the amount awarded was split equally between the two broad research areas. No awards were categorised as Basic Biomedical Research in 2018–19.

Health Services Research accounted for the largest proportion of funding (40% of total spend, €19.9 million), followed by Clinical Research (26% of total HRB spend, €13.0 million) and Applied Biomedical Research (23% of total spend, €11.5 million). This is the first time that Health Services Research received the most funding in a reporting period. Health Services Research and Population Health Sciences funding

combined accounted for 50% of the total expenditure for awards ending in 2018–19, reflecting the strategic direction of HRB investment in these areas.

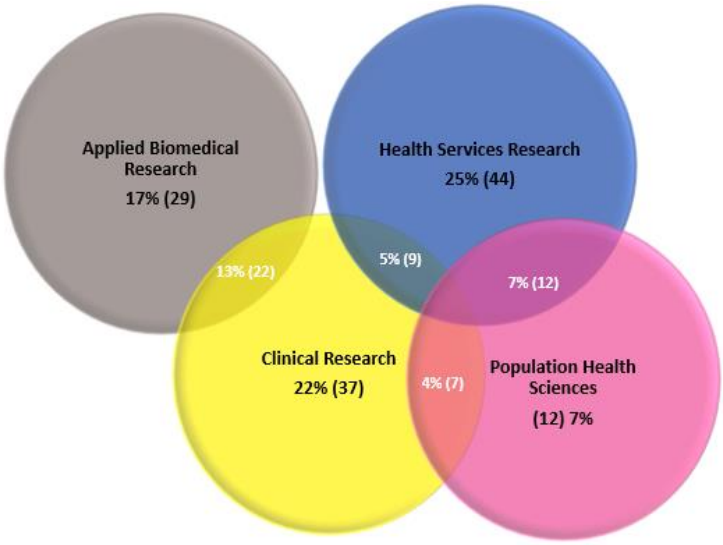


Figure 2.4: Number of awards, per broad research area, including intersections, 2018–19

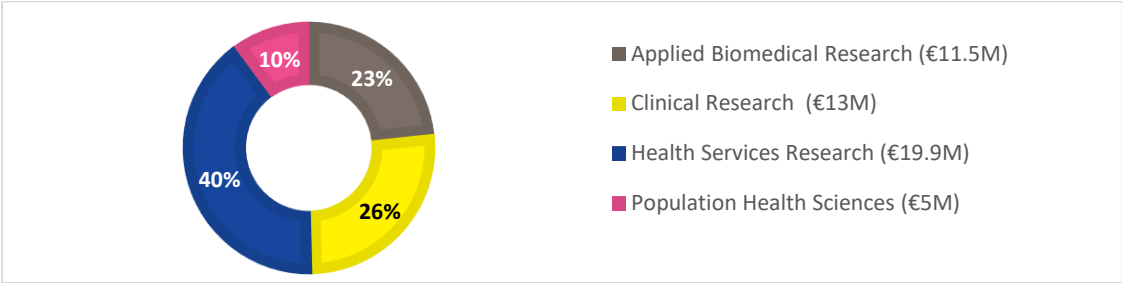


Figure 2.5: Distribution of value of awards, per broad research area, 2018–19

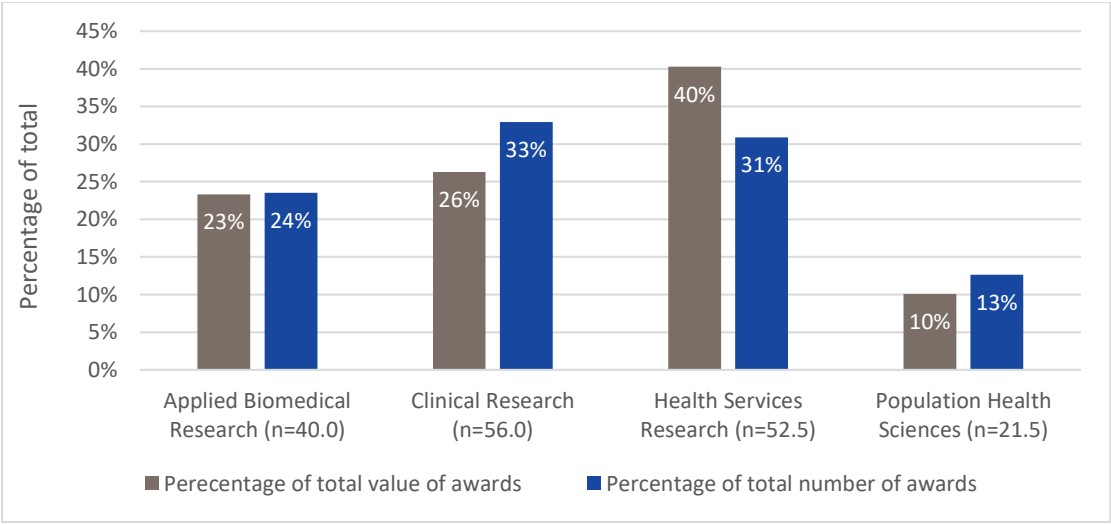


Figure 2.6: Comparison of number and value of awards, per broad research area, 2018–19

The distribution of broad research areas by award type is shown in Figure 2.7. Awards categorised as Projects and Programmes and Capacity Building and Leadership Enhancement were made across all broad research areas, while the Infrastructure and Networks award (i.e., the HRB Trials Methodology Research Network award) that completed in 2018–19 was categorised as equal parts Health Services Research and Population Health Sciences.

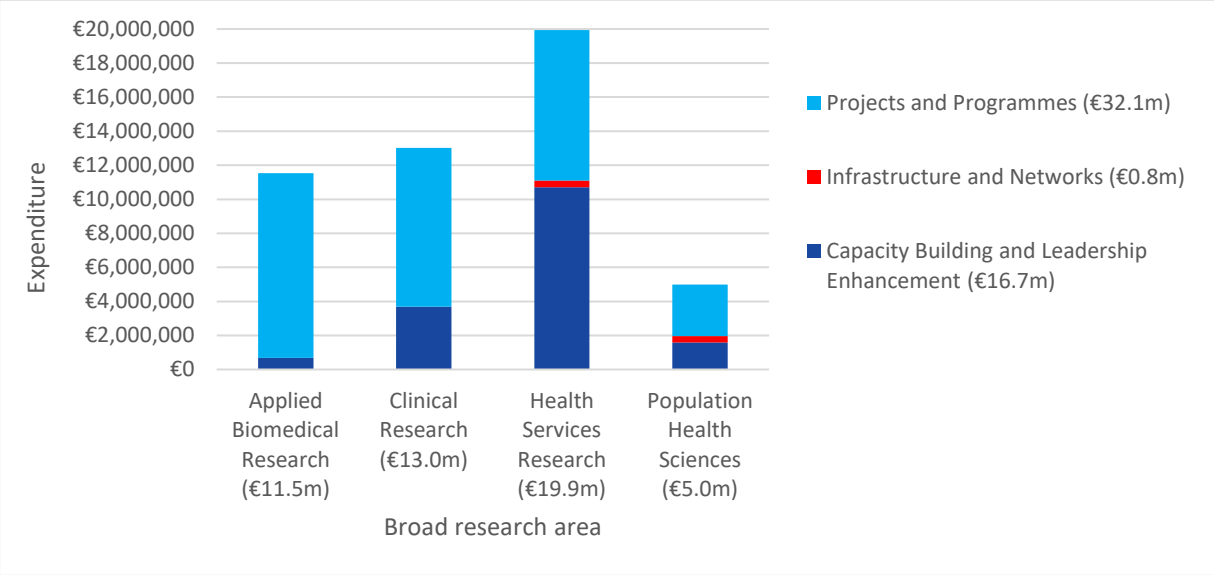


Figure 2.7: Distribution of awards, per broad research area and award type, 2018–19

Table 2.3 shows a mapping of schemes by broad research area. As noted previously, some awards are categorised into two broad research areas.

Table 2.3: Awards per scheme, per broad research area, 2018–19

Scheme	ABR	CR	HSR	PHS	ABR/CR	CR/HSR	CR/PHS	PHS/ HSR	Total
Applied Partnership Awards			€358,799						**€358,799**
Applied Research Projects in Dementia			€548,596						**€548,596**
Cancer Prevention Fellowship Programme							€99,898	€103,500	**€203,398**
Cancer Nursing Award			€20,284				€6,000		**€26,284**
Clinician Scientist Awards		€1,475,168							**€1,475,168**
Cochrane Training Fellowships		€539,487	€48,874	€205,343	€54,436	€20,748			**€868,888**
Collaborative Applied Research Grants			€3,546,258	€1,249,909					**€4,796,167**
Health Professional Fellowship	€258,489	€390,002	€250,838		€408,648				**€1,307,977**
Health Research Awards	€6,424,921	€4,253,862	€1,964,323	€329,267	€3,379,443	€902,231	€956,796	€963,655	**€19,174,498**

Scheme	ABR	CR	HSR	PHS	ABR/CR	CR/HSR	CR/PHS	PHS/ HSR	Total
HRB Trials Methodology Research Network								€761,835	**€761,835**
Interdisciplinary Capacity Enhancement Awards				€567,394				€748,793	**€1,316,187**
Investigator Led Projects	€336,453				€179,670				**€516,123**
Joint Programming Initiative in Neurodegenerative Diseases		€243,829	€195,743						**€439,572**
Knowledge Exchange and Dissemination Scheme	€13,300	€272,147	€576,165	€229,410	€118,665	€31,820	€59,990	€182,791	**€1,484,288**
Medical Education Research Grants			€326,034						**€326,034**
MRCG-HRB Joint Funding Scheme	€1,284,684	€339,375			€199,999				**€1,824,058**
National SpR/SR Academic Fellowship Programme					€389,921			€353,868	**€743,789**
PhD Scholars Programmes			€6,870,967						**€6,870,967**
Research Collaborative in Quality and Patient Safety			€280,000				€279,498		**€559,498**
Research Leader Awards			€1,417,386						**€1,417,386**
Research Training Fellowships for Healthcare Professionals		€493,360	€725,144			€614,583		€306,950	**€2,140,037**
Translational Research Awards					€1,691,971	€631,747			**€2,323,718**
Total	**€8,317,847**	**€8,007,230**	**€17,129,411**	**€2,581,323**	**€6,422,753**	**€2,201,129**	**€1,402,182**	**€3,421,392**	**€49,483,267**

ABR=Applied Biomedical Research; CR=Clinical Research; HSR=Health Services Research; PHS=Population Health Sciences

It is also interesting to compare expenditure in the broad research areas over the 12 years from 2008 to 2019 (Figure 2.8), although it should be remembered that the data presented here are based on award end dates rather than start dates.

Funding of awards categorised as Basic Biomedical Research has been in steady decline since 2008, with no awards that completed in 2016–17 or 2018–19 falling into this category. This reflects the HRB's gradual shift in funding focus away from basic biomedicine to more patient-oriented research (Applied Biomedical Research and Clinical Research), Population Health Sciences, and Health Services Research. However, HRB

still supports some Basic Biomedical Research through co-funding arrangements with national and international partners such as Science Foundation Ireland and the Wellcome Trust in the United Kingdom.

The distribution of spend on awards categorised as Applied Biomedical Research decreased in the 2016–17 and 2018–19 reporting periods, relative to previous periods. Expenditure on awards categorised as Clinical Research more than trebled between 2008-09 and 2014-15 and remained relatively steady since then.

Expenditure on awards categorised as Health Services Research remained relatively constant from 2010–11 to 2016–17; however, the 2018–19 data indicated more than double the proportion of total investment in this area compared to 2016–17 (40% in 2018–19 versus 17% in 2016–17). Health Services Research represented the highest spend in 2018–19.

In the 2012-13 reporting period there was a decline in Population Health Sciences spending compared to previous reporting periods. This has since been reversed and doubled between the 2014-15 and 2016–17 reporting periods. Funding of Population Health Sciences awards remained relatively steady in 2018–19, accounting for 10% of the total spend in this reporting period.

Notably, Health Services Research and Population Health Sciences combined accounted for 50% of HRB investment in awards ending in 2018–19. This change in spending behaviours is due to the HRB's conscious decision to invest in these areas of research. A number of these awards reached completion during 2018–19 (such as awards in the PhD Scholars Programmes, Medical Education Research Grants, and Research Leader Awards), reflecting this strategic shift.

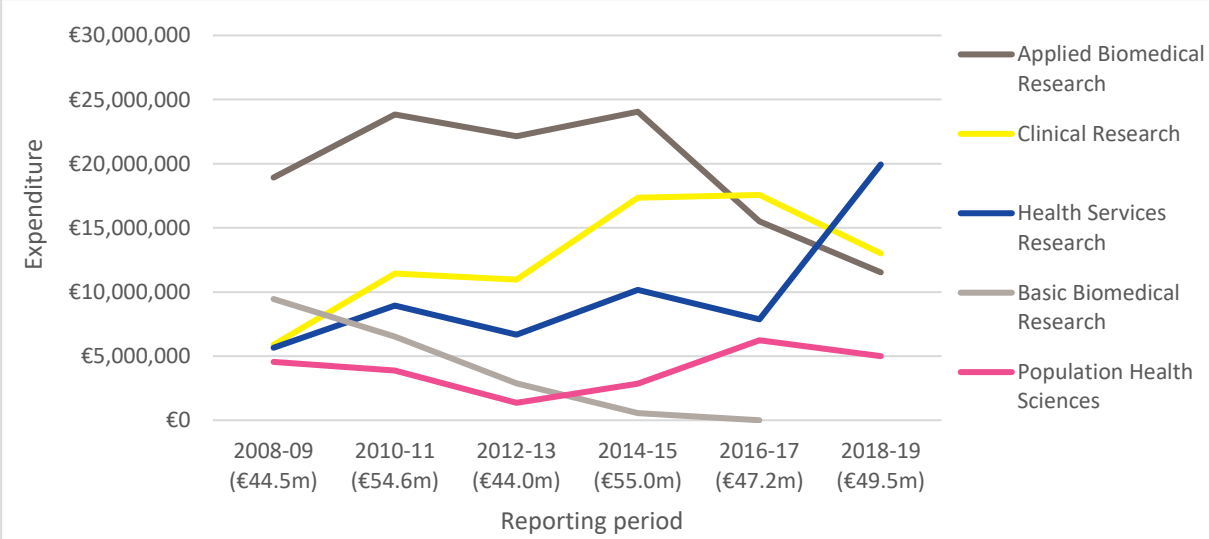
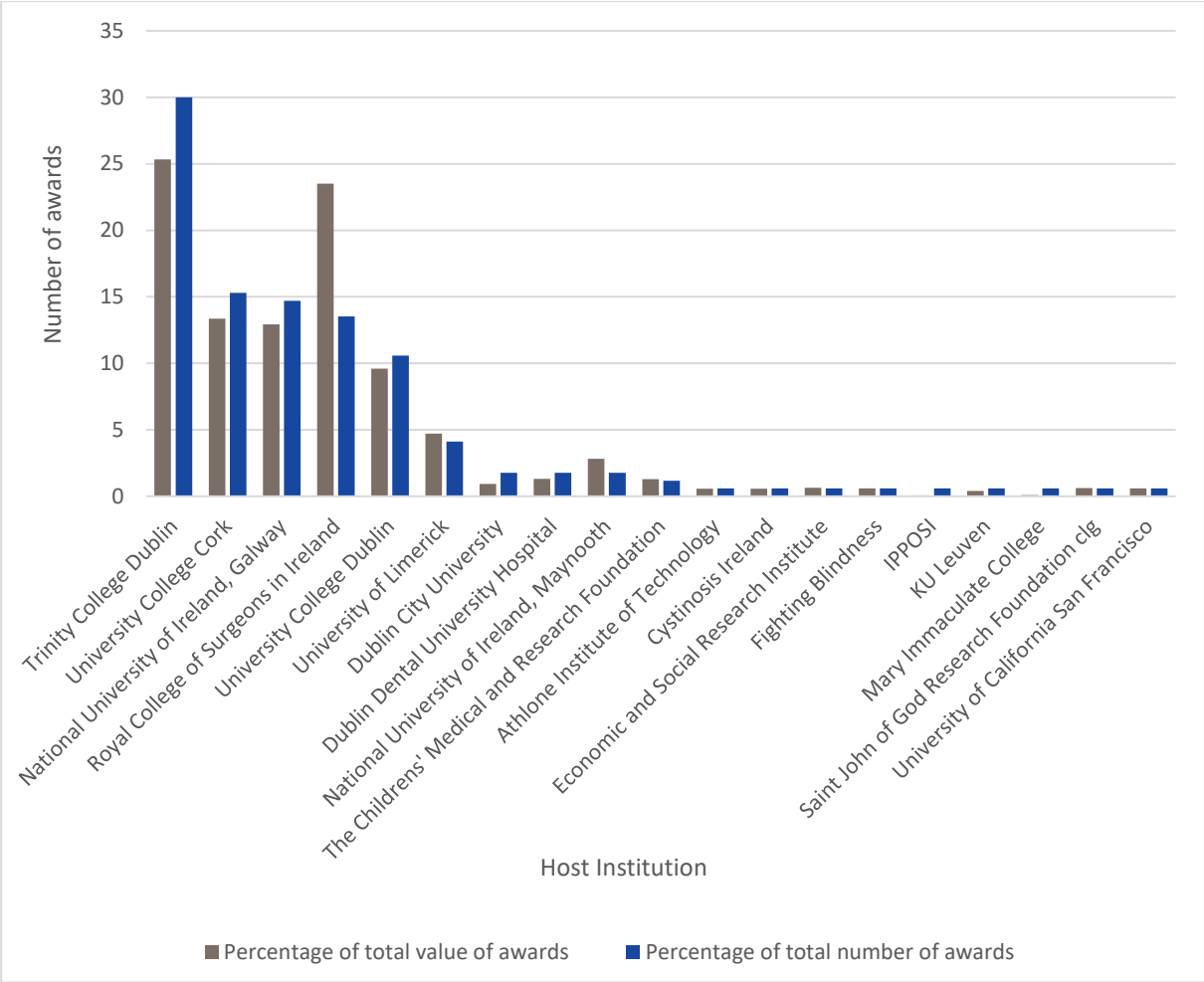


Figure 2.8: Comparison of expenditure for awards ending in 2008–09 to 2018–19, per broad research area

2.1.3 Distribution of spend, by host institutions

Figure 2.9 shows the distribution of awards that completed in the 2018–19 reporting period by host institution. Trinity College Dublin received the highest proportion of the total value of awards (25%), followed by the Royal College of Surgeons in Ireland (24%). University College Cork and the National University of Ireland, Galway each received the third highest proportion of the total value of awards (13%).



*Research Foundations: St John of God Research Foundation and the Children's' Medical and Research Foundation

Figure 2.9: Distribution of awards, per host institution, 2018–19

3 Achievement of objectives

In their original grant application, award holders outlined the specific research objectives that they sought to achieve with their HRB funding. At the completion of their awards, award holders were asked to indicate the extent to which these objectives were fulfilled during the period of the award. The purpose of this question was not punitive, but rather to learn about the impediments that HRB award holders experience in carrying out their research. This chapter examines the responses to that question.

Key findings

- There has been a steady increase in the number of objectives reported as fully achieved by the award holders, from 43% in 2008–09 to 73% in 2018–19.
- Award holders reported that 21% of their original research objectives were only partially achieved. The most common reasons cited for partial achievement were: underestimating the time required or aspects of the research taking longer than originally anticipated (37%, n=59); early findings in the research leading to a shift in research focus (18%, n=28); and technical problems, or lack of access to essential equipment or infrastructure (15%, n=24).
- Award holders reported that 4% of their original research objectives were not achieved at all. The most common reasons cited for not achieving the original research objectives were: early findings in the research leading to a shift in research focus (25%, n=7); research objectives changing due to developments in the external environment/society (25%, n=7); and underestimating the time required or aspects of the research taking longer than originally anticipated (14%, n=4). COVID-19-related delays were also cited by 14% of award holders (n=4).

3.1 Number of awards achieving all objectives

As shown in Figure 3.1, 73% of HRB award holders indicated that they had achieved all their original research objectives by the time they completed their award. There has been a steady increase in this statistic since 2008, when just under one-half of award holders achieved all their original objectives by the end of their award. The reasons for this upward trend are difficult to quantify with any certainty. It may be due to careful review and improved feedback from international peer review panels on the feasibility of achieving the stated objectives over the award and with the requested resources. It may also be due to growing researcher experience of what can realistically be achieved over the lifetime of an award.

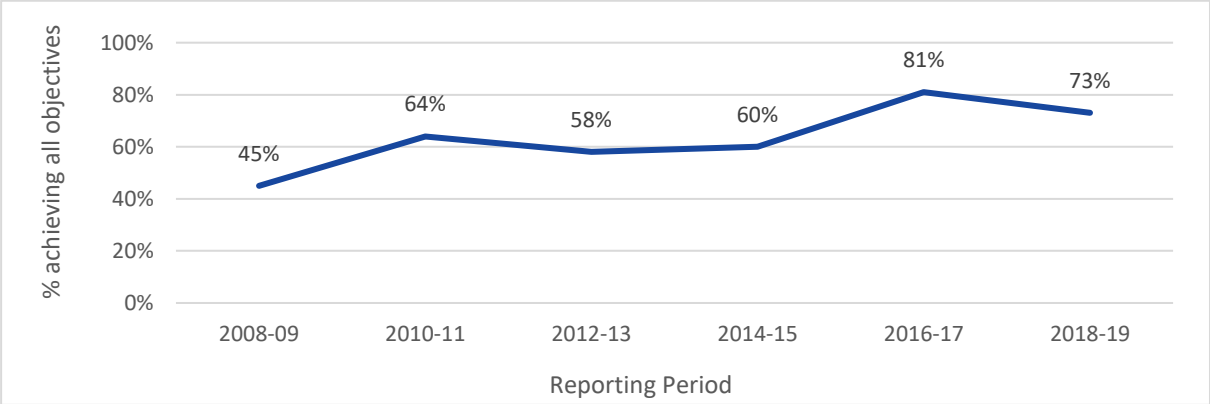


Figure 3.1: Percentage of awards achieving all objectives, from 2008–09 to 2018–19

Over time, the HRB has also adopted more robust and consistent award monitoring procedures, including the introduction of detailed annual reporting; the requirement to request permission in real time from the HRB if a researcher needs to shift their focus or change their objectives; and a practice of awarding short, no-cost extensions to award holders – when well-justified – in order to complete their research. As is evident from Figure 3.1, the HRB's emphasis since 2008 on clarity in the application process, international peer review, and ongoing award monitoring have had a real impact in this regard.

Figure 3.2 provides a breakdown of achievement of objectives by award type. As shown, most award holders across all award types reported that they had achieved all their original objectives. Reported failure to achieve all objectives was lowest for the Infrastructure and Networks award holder (n=1). The highest proportion of partially achieved research objectives was reported by Capacity Building and Leadership Enhancement award holders, which may be accounted for by the relative inexperience of many of the recipients of this type of award.

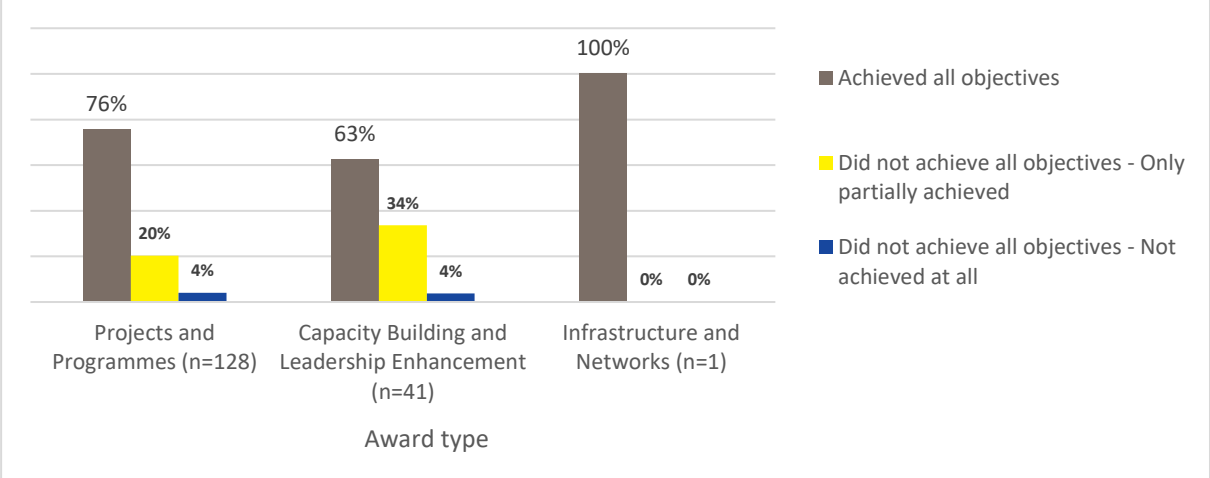


Figure 3.2: Achievement of research objectives, per award type, 2018–19

3.2 Reasons for not achieving objectives

Award holders were asked to indicate the reasons behind their inability to fulfil all their original research objectives, where relevant. Awards holders could choose more than one reason. Figures 3.3 and 3.4 show the share of award holders who cited each given reason.

Overall, award holders reported that 21% of their original research objectives were only partially achieved (n=158 of 700 total objectives). The most common reasons cited for partial achievement of the original research objectives were: underestimating the time required or aspects of the research taking longer than originally anticipated (37%, n=59); early findings in the research leading to a shift in research focus (18%, n=28); and technical problems, or lack of access to essential equipment or infrastructure (15%, n=24).

Other reasons cited for partially achieving research objectives included issues around staff recruitment, staff retention, and/or a lack of suitably trained personnel (7%). This also featured in the reasons for complete failure to achieve research objectives. In their expanded comments, it was evident that award holders struggled with the ongoing issue of qualified and trained professionals leaving the field. This important finding further highlights the need to improve the job security and career prospects for people working in State-funded health research in order to both retain existing staff and attract new researchers in the future.

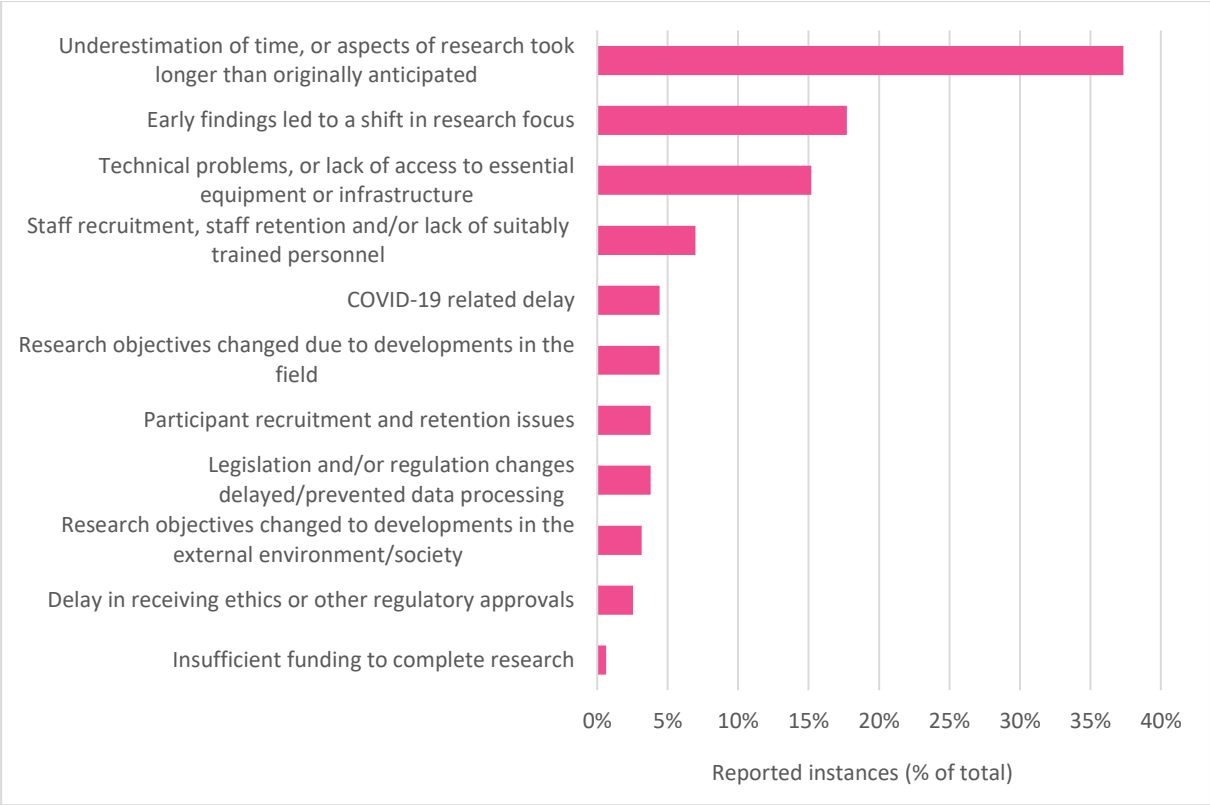


Figure 3.3: Reasons cited for partial non-fulfilment of original research objectives, 2018–19

Award holders reported that 4% of their original research objectives were not achieved at all (n=28 of 700 total objectives). The most common reasons cited for not achieving the original research objectives were: early findings in the research leading to a shift in research focus (25%, n=7); research objectives changing due to developments in the external environment/society (25%, n=7); and underestimating the time required or aspects of the research taking longer than originally anticipated (14%, n=4). COVID-19-related delays were also cited by 14% of award holders (n=4).

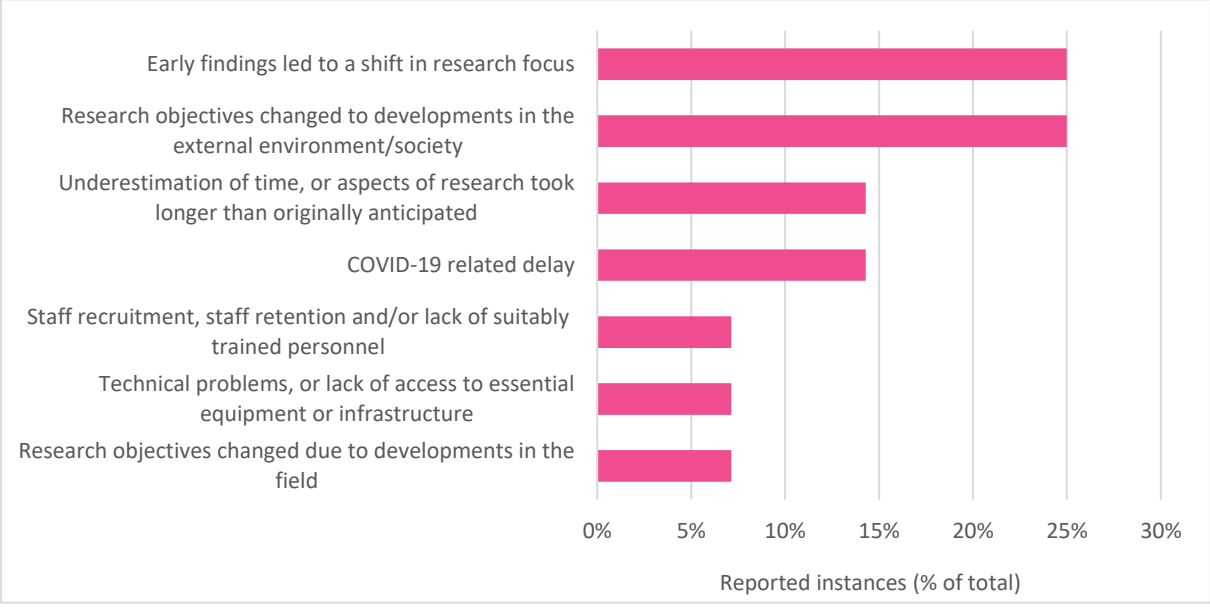


Figure 3.4: Reasons cited for complete non-fulfilment of original research objectives, 2018–19

In this reporting period, a small number of award holders (six) reported some original research objectives were not achieved due to legislation and/or regulation changes causing delays or preventing data processing. This was mainly associated with the introduction of the General Data Protection Regulation (GDPR) in May 2018 and the subsequent difficulties in accessing data that had previously been available.

It should be noted that the 2019 data were collected in mid-2020 when the impact of the COVID-19 pandemic was already beginning to be felt within the research community. It is expected that the report for awards ending in 2020–21 will further demonstrate the effects of the pandemic on the health research community.

Table 3.1 contains the specific reasons offered by award holders for being unable to achieve all their original research objectives; there is often more than one reason why an award might not achieve all its original objectives.

3.3 Examples of reasons for not achieving original research objectives

Table 3.1: Examples of reasons cited by award holders for not achieving their original research objectives, 2018–19

Award type	Was the objective achieved?	Reason(s) for non-completion of all objectives	Description of issue by Principal Investigator (PI)*
Projects and Programmes	Only partially achieved	Early findings led to a shift in research focus	"All materials have been created and collated except an animated video on cancer research. This video was different from the original concept (about 'the science'), in that we took a more lay approach ('what happens to your sample?'), as advised by the management group, which saw us work with a school in Finglas to create this video. Most of the animation is done, however, so we do not anticipate any further delays. Once this video is ready, all materials will be uploaded and available immediately online."
Projects and Programmes	Only partially achieved	Legislation and/or regulation changes delayed/prevented data processing	"The new consent legislation overseen by the HRCDC in 2019 was a major obstacle to the dissemination of the data. The data were collected during the previous years (2016–2018) with the consent of the participants. However, the introduction of stricter rules in 2019 prevented the publication of the main dataset and several other datasets had to be deleted."
Projects and Programmes	Only partially achieved	Legislation and/or regulation changes delayed/prevented data processing	"The implementation of the General Data Protection Regulation (GDPR) resulted in a loss of access to samples for approximately 12 months. To get the project back on track we generated a Tissue Micro Array instead and completed analysis using that."
Capacity Building and Leadership Enhancement	Only partially achieved	Participant recruitment and retention issues	"The study was not powered to determine efficacy. This was because of a delay with accessing the ICT programme, which also led to a delay in recruitment of participants. A no-cost extension was provided by the HRB, but the timelines and the research design meant that the number of participants recruited did not reach the sample size required for sufficient power. However, the small sample size did allow for examination of the feasibility of this mode of

Award type	Was the objective achieved?	Reason(s) for non-completion of all objectives	Description of issue by Principal Investigator (PI)*
			intervention but does not answer the question of efficacy."
Capacity Building and Leadership Enhancement	Only partially achieved	Early findings led to a shift in research focus	"We had originally planned to use Activity Systems Analysis for this study, but following on from the first two studies, we decided to use Multiple Case Study methodology instead. We flagged the change in methodology in an annual report. We have produced a report of the study and the associated publication is currently in peer review."
Projects and Programmes	Only partially achieved	Technical problems, or lack of access to essential equipment or infrastructure	"Technical difficulties with creating human transgene cell lines slowed progression."
Projects and Programmes	Only partially achieved	COVID-19-related delay	"Delays in completing the planned activities for the parent study, plus restrictions in research activities due to COVID-19, impacted the proposed timelines for this project."
Projects and Programmes	Not achieved	COVID-19-related delay	"Delays in recruiting teams to the study resulted in the start date being postponed to January 2020. Teams that commenced on the programme were advised to cease activity during the COVID-19 pandemic."

*Direct quotes from EOG survey responses

4 Knowledge creation

Scientific dissemination is at the core of the research process. It enables award holders to build on existing scientific knowledge and to develop collaborations with colleagues both nationally and internationally in order to advance specific areas of research. Important indicators of scientific dissemination activity include:

- Publication of peer-reviewed papers in scientific journals that have a wide readership and scientific credibility,
- Oral presentations and the presentation of scientific posters to peers at national and international scientific conferences, and
- Invitations to present keynote presentations at national and international scientific conferences.

Award holders were asked to report on all activities of knowledge creation and scientific dissemination in their end of grant (EOG) report. The findings are presented in this chapter.

Summary of scientific dissemination outputs, 2018–19, compared to previous reporting periods

Knowledge creation	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Peer-reviewed publications						
Total number of peer-reviewed journal publications	792	849	693	584	470	526
Average number of peer-reviewed papers per award	4.6	4.5	3.5	4.5	2.4	2.5
Percentage of papers in open access journals and/or on open publishing platforms	85%	70%	56%	N/A	N/A	N/A
Average number of publications per €1 million spend	16.0	17.8	12.6	13.3	8.6	11.6
Scientific presentations						
Number of scientific presentations	1,560	1,524	1,414	940	1,427	1,118
Number of keynote presentations internationally	20	23	21	35	35	51
Percentage of award holders reporting at least one other scientific dissemination activity	81%	70%	72%	96%	87%	92%

*N/A = data on all metrics was not available in every reporting period

Key findings

Peer-reviewed journal papers

- A total of 792 peer-reviewed publications were reported by holders of awards that ended in 2018–19. Sixty-eight per cent of awards (n=115) reported at least one peer-reviewed publication at EOG, with

an average of 16.0 publications per €1 million spend and an average of 4.6 peer-reviewed publications per grant, although there was variation in award type and broad research area.

- Eighty-five per cent of papers were published in open access compliant journals or on open publishing platforms in 2018–19 compared to 70% and 56% in 2016–17 and 2014–15, respectively.
- Projects and Programmes awards produced the greatest number of publications, followed closely by Capacity Building and Leadership Enhancement awards, then Infrastructure and Networks awards (49%, 44%, and 7%, respectively).
- Health Services Research produced the greatest number of papers (n=20.6) per €1 million spend, followed by Population Health Sciences (N=15.2), Clinical Research (n=14.0), and Applied Biomedical Research (n=10.8).

Other means of scientific dissemination

- A total of 112 non-peer-reviewed publications were reported, most notably 28 technical reports, 22 invited reviews, and 16 articles in professional bulletins and magazines.
- HRB-funded award holders are very active in disseminating their work to peers at both national and international scientific events, with 1,560 activities recorded by 81% (n=138) of award holders.
- A total of 20 international and 11 national keynote presentations were reported, with the highest proportion of these being in Clinical Research (40%, n=8). A total of 127 international invited speaker addresses were reported, the highest proportion of which were in Applied Biomedical Research (38%, n=49), followed by Clinical Research (32%, n=41) and Population Health Sciences (22%, n=28).

4.1 Peer-reviewed scientific publications

Peer-reviewed publications are an important primary output from research since they communicate information to peers that allows them to build a knowledge base and validate research quality. In the 2018–19 reporting period, award holders reported a total of 792 peer-reviewed scientific publications[1] at the point of EOG. This was an average of 4.6 papers per award, which is higher than all previous reporting periods, yielding an average productivity rate of 16.0 publications per €1 million spend, or 1 paper per €126,232 spend. Figure 4.1 presents the peer-reviewed publication data over 10 years of HRB investment, where the trend towards higher levels of scientific dissemination each year can be seen.

Sixty-eight per cent (n=115) of awards that completed in 2018–19 reported at least one publication at the point of EOG; 67 of these awards reported between one and three publications; 31 awards reported between four and seven publications; 13 awards reported between eight and twenty publications; and 3 awards reported more than twenty publications. One award in particular – the PhD Scholars Programmes award – reported 206 publications over the lifetime of the grant (2007–2019). While this is, in part, attributable to the length of the award, it also demonstrates the productivity of this programme.

Over time, the total number of peer-reviewed publications and the number of publications per award are expected to rise.

[1] Publications reported by award holders in EOG reports were excluded from the analysis if the date of publication preceded the award start date; if the paper was cited as being in preparation, under revision, accepted, or in press; or if the subject matter of the paper was clearly unrelated to the research objectives.

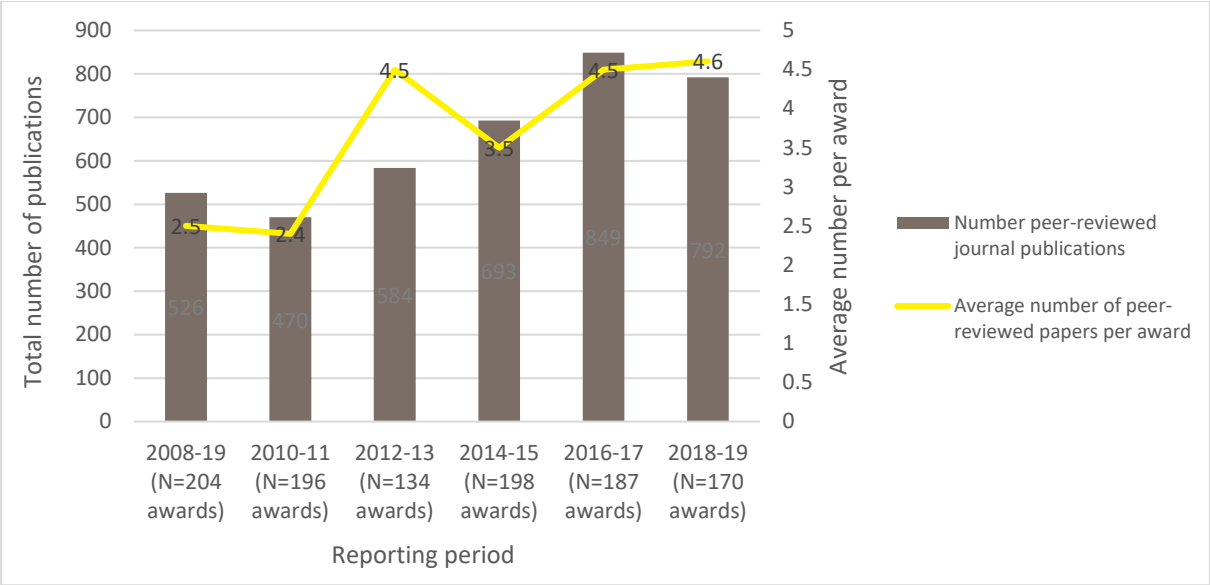


Figure 4.1: Number of peer-reviewed publications from HRB-funded awards, 2008–09 to 2018–19

4.1.1 Distribution of peer-reviewed publications, by award type

Figure 4.2 shows the distribution of peer-reviewed publications by award type for awards that completed in 2018–19 and the proportion of the total investment of €49.5 million that each award type received.

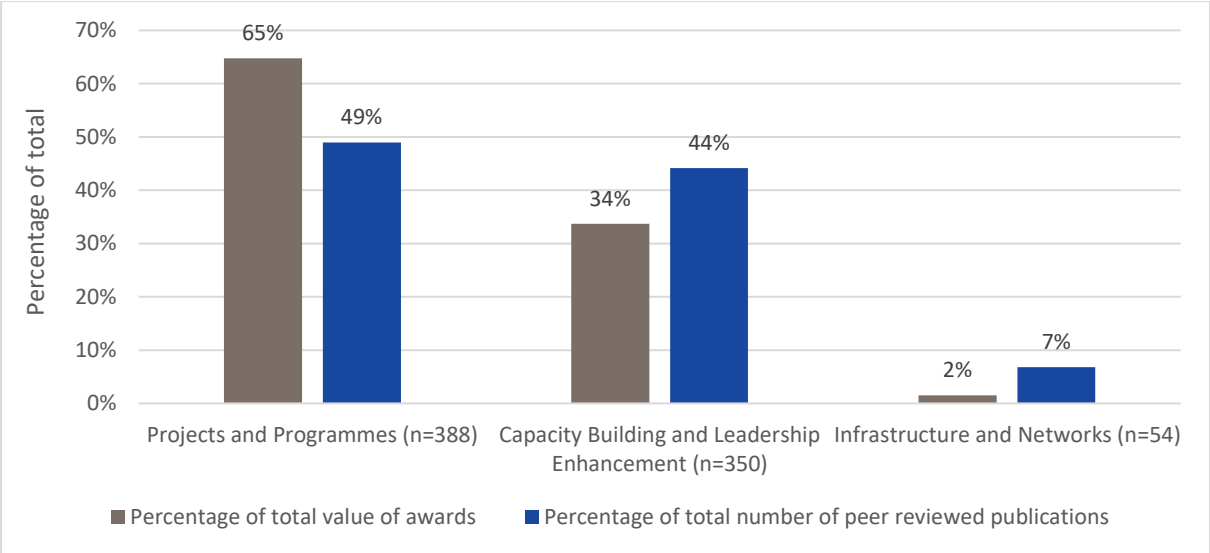


Figure 4.2: Breakdown of peer-reviewed publications, per award type, 2018–19

As shown in Figure 4.2, the single Infrastructure and Networks award (Phase 1 HRB Trials Methodology Research Network award), which received 2% of the total value of awards, was highly productive and accounted for 7% of the total number of peer-reviewed publications (n=54).

Projects and Programmes awards accounted for 65% of the total value of awards and resulted in 49% of the total number of peer-reviewed papers. This difference might be explained by the high number of Knowledge Exchange and Dissemination Scheme (KEDS) awards included in this award type, the focus of which is not on the publication of peer-reviewed articles but on other means of scientific dissemination, such as online engagement and event hosting. Capacity Building and Leadership Enhancement awards received 34% of the total value of awards and accounted for 44% of the peer-reviewed publications.

Table 4.1 looks more closely at the cost of producing these publications per €1 million spend, and the cost per paper.

Table 4.1: Breakdown of publication rate and productivity, per award type, 2018–19

Award type	Average number of papers per award	Number of papers per €1 million spend	Cost per paper
Projects and Programmes	3.0	12.1	€82,607
Capacity Building and Leadership Enhancement	8.5	21.0	€47,628
Infrastructure and Networks	54.0	71.1	€14,108

4.1.2 Distribution of peer-reviewed publications, by broad research area

Figure 4.3 shows the distribution of peer-reviewed publications by broad research area for awards that completed in 2018–19 and the proportion of the total investment of €49.5 million that awards under each broad research area received.

This shows that Health Services Research accounted for the highest proportion of peer-reviewed publications (52%, n=409) – tripling the share of publications in this research area from 17% in 2016–17 – and 40% of the funding. Clinical Research accounted for 23% (n=182.5) of the peer-reviewed publications and 26% of the total funding. Applied Biomedical Research accounted for 16% of the total publications and 23% of the funding, and Population Health Sciences accounted for 10% of both the total value of awards and the total number of peer-reviewed publications.

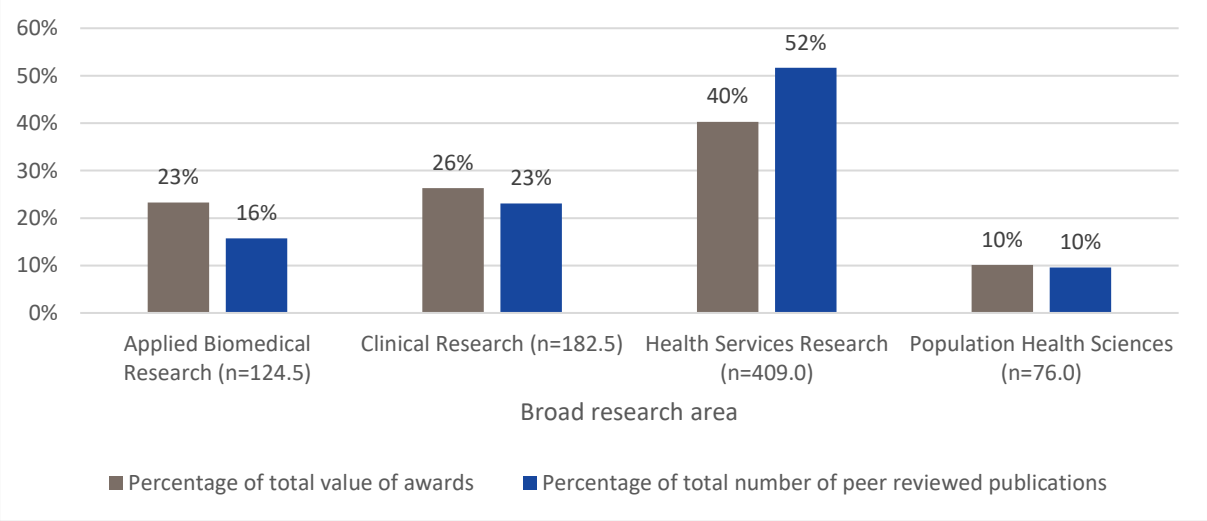


Figure 4.3: Breakdown of peer-reviewed publications, per broad research area, 2018–19

Table 4.2 illustrates the average number of peer-reviewed publications per broad research area for all awards, as well as the publication productivity in each area. In terms of productivity (defined by the number of papers produced per €1 million spend) of awards classified according to broad research area, Health Services Research produced the greatest number of papers (20.6 per €1 million spend). This replaced Population Health Sciences as the most productive research area in 2018–19 compared to 2016–17. Population Health Sciences and Clinical Research generated 15.2 and 14.0 papers per €1 million spend, respectively, followed by Applied Biomedical Research with 10.8 papers per €1 million spend.

Table 4.2: Breakdown of publication rate and productivity, per broad research area, 2018–19

Broad research area	Total number of papers	Average number of papers per award	Number of papers per €1 million spend	Cost per paper
Applied Biomedical Research	124.5	3.1	10.8	€92,604
Clinical Research	182.5	3.3	14.0	€71,344
Health Services Research	409.0	7.8	20.6	€48,755
Population Health Sciences	76.0	3.5	15.2	€65,699

4.1.3 Publishing platforms used

HRB has mandated Open Access to publications for its award holders and has been monitoring compliance with this policy since 2015. There are two main routes to making research outputs openly accessible. One involves publishing articles or books via the OA route on a publisher's platform (often referred to as gold open access). The other involves archiving a version of the manuscript in an OA repository (often described as green open access). Content published via the gold OA route is accessible immediately on publication, while manuscripts deposited via the green OA route may, in many cases, be made accessible only once a self-archiving embargo period has elapsed.

Figure 4.4 presents the type of publications that emerged from awards completed in 2018–19. Most award holders published in international peer-reviewed journals, including electronic publications (92% of total publications, n=728), and, to a much lesser extent, in national peer-reviewed journals (3% of total publications, n=26). The remaining publications were published in the Cochrane Database of Systematic Reviews (3%, n=22) and in e-Databases (2%, n=16).

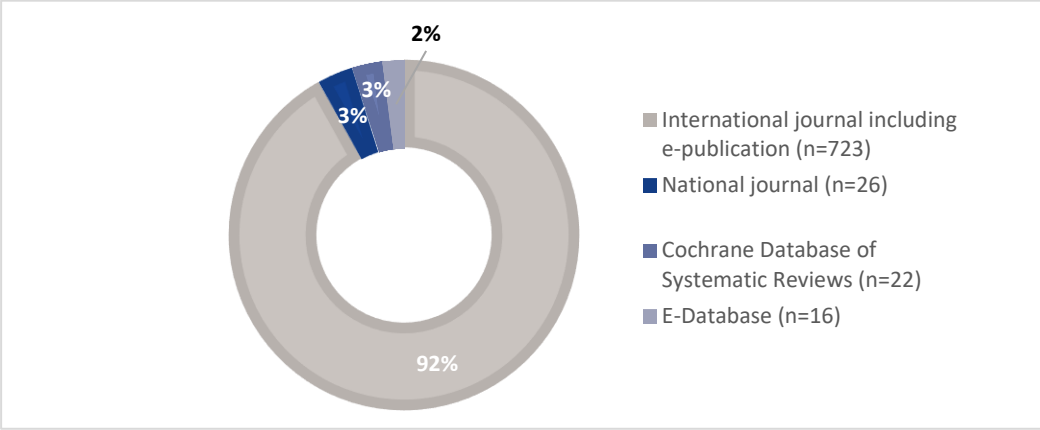


Figure 4.4: Breakdown of peer-reviewed publications, per publication platform, 2018–19

As seen in Figure 4.5, 85% (n=674) of papers were published in open access compliant journals or on open publishing platforms in 2018–19, an increase from the 2016–17 figure of 70% and the 2014–15 figure of 56%. This may reflect the HRB's advocacy efforts regarding the importance of open access and its move to mandatory open access publication in the context of the global move away from closed (paywalled) journals. The launch of the HRB Open Research publishing platform in 2018 also serves as a reputable and accepted avenue through which award holders can publish their HRB-funded research.

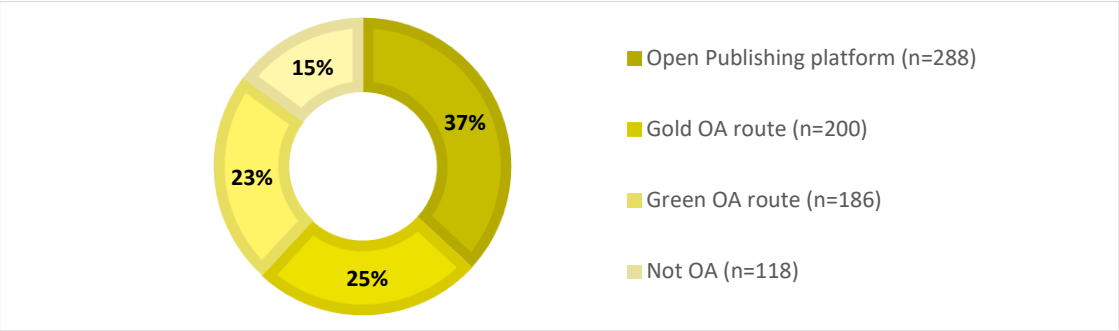


Figure 4.5: Number of publications in open access journals and on open publishing platforms, 2018–19

Award holders reported that 15% (n=118) of peer-reviewed publications were not published in open access compliant journals or on open publishing platforms. When asked for a reason, the top response by award holders was the "prohibitive cost of open access publication" (81%, n=69). Others stated that "the journal of choice is closed access only" (18%, n=2). While the HRB Open Research platform serves as a freely available open publishing platform for all HRB-funded award holders, some award holders remain under pressure (from their supervisors, institutions, or otherwise) to publish through the traditional model of high impact factor journals. These journals may not have an open access route, and if they do, the cost of open access publication may be €3,000 or more. These data from the award holders highlight the importance of continuing to reassure researchers about the validity and quality of open access publications and continuing to advocate for a focus on the open dissemination of high-quality, impactful research open dissemination in preference to closed-access publication avenues.

4.2 Other scientific publications

In addition to publications in peer-reviewed journals, HRB award holders published the outcomes of their research in a variety of ways at both national and international level (Table 4.3).

Table 4.3: Other scientific publications, 2018–19

	National	International	Total
Technical report	28	4	**32**
Invited review	13	9	**22**
Article	11	5	**16**
Journal editorial	7	8	**15**
Chapter in edited book	1	14	**15**
University publication	3		**3**
Conference abstract		3	**3**
Health report	1	1	**2**
Industry bulletin	2		**2**
Book	1		**1**
Infographic	1		**1**
Total	**68**	**44**	**112**

Of the 112 other scientific publications reported, some (such as chapters in edited books) were reviewed by peers, while others (such as articles in industry bulletins, journal editorials, blogs, and reviews for popular magazines) were not. However, even when the publication output was not peer reviewed, it still served to disseminate the results of the research to a wider audience. Many of the non-journal

publications have a significant policy or clinical practice focus. The PhD Scholars Programmes award produced 28 of the 32 technical reports and 12 of the 22 invited reviews. Collaborative Applied Research Grants awards produced the most published articles (n=9).

Table 4.4 provides a comparison of the output of other scientific publications from 2012–13 to 2018–19. While not all categories were included in previous analyses, these data do illustrate that the most common types of other scientific publications were book chapters, articles, invited reviews, and technical reports.

Table 4.4: Comparison of other scientific publications for the 2012–13 to 2018–19 reporting periods

	2018–19	2016–17	2014–15	2012–13
Chapter in edited book	13.0%	37.3%	52.5%	44.9%
Article	14.0%	7.8%	N/A*	N/A
Invited review	20.0%	6.1%	5.1%	7.2%
Technical report	29.0%	10.4%	N/A	N/A
Journal editorial	13.0%	7.0%	3.4%	5.8%
Health report	2.0%	8.7%	18.6%	18.8%
Practice manual	1.0%	0.9%	0.0%	1.4%
Book	1.0%	0.9%	N/A	N/A
Industry bulletin	0.0%	7.0%	11.9%	14.5%

* N/A – data on all metrics are not available for every reporting period.

Table 4.5 provides specific examples of publications reported by holders of awards that completed in 2018–19.

Table 4.5: Examples of other publications linked to HRB-funded awards, 2018–19

Scheme		Type of publication	Description
Health Research Awards	Projects and Programmes	Book chapter	Waeber C (2017) Cerebral Blood Flow Methods, in Primer on Cerebrovascular Diseases: Second Edition, pp 324 - 327.
Medical Education Research Grants	Capacity Building and Leadership Enhancement	Technical report	Medical Professionalism in Relation to Patient Safety: Summary Report. University College Dublin. https://www.lenus.ie/handle/10147/621274
Collaborative Applied Research Grants	Projects and Programmes	University publication	College of Medicine & Health, University College Cork. 2019. The Research Impact Anthology: Research for a Healthier Future. Cork: Author.
PhD Scholars Programmes	Capacity Building and Leadership Enhancement	Book chapter	The Research Impact Anthology: Research for a Healthier Future. University College Cork. https://www.ucc.ie/en/media/academic/medicineandhealth/UCCCollegeofMedicineandHealth_ResearchImpactAnthology_FINAL(1).pdf
		Technical report	Currie Laura 2011 Tauras J, Currie L. Chapter 6: Price, tax and tobacco use among young people. In IARC Working Group: IARC Handbooks of Cancer Prevention Volume 14: The Effectiveness of Price and Tax for tobacco

Scheme		Type of publication	Description
			control in Europe. (2011) Lyon, International Agency for Research on Cancer.
		Editorial	Ryan Padhraig 2013 Vaughan, D. and Ryan, P. (2013). "Doctors know best. Or do they?" The Consultant, Journal of the Irish Hospital Consultants Association. Spring Edition, pp 22-4
Health Research Awards	Projects and Programmes	Conference abstract	Wallace Emma 2016 Wallce E: Reflections on structured PhD training for general practitioners in Ireland. http://cmajblogs.com/reflections-on-structured-phd-training-for-general-practitioners-in-ireland
Research Training Fellowships for Healthcare Professionals	Capacity Building and Leadership Enhancement	Invited review	Informal Caregiving for Dementia Patients: The Contribution of Patient Age, Cognitive and Functional Impairment and Challenging Behaviours to Caregiver Burden Allen AP, O'Caoimh R, Daly B, Dukelow T, Calnan M, Dinan, TG, Clarke G, Molloy, DW Age and Ageing, Volume 47, Issue suppl_5, 1 September 2018, Pages v13?v60

4.3 Conference presentations

The extent to which award holders present their work to peers at national and international scientific conferences is an indicator of international involvement and recognition, and of the desire to disseminate their research results. It also facilitates networking among peers and increases the potential for future collaboration.

Of the 170 awards ending in 2018–19 that reported on their activities, 81% of award holders reported some type of scientific dissemination event at which they presented their HRB-funded research findings. This is higher than the 70% reported in 2016–17.

Importantly for networking and for academic recognition, HRB-funded award holders are very active on both the national and international scientific stages.

4.3.1 Distribution of conference presentations, by award type

Figure 4.6 looks at the number of dissemination activities per award type, and Table 4.6 looks at the number of dissemination activities per €1 million spend per award type.

From a total of 1,560 dissemination activities, poster presentations (n=672) and oral presentations (n=633) at national and international conferences accounted for the highest number of outputs across all award types. Projects and Programmes accounted for more than one-half of these presentations, with 406 poster and 340 oral presentations, demonstrating the extent of activity occurring at project level and the level of active scientific dissemination being coordinated by these HRB-funded award holders.

Other indicators of scientific recognition and prestige include being invited to participate in a conference, to chair a scientific session at a conference, or to become involved in the organising committee for a conference. HRB award holders performed well in all these indicators, both nationally and internationally and across all award types. In total, HRB award holders reported 212 invitations to speak at 85 national and 137 international scientific conferences; this was significantly higher than the 98 speaker invitations

reported in 2016–17. Projects and Programmes accounted for 169 (80%) of these activities. HRB award holders chaired one national scientific session and four international scientific sessions and participated in the organising committees of two national and four international scientific conferences.

Invitations to deliver keynote presentations at international conferences are also an important indicator of scientific recognition and prestige among the international scientific community. HRB award holders whose awards completed in 2018–19 delivered a total of 31 keynote presentations at national and international scientific conferences. Keynote presentations reported in 2018–19 were predominantly held internationally (n=20), and Projects and Programmes awards again accounted for most of this activity (96%, n=30), with the remaining keynote presentation categorised as a Capacity Building and Leadership Enhancement award.

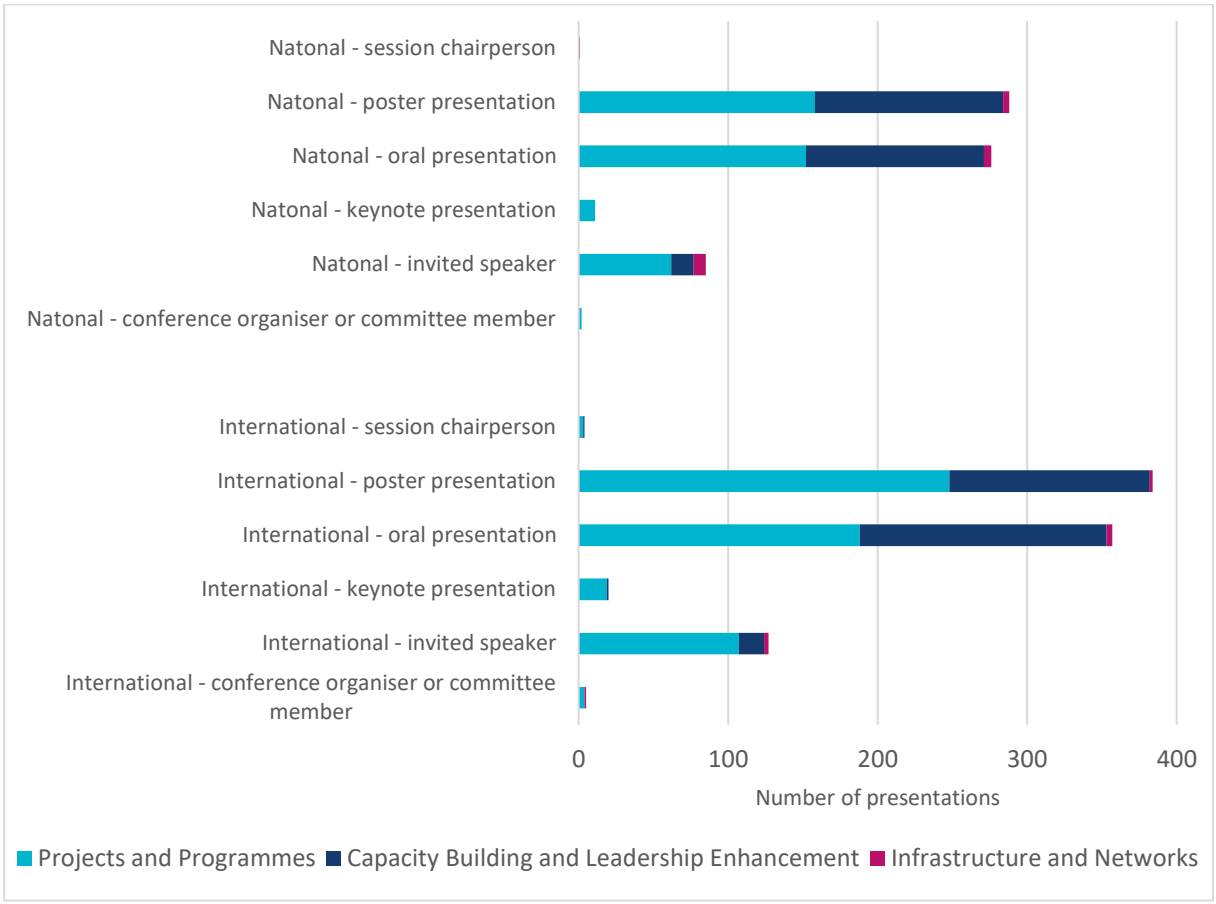


Figure 4.6: Number and type of scientific presentations, per award type, 2018–19

In terms of scientific productivity, Table 4.6 shows that Projects and Programmes award holders reported international poster presentations as their most productive output (7.7 presentations per €1 million spend), followed by international oral presentations (5.9 presentations per €1 million spend.) The pattern was reversed for Capacity Building and Leadership Enhancement awards, where international oral presentations were reported as their most productive output (9.9 presentations per €1 million spend), followed by international poster presentations (8.0 presentations per €1 million spend).

The single Infrastructure and Networks award reported national invited speaker presentations as its most productive output (10.5 presentations per €1 million spend), demonstrating the interest and engagement of the HRB Trials Methodology Research Network in Ireland.

Table 4.6: Number of scientific presentations per €1 million spend, by presentation type and award type, 2018–19

	Projects and Programmes	Capacity Building and Leadership Enhancement	Infrastructure and Networks
Conference organiser or committee member – international	0.1	0.0	1.3
Conference organiser or committee member – national	0.1	0.0	0.0
Invited speaker – international	3.3	1.0	3.9
Invited speaker – national	1.9	0.9	10.5
Keynote presentation – international	0.6	0.1	0.0
Keynote presentation – national	0.3	0.0	0.0
Oral presentation – international	5.9	9.9	5.3
Oral presentation – national	4.7	7.1	6.6
Poster presentation – international	7.7	8.0	2.6
Poster presentation – national	4.9	7.5	5.3
Session chairperson – international	0.1	0.1	0.0
Session chairperson – national	0.0	0.0	1.3
Total	**29.7**	**34.6**	**36.8**

Values greater than 6.0 presentations per €1 million spend shaded in pink

4.3.2 Distribution of conference presentations, by broad research area

Figure 4.7 looks at the number of scientific dissemination outputs at national and international conferences per broad research area, while Table 4.7 looks at the number of scientific dissemination outputs at national and international conferences per €1 million spend per broad research area.

Health Services Research reported the highest number of outputs (n=608) from the total of 1,560 dissemination outputs in this reporting period, a first for this broad research area. Oral and poster presentations at national and international conferences accounted for most of these outputs. This was followed by Clinical Research with 3789 outputs, Applied Biomedical Research with 366 outputs, and Population Health Sciences with 208 outputs.

Clinical Research awards reported the highest number of keynote presentations (n=11), an important indicator of international credibility and prestige, followed by Health Services Research awards (n=9). This is different to the 2016–17 report, where Population Health Sciences reported the highest number of these outputs.

There were many recorded invitations to speak at both national and international conferences (n=212). Applied Biomedical Research reported the highest number of international speaker invitations (n=48.5), followed by Clinical Research (n=41.0), Population Health Sciences (n=28.0), and Health Services Research (n=9.5).

Population Health Sciences reported 9.7 international poster presentations and 8.3 international oral presentations per €1 million spend. Population Health Sciences award holders reported 5.6 international invited speaker presentations per €1 million spend – nearly twice the return compared to Clinical Research and 10 times the return compared to Health Services Research.

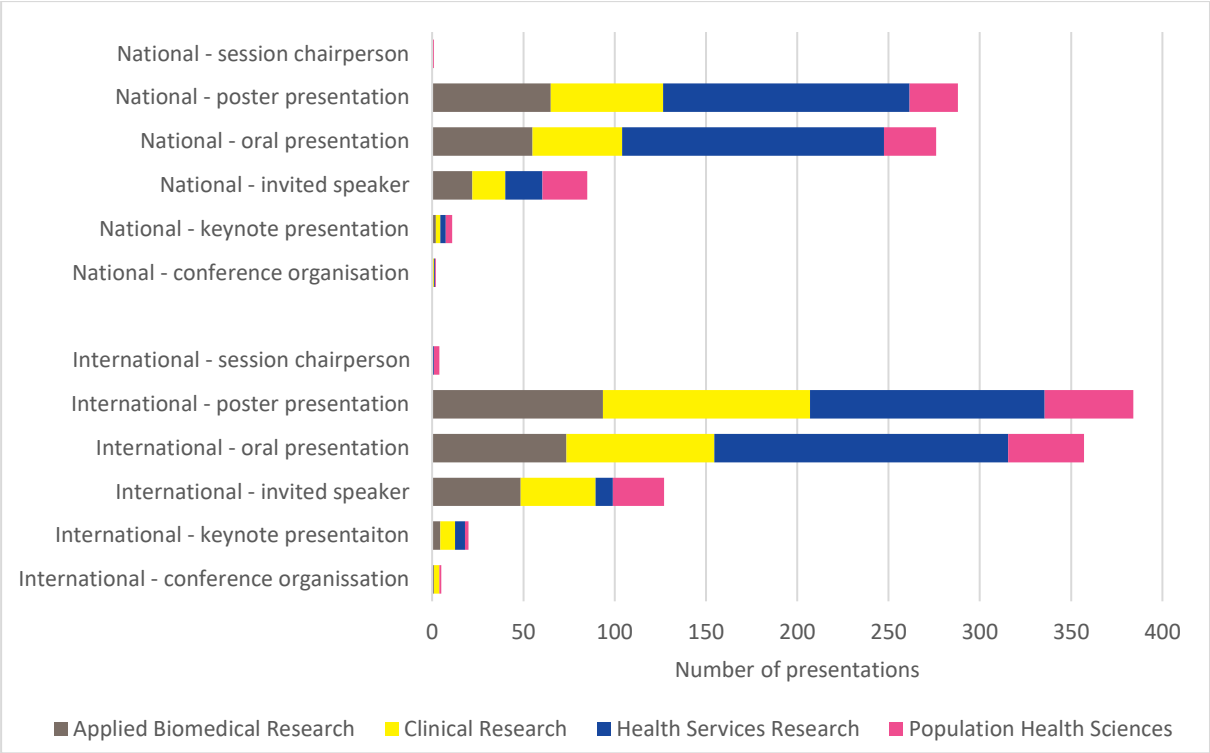


Figure 4.7: Number and type of scientific presentations, per broad research area, 2018–19

Table 4.7: Type of scientific presentation per €1 million spend, by broad research area, 2018–19

	Applied Biomedical Research	Clinical Research	Health Services Research	Population Health Sciences
Conference organiser or committee member – international	0.1	0.2	0.0	0.2
Conference organiser or committee member – national	0.0	0.0	0.0	0.1
Invited speaker – international	4.2	3.2	0.5	5.6
Invited speaker – national	1.9	1.4	1.0	4.9
Keynote presentation – international	0.4	0.6	0.3	0.4
Keynote presentation – national	0.2	0.2	0.2	0.7
Oral presentation – international	6.4	6.2	8.1	8.3
Oral presentation – national	4.8	3.8	7.2	5.7
Poster presentation – international	8.1	8.7	6.5	9.7
Poster presentation – national	5.7	4.7	6.8	5.3
Session chairperson – international	0.0	0.0	0.1	0.6
Session chairperson – national	0.0	0.0	0.0	0.1

Values greater than 6.0 presentations per €1 million spend shaded in pink

Table 4.8 shows the breakdown of dissemination activities per scheme in order to highlight the full extent of award holders' activities. The total number of awards granted under each scheme is in parentheses next to the scheme name. Health Research Awards and PhD Scholars Programmes accounted for most oral presentations and poster presentations.

Table 4.8: Breakdown of scientific presentation activities, per scheme, 2018–19

Scheme	Conference organiser	Invited speaker	Keynote presentation	Oral presentation	Poster presentation	Session chair	Total
Health Research Awards (n=61)	3	79	16	185	245	3	**531**
PhD Scholars Programmes (n=1)		5		146	170		**321**
Collaborative Applied Research Grants (n=4)		38	5	63	57		**163**
Research Training Fellowships for Healthcare Professionals (n=15)		12	1	75	35		**123**
MRCG-HRB Joint Funding Scheme (n=9)		19	1	22	38		**80**
Knowledge Exchange and Dissemination Scheme (n=38)	3	11	1	23	19		**57**
Translational Research Awards (n=3)		10	6	19	7		**42**
National SpR/SR Academic Fellowship Programme (n=2)		7		13	14		**34**
HRB Trials Methodology Research Network (n=1)	1	11		9	6	1	**28**
Applied Research Projects in Dementia (n=2)		3	1	11	10		**25**
Cochrane Training Fellowships (n=15)		1		8	15		**24**
Clinician Scientist Awards (n=1)		4		5	13		**22**
Research Collaborative in Quality and Patient Safety (n=2)		5		6	8		**19**
Medical Education Research Grants (n=2)		1		11	4	1	**17**
Research Leader Awards (n=1)				13	2		**15**
Interdisciplinary Capacity Enhancement Awards (n=2)				12	3		**15**
Applied Partnership Awards (n=2)		2		6	6		**14**
Joint Programming Initiative in Neurodegenerative Diseases (n=2)				3	8		**11**
Cancer Prevention Fellowship Programme (n=2)		2		1	4		**7**
Project Development Grant (n=3)		2		1	4		**7**
Investigator Led Projects (n=2)				1	4		**5**
Total	**7**	**212**	**31**	**633**	**672**	**5**	**1,560**

5 Capacity building and leadership

A key strategic objective for the HRB is to embed research into the health system by:

- Building capacity for research among health professionals and other professionals who can contribute to a multidisciplinary research environment
- Supporting young researchers as they progress to become independent investigators, and
- Supporting established researchers to strengthen their reputation as world leaders in their field.

Measures of success in terms of capacity building include the development of not only human capacity, but also indicators of the extent to which HRB award holders are advancing their field, and the quality and impact of award holders' research as perceived by their peers through recognition and academic awards.

Summary of capacity building outputs, 2018–19, compared to previous reporting periods

Research capacity building	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Human capacity outputs						
Total number of research-related posts created	451	329	385	422	280	296
Number of PhD students trained	103	77	93	133	72	88
Number of postdoctoral researchers supported	136	124	154	130	92	112
Percentage of cohort from health professional background	39.0%	40.1%	43.6%	32.2%	29%	N/A*
Average number of posts per award	2.7	1.8	1.9	3.1	1.4	1.4
Recognition and academic awards						
Percentage of awards reporting indicators of peer recognition	44.0%	53.5%	42.9%	70.0%	75.0% (2011 only)	N/A*

* N/A – data on all metrics are not available for every reporting period.

Key findings

Posts created via HRB awards

- In total, 451 research-related posts were created. Of these, 39.0% of positions were filled by people from a health professional background (medical doctors, nurses, and allied health professionals).
- The majority of the 451 research-related roles were at postdoctoral level (n=136) and research assistant level (n=130).
- Projects and Programmes awards accounted for 74% of the posts created (n=335), representing 10.4 posts per €1 million spend. Capacity Building and Leadership Enhancement awards accounted for 25% of the total number of posts created (n=114), with 6.8 posts per €1 million spend. The Infrastructure and Networks award accounted for 0.5% of the posts created, with 2.6 posts per €1 million spend.
- For the first time, Health Services Research accounted for the most posts created (n=202, 45%), followed by Clinical Research (n=127, 28%), Applied Biomedical Research (n=81, 18%), and Population Health Sciences (n=41, 9%).

- A total of 103 people were enrolled in PhD programmes, chiefly in the PhD Scholars Programmes, and 6 received master's degrees.

Next destination

- By far the most common sector for follow-on employment was academia (n=284). The remainder of the personnel were employed in clinical practice (n=55), other professions (n=60) or in industry (n=52).
- The most common follow-on roles were as a postdoctoral researcher (n=87), in a PhD position (n=39), or in research management (such as data managers and biostatisticians) (n=39).
- Thirty-nine people were recorded as lecturers at third-level institutions, 30 people had taken up roles in the health services, and 21 people were employed as research assistants. Eighteen people were now working as full-time medical doctors; 2 as full-time clinical nurses or midwives; and 5 in allied health professional roles, including dietitians, physiotherapists, and psychologists.
- Following completion of their HRB-funded award, 51 people had secured employment in the private sector, characterised as 'industry'. Most of these people had a background in biomedical science. This is a strong indicator that the skills development and training acquired by people who participated in HRB awards had value outside of academia and the health system.
- Most personnel (87%, n=392) were employed in Ireland or Northern Ireland, while the remainder moved overseas, with the United Kingdom as the most popular destination.

Awards, prizes, and other recognition

- A total of 324 awards, prizes, and other forms of recognition were reported by 44% of the award holders. Research prizes, medals, or other forms of acclaim were the most common types of recognition reported. HRB award holders were also invited to contribute as keynote speakers internationally, to sit on organising committees of international scientific conferences, and to participate in international scientific bodies such as scientific advisory committees.
- Twenty award holders were appointed to the editorial boards of journals or book series, and 32 were invited onto scientific conference organising committees.
- Thirteen people received prestigious/honorary positions with an external body.
- The types of awards and recognition that HRB and Medical Research Council (MRC) award holders attracted were very similar, despite the different scales and remits of these organisations.

5.1 Personnel outputs

5.1.1 Types of personnel funded

In total, 451 research-related posts were supported by the 170 HRB awards analysed in this report that completed in 2018–19. A breakdown of the role and academic level of personnel in these awards is shown in Figure 5.1.

Of the 451 posts, 136 were employed as postdoctoral researchers (with varying levels of experience); 130 as research assistants; 92 as PhD students; 30 as research fellows; and 63 across a mix of other posts, including research nurses, midwives, allied health professionals, research support staff, professors,

associate professors, and research administrators. Research support staff included the roles of data manager, biostatistician, and quality and regulatory affairs manager.

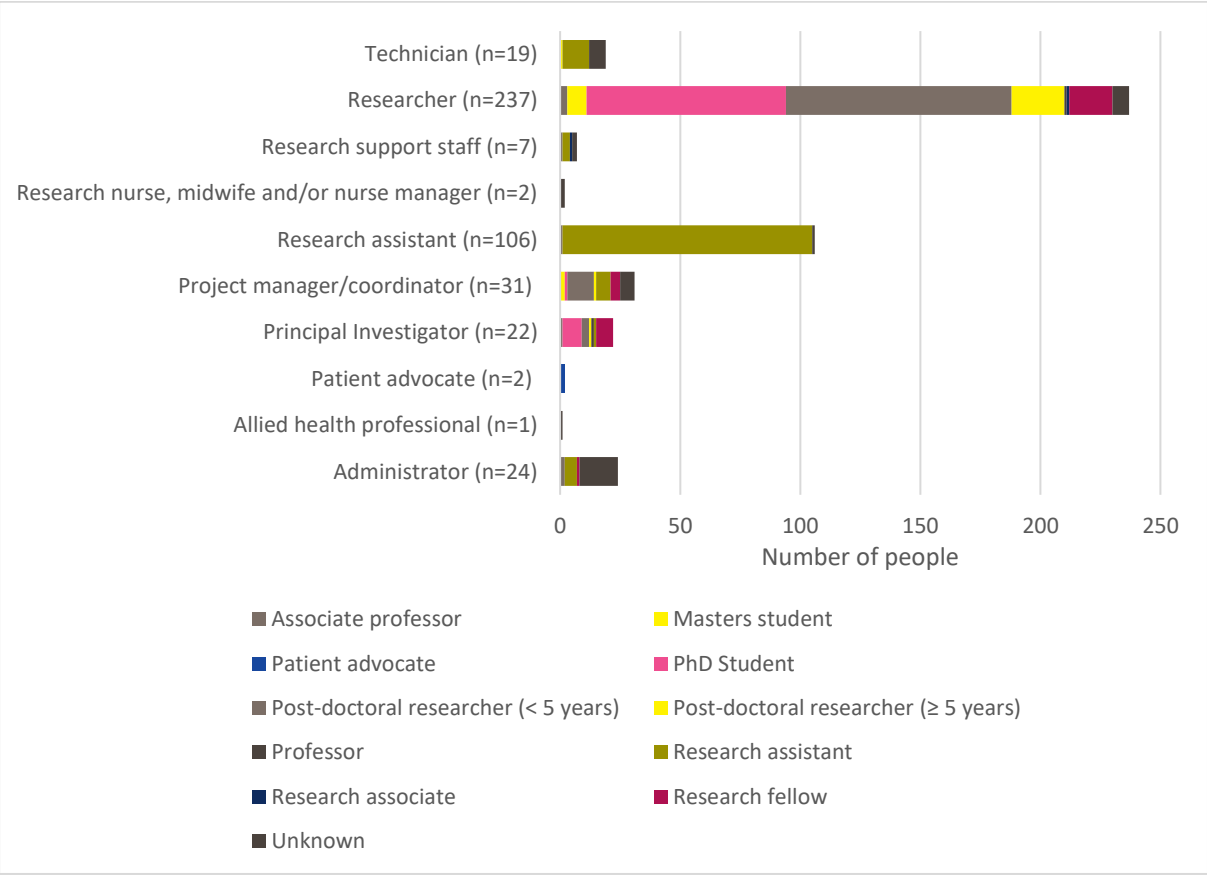


Figure 5.1: Employment level versus role of personnel supported on awards, 2018–19

Examining these figures in greater detail revealed that the majority of those employed at postdoctoral level worked as researchers on the awards (n=116 of 136 total). However, not all of these people had a PhD. The remainder of those reported to be working at postdoctoral level were employed as project managers (n=11), principal investigators (n=3), administrators (n=2), research support staff (n=1), and as a research assistant (n=1).

There were 130 people employed at research assistant level. Most of these people (n=104) were reported to be working in a research assistant role on the award. Of the remaining 26 people, 11 were employed as technicians, 6 as project managers, 5 as administrators, 3 as research support staff, and 1 as a principal investigator.

There were 92 people employed at PhD level. Of these, 83 worked as researchers on the awards, 8 were reported as the principal investigator of the award, and 1 was a project manager. The principal investigator positions related to Research Training Fellowships for Healthcare Professionals awards (n=19), one National SpR/SR Academic Fellowship Programme award, one Knowledge Exchange and Dissemination Scheme award, and one Cochrane Training Fellowships award.

These differences between the level of employment compared to the role the same individuals fulfilled on the award is notable, such as project managers working at PhD student level, research assistant level, or postdoctoral level, depending on the award. Streamlining the appropriate level of employment compared to the role filled might help to retain staff in research, prevent employee attrition from the field, and provide clarity in terms of career structure.

When examining the data with a focus on the reported role of personnel, 'researcher' was the most common research post reported (53%, n=237). This role profile consisted of, in order of descending proportion, postdoctoral researchers of varying degrees of experience (n=116), PhD students (n=83), research fellows (n=18), and master's students (n=8). There were 106 personnel recorded as research assistants; 31 as project managers; 24 as administrators; 22 as principal investigators; 19 as technicians; 7 as research support staff; 2 as research nurses; 2 as patient advocates; and 1 as an allied health professional. This array of roles highlights the breadth of expertise required in order for health research to take place and demonstrates the diverse array of employees supported by the HRB.

5.1.2 Distribution of posts, by award type

Figure 5.2 shows the broad distribution of posts across HRB award types in 2018–19, while Figure 5.3 shows the distribution of posts supported by HRB awards, broken down by role on award and award type. Table 5.1 shows the breakdown of the average cost of posts per €1 million spend in order to provide a normalised picture of posts created, by award type.

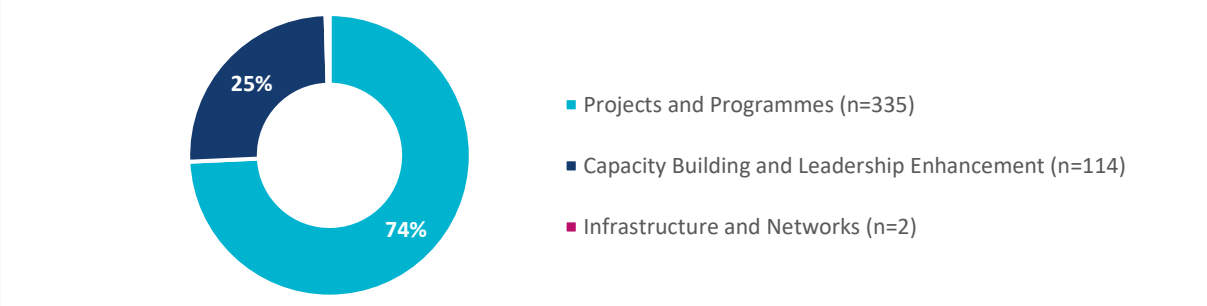


Figure 5.2: Breakdown of total number of posts created, per award type, 2018–19

Overall, Projects and Programmes awards accounted for 74% (n=335) of the posts created through HRB awards that completed in 2018–19, from a total investment in this area worth €32.1 million. There were 10.4 posts created per €1 million spend. Posts were primarily for researchers (n=170), research assistants (n=97), project managers (n=30), and technicians (n=17). It is worth noting that Projects and Programmes awards supported roles in all categories except for the allied health professional category.

Capacity Building and Leadership Enhancement awards created 114 posts (25%) for an investment of €16.7 million, or 6.8 posts per €1 million spend. Most of these posts were for researchers (n=67), with the PhD Scholars Programmes award accounting for 45 PhD students, 17 principal investigators, and 15 administrators.

The Infrastructure and Networks award created two posts (0.5%) for an investment of €760,835, or 2.6 posts per €1 million spend. Given that this is the HRB Trials Methodology Research Network award, it is unsurprising that just two positions (a project manager and an administrator) were filled.

Compared to 2016–17, there was a higher average number of posts per grant across all award types. For awards ending in 2018–19, there were an average of 2.7 posts created per grant, compared to 1.8 in 2016–17.

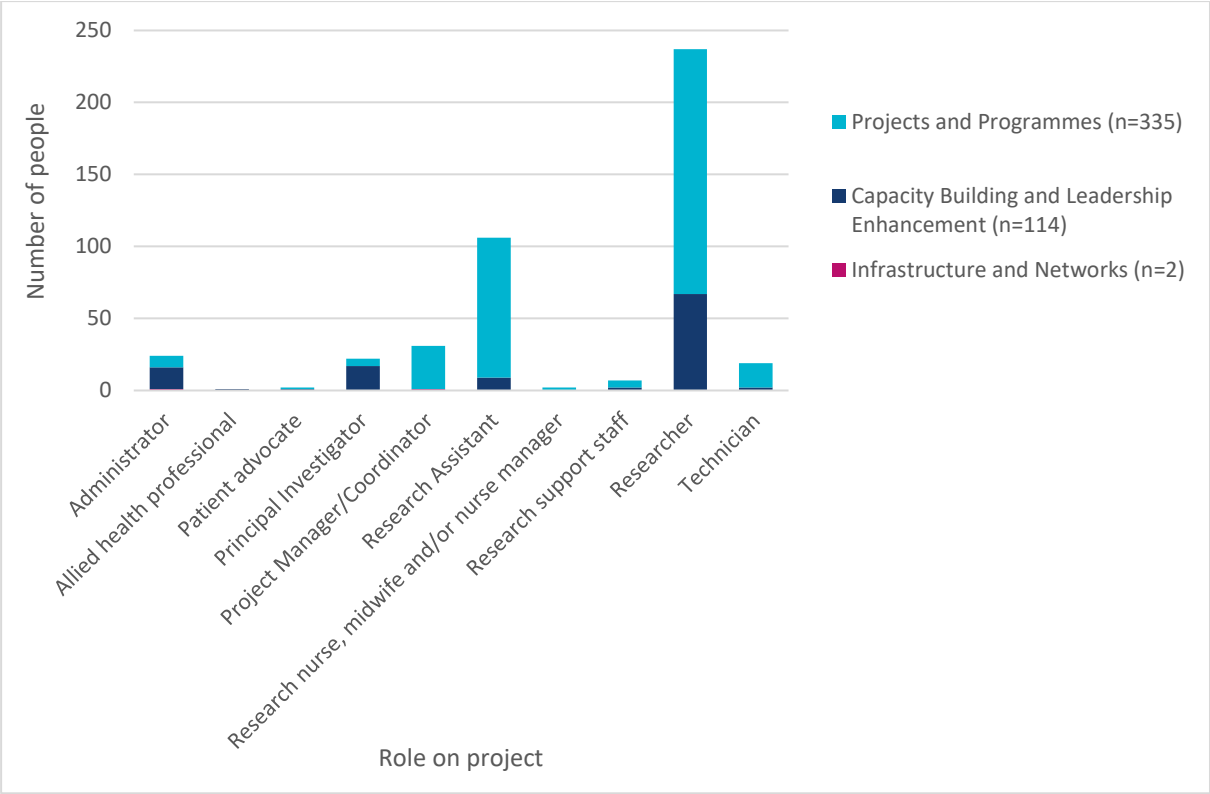


Figure 5.3: Number and role of personnel funded, per award type, 2018–19

Table 5.1: Breakdown of number of posts and productivity, per award type, 2018–19

Award type	Value of awards	Percentage of total value of awards	Number of posts	Percentage of total number of posts	Number of posts per €1 million spend
Projects and Programmes	€32,051,601	64.7%	335	74.5%	10.4
Capacity Building and Leadership Enhancement	€16,669,831	33.7%	114	25.0%	6.8
Infrastructure and Networks	€761,835	1.6%	2	0.5%	2.6
Total	**€49,483,267**	**100%**	**451**	**100%**	**17.2**

5.1.3 Distribution of posts, by broad research area

Figure 5.4 shows the distribution of total numbers of posts created by broad research area. When compared to the number of posts in each broad research area in previous reporting periods, the number of posts in Health Services Research, Population Health Sciences, and Clinical Research are increasing substantially every year, while there has only been a modest increase in the number of posts in Applied Biomedical Research. For the first time, the combination of Health Services Research and Population Health Sciences posts account for over 50% of all positions supported. This reflects the growing level of investment that the HRB has been making in these areas since 2001.

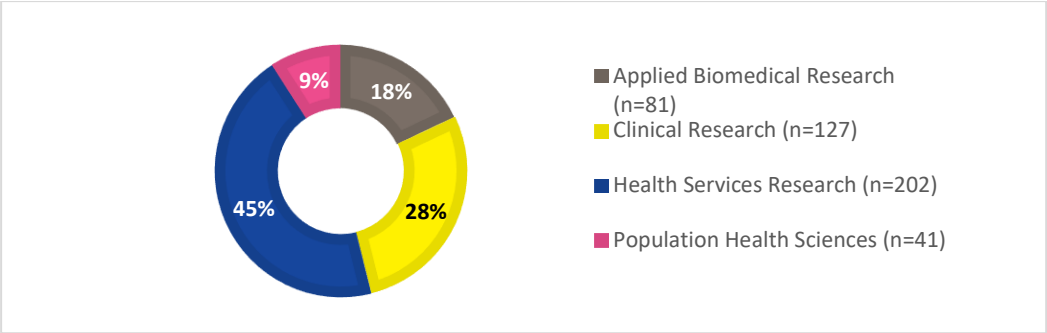


Figure 5.4: Breakdown of total number of posts created, per broad research area, 2018–19

Figure 5.5 shows the type of posts being supported by HRB awards, by broad research area. Table 5.2 shows the breakdown of post types and number of posts per €1 million spend, by broad research area.

For the first time, posts associated with Health Services Research (45%, n=202) accounted for the highest proportion of positions filled. This was followed by Clinical Research (28%, n=127), Applied Biomedical Research (18%, n=81), and Population Health Sciences (9%, n=41). Researchers and research assistants accounted for the most positions across all research areas.

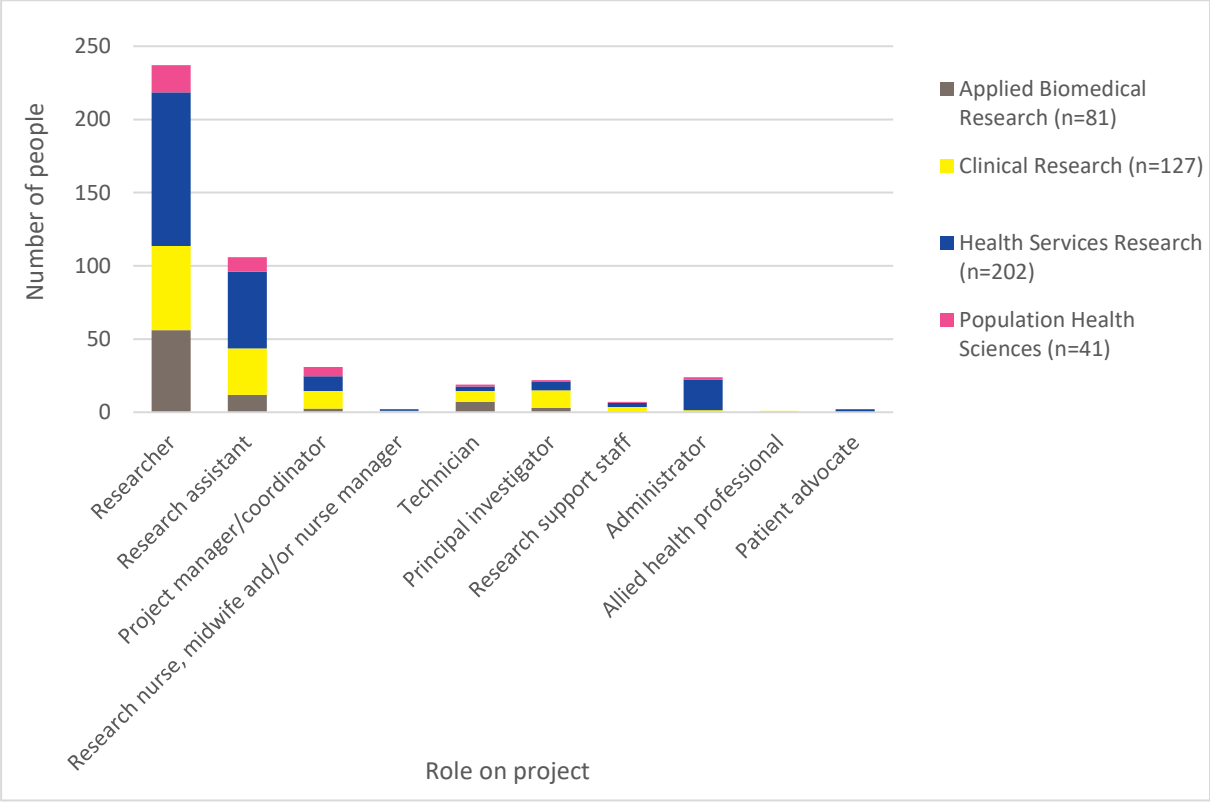


Figure 5.5: Number and role of personnel, per broad research area, 2018–19

Health Services Research awards were the most productive in terms of the number of posts created per €1 million spend, with 10.2 posts per €1 million spend, followed closely by Clinical Research awards with 9.8 posts per €1 million spend (Table 5.2). This high trend in Health Services Research echoes the previous 2016–17 reporting period, when 11.2 posts per €1 million spend were created by Health Services Research awards. Population Health Sciences awards generated 8.2 posts per €1 million spend in 2018–19, a higher figure than for the 2016–17 reporting period (6.9 posts per €1 million spend), followed by Applied Biomedical Research with 7.0 posts per €1 million spend.

Table 5.2: Breakdown of number of posts and productivity, per broad research area, 2018–19

Award type	Value of awards	Percentage of total value of awards	Number of posts	Percentage of total number of posts	Number of posts per €1 million spend
Applied Biomedical Research	€11,529,224	23%	81	18%	7.0
Clinical Research	€13,020,262	26%	127	28%	9.8
Health Services Research	€19,940,672	40%	202	45%	10.2
Population Health Sciences	€4,993,110	10%	41	9%	8.2
Total	**€49,483,267**	**100%**	**451**	**100%**	**9.7**

Tables 5.3 and 5.4 provide a comparison by broad research area of the share of postgraduate students (Table 5.3) and postdoctoral researchers (Table 5.4) associated with HRB awards from 2008–09 to 2018–19. The figures are presented as a percentage of the total number of posts created for each 2-year reporting period. Overall, the HRB awards ending in 2018–19 reported that 20% of post holders, a total of 103 people, were postgraduate students, including 45 people in the PhD Scholars Programmes.

Table 5.3: Comparison of share of postgraduate students*, per broad research area, 2008–09 to 2018–19

Broad research area	2018–19	2016–17	2014–15	2012–13	2010–11	2008–09
Basic Biomedical Research	0%	0%	0%	4%	11%	15%
Applied Biomedical Research	16%	26%	26%	63%	39%	39%
Clinical Research	25%	34%	22%	18%	18%	18%
Health Services Research	55%	26%	28%	14%	24%	17%
Population Health Sciences	4%	15%	14%	1%	8%	11%

* Includes all people registered for a PhD or Masters (MSc) regardless of whether they were categorised as postgraduate students or another personnel type by the PI at the time of reporting.

Table 5.4: Comparison of share of postdoctoral researchers*, per broad research area, 2008–09 to 2018–19

Broad research area	2018–19	2016–17	2014–15	2012–13	2010–11	2008–09
Basic Biomedical Research	0.0%	0.0%	1.3%	11.8%	24.0%	29.0%
Applied Biomedical Research	33.0%	27.8%	40.3%	44.1%	59.0%	55.0%
Clinical Research	28.0%	37.1%	30.8%	21.8%	11.0%	11.0%
Health Services Research	30%	21.0%	19.2%	17.7%	4%	2%
Population Health Sciences	9.0%	14.1%	8.4%	4.5%	2.0%	4.0%

* Excludes all people registered for a PhD or MSc (even if categorised as postdoctoral by the PI at the time of reporting), and people categorised as administrators, technicians, or research assistants.

Taken together, the data show a continuing and significant decrease in the proportion of postgraduates and postdoctoral researchers funded in Basic Biomedical Research from 2008 to 2019. The share of postgraduate students in awards categorised as Applied Biomedical Research has also decreased compared to previous reporting periods (16% in 2018–19 compared to 26% in 2016–17 and 2014–15). Conversely, the share of both postgraduate students and postdoctoral researchers in Health Services Research has been steadily increasing since 2008–09. Tables 5.3 and 5.4 demonstrate that the HRB's efforts to promote research in the area of Health Services Research is driving job creation. These trends are illustrated in Figures 5.6 and 5.7.

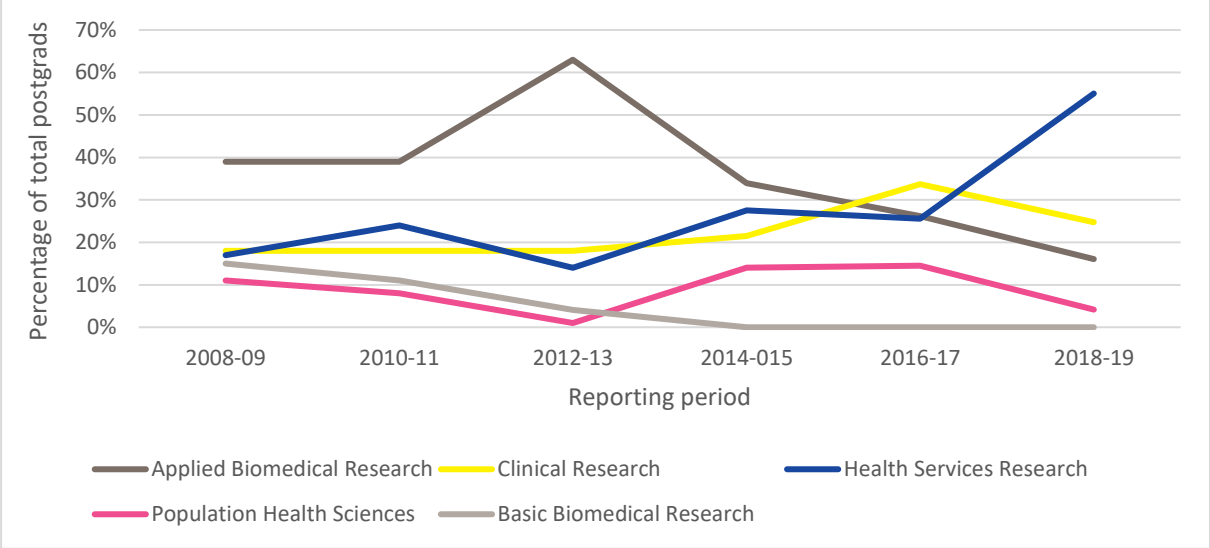


Figure 5.6: Comparison of the share of postgraduate students, per broad research area, 2008–09 to 2018–19

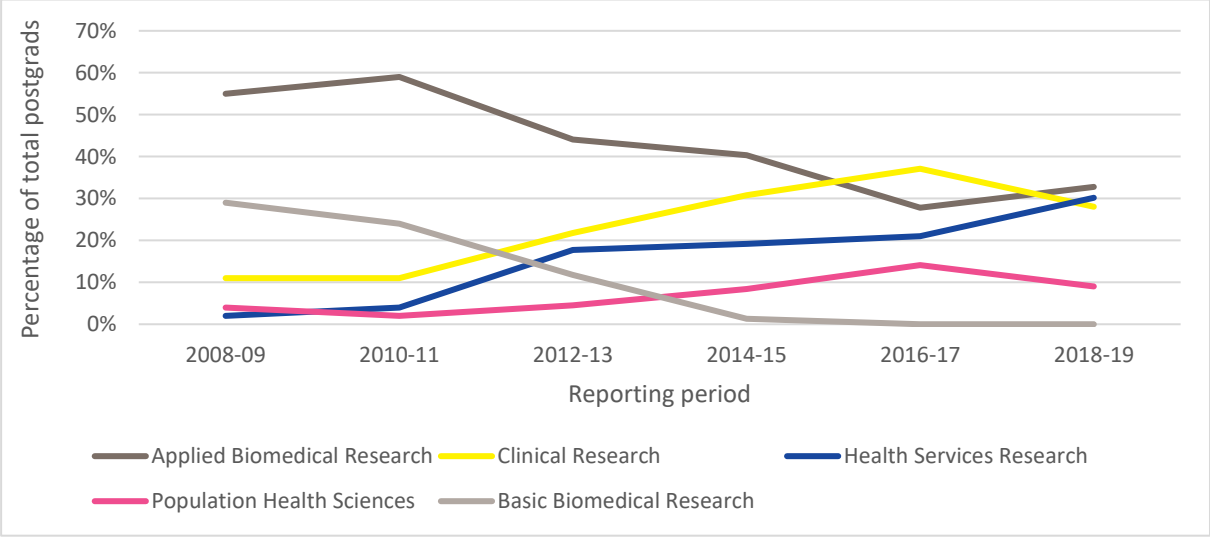


Figure 5.7: Comparison of the share of postdoctoral researchers, per broad research area, 2008–09 to 2018–19

5.2 Professional background of personnel

An ambition of the *HRB Strategy 2016-2020* was to increase the number of non-biomedical researchers (health professionals, economists, biostatisticians, systems engineers, epidemiologists, etc.) engaged in research at some level, either in training or as researchers. Table 5.5 presents a breakdown of the

professional background of personnel employed on HRB-funded awards that completed in 2018–19, by the type of scheme through which these personnel were employed. These data demonstrate that the ambition of the HRB strategy was realised in the awards that finished in 2018–19.

Table 5.5: Professional background of personnel employed on HRB awards, per award type, 2018–19

Professional background	Projects and Programmes	Capacity Building and Leadership Enhancement	Infrastructure and Networks	Total
Administration	1	12		**13**
Architecture	1			**1**
Bioinformatics	3			**3**
Biomedical science	105	6		**111**
Business studies		1		**1**
Clinical research	1			**1**
Communications	2			**2**
Dentistry*	11	2		**13**
Dietetics/nutrition*	5	2		**7**
Engineering	4			**4**
Epidemiology and public health	8	1		**9**
Health economics	17	5		**22**
Human resources	1			**1**
Humanities	3	1		**4**
International relations	1			**1**
IT	12	1		**13**
Laboratory technical	3			**3**
Medicine/surgery*	15	4		**19**
Nursing or midwifery (including clinical research nursing)*	14	7		**21**
Occupational therapy*	1	3		**4**
Pharmacy or pharmacology*	6	1		**7**
Physiotherapy*	11	8		**19**
Politics/academic sociology	5			**5**
Psychology or behavioural sciences*	72	4		**76**
Radiography*	1			**1**
Social care or social services*	2	2		**4**
Social science	2	3		**5**
Speech and language therapy*	4	1		**5**
Statistics or mathematics	7	3		**10**
Teaching and education	2			**2**
Unknown	15	47	2	**64**
Total	**335**	**114**	**2**	**451**

*Entries included in health and care professional figures.

Of the 451 personnel reported, 56 came from a non-health or science background, representing 12% of the personnel cohort. These people were primarily employed in Projects and Programmes awards. The list of positions in non-health and care-related professions is diverse and includes those trained in information and communication technology (ICT) (n=13), administration (n=13), politics and academic sociology (n=5), and engineering (n=4), as well as people trained in communications, business studies, architecture, and human resources (n=5).

In total, 176 people (39%) came from health and care-related backgrounds, including medical doctors, nursing and midwifery professionals, and allied health professionals. Those with a scientific or social sciences background accounted for 27% of the total personnel cohort (n=122). This is the first reporting year where those with a health and care-related background accounted for a higher proportion of staff compared to those with a scientific or social sciences background. Notably, a total of 64 people (14%) did not record a background profession or training, which should be kept in mind when interpreting these figures.

Most of the staff were employed on Projects and Programmes awards (n=335), while 114 were employed through Capacity Building and Leadership Enhancement awards and 2 were employed on Infrastructure and Networks awards. Most staff working in Projects and Programmes were from a scientific background. Unfortunately, a high number of unknowns (n=47, 41%) were reported for background information on Capacity Building and Leadership Enhancement awards.

It is also interesting to look at the professional backgrounds of personnel employed across the broad research areas (Table 5.6).

As outlined previously, Health Services Research employed the highest number of staff (n=202) in the awards ending in 2018–19. Many of these personnel were from a psychology or behavioural science background (n=43.5), followed by nursing and/or midwifery (n=6.0), and health economics (n=17.0). This reflects the desired change in staffing make-up that was outlined in the *HRB Strategy 2016-2020*.

Clinical Research employed 127.0 people, primarily from a biomedical sciences background (n=35.0), a medical or surgical background (n=10.0), psychology (n=20.0), and nursing and/or midwifery (n=10.0). This distribution is as expected for the completion of clinical research. Population Health Sciences research posts were mainly from a psychology background (n=12.5).

Most significantly and reflecting the HRB's increased emphasis on the areas of Population Health Sciences and Health Services Research, there were 9 epidemiologists, 22 health economists, and 10 statisticians engaged in HRB projects over the reporting period. These figures reflect an increasing trend towards employing individuals with these backgrounds compared to 2016–17.

For personnel who came from non-biological or non-health backgrounds, the majority were employed on awards categorised as Health Services Research (n=69.0) and Clinical Research (n=15.5).

Table 5.6: Professional background of personnel on HRB-funded awards, per broad research area, 2018–19

Professional background	Applied Biomedical Research	Clinical Research	Health Services Research	Population Health Sciences	Total
Architecture	0	0	1	0	**1**
Bioinformatics	3	0	0	0	**3**
Biomedical science	64	35	7	5	**111**
Business studies	0	0	1	0	**1**
Clinical research	0.5	0.5	0	0	**1**
Communications	0	1.5	0.5	0	**2**
Dentistry*	0	2	11	0	**13**
Dietetics/nutrition*	0	5	2	0	**7**
Engineering	1	3	0	0	**4**
Epidemiology and public health	0	0.5	8	0.5	**9**
Health economics	0	2.5	17	2.5	**22**
Human resources	0	0	1	0	**1**
Humanities	0	0	4	0	**4**
International relations	0	0	1	0	**1**
Information Technology	0	2	9	2	**13**
Laboratory technician	1.5	0.5	1	0	**3**
Medicine/surgery*	6	10	1	2	**19**
Nursing or midwifery (including clinical research nursing)*	1.5	10	6	3.5	**21**
Occupational therapy*	0	0.5	3.5	0	**4**
Pharmacy or pharmacology*	3.5	2.5	0.5	0.5	**7**
Physiotherapy*	0	17	2	0	**19**
Politics/academic sociology	0	0.5	4	0.5	**5**
Psychology or behavioural science*	0	20	43.5	12.5	**76**
Radiography*	0	0.5	0	0.5	**1**
Research administration	0	0	12.5	0.5	**13**
Social care or social services*	0	1.5	2.5	0	**4**
Social science	0	1	3	1	**5**
Speech and language therapy*	0	3	2	0	**5**
Statistics or mathematics	0	4.5	4	1.5	**10**
Teaching and education	0	0.5	0	1.5	**2**
Unknown	0	3	54	7	**64**
Total	**81**	**127**	**202**	**41**	**451**

*Entries included in health and care professional figures.

5.3 Next destination of employment for personnel

5.3.1 Sector of employment

HRB award holders were asked to provide information on the next destination of research personnel who were supported on their award. Figure 5.8 shows the overall breakdown of their current employment posts.

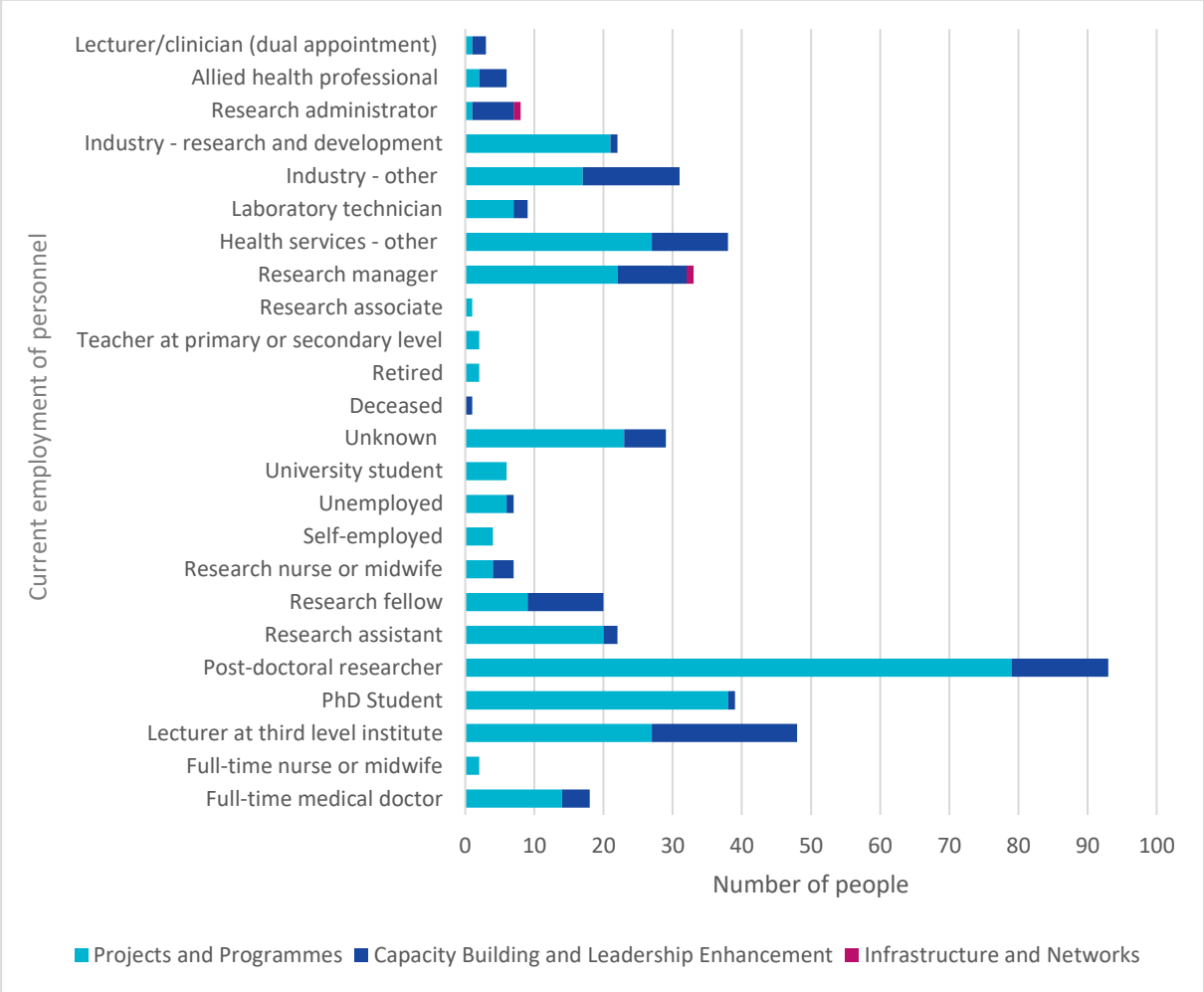


Figure 5.8: Current employment of previously HRB-funded personnel, 2018–19

Of the 451 staff employed on awards ending in 2018–19, a total of 339 people stayed in the research and health sector. Consistent with the previous reporting periods, by far the most common follow-on employment role reported was as a postdoctoral researcher (21%, n=93). The second and third most common positions following HRB-funded employment were lecturing positions at third-level institutions (11%, n=48) and completing PhD programmes (9%, n=39), while three people had obtained dual lecturing and clinician appointments.

For the first time, research management roles (7%, n=33) were included as a common follow-on position following employment on HRB-funded awards. Other research roles (e.g., as a research assistant, research fellow, research nurse or midwife, research associate, or laboratory technician) combined to account for 13% of the personnel (n=59). A total of 38 people (8%) had taken up other health services roles, such as positions with the Health Service Executive and Health Information and Quality Authority.

Eighteen people were reported to be back working in full-time clinical practice as medical doctors, 7 as nurses/midwives, and 5 as allied health professionals, totalling 30 people. These records are similar to 2016–17, when a total of 32 personnel supported by HRB awards were employed as medical doctors, midwives, nurses, and allied health professionals.

Those remaining in the research and health sector (n=339) were distributed across award types, with 253 from Projects and Programmes (76% of all the personnel working in this award type), 85 from Capacity Building and Leadership Enhancement (74% of all the personnel working in this award type), and 1 of the 2 people from Infrastructure and Networks remaining in this sector. This shows that all award types were very successful at retaining staff in research and health.

5.3.1.1 Employment in the private sector

In the 2018–19 reporting period, 52 people (12%) had secured employment in the private sector (a slight decrease from 16% in the previous reporting period). These roles included industry research and development (R&D) and other roles in industry and non-profit organisations. This is a strong indicator that the skills development and training acquired by people who participated in HRB awards had value outside of academia and the health system. Figure 5.9 shows the awards and types of schemes on which the 52 people who had moved to the private sector were employed, while Figure 5.10 shows the professional background of these people; most of them had worked on Health Research Awards. While almost one-half of these people (n=20) were from a biomedical background, a number came from a variety of health backgrounds: 6 from a psychology background, 5 from an engineering background, 4 from a pharmacy background, and 4 from a statistics/mathematics background.

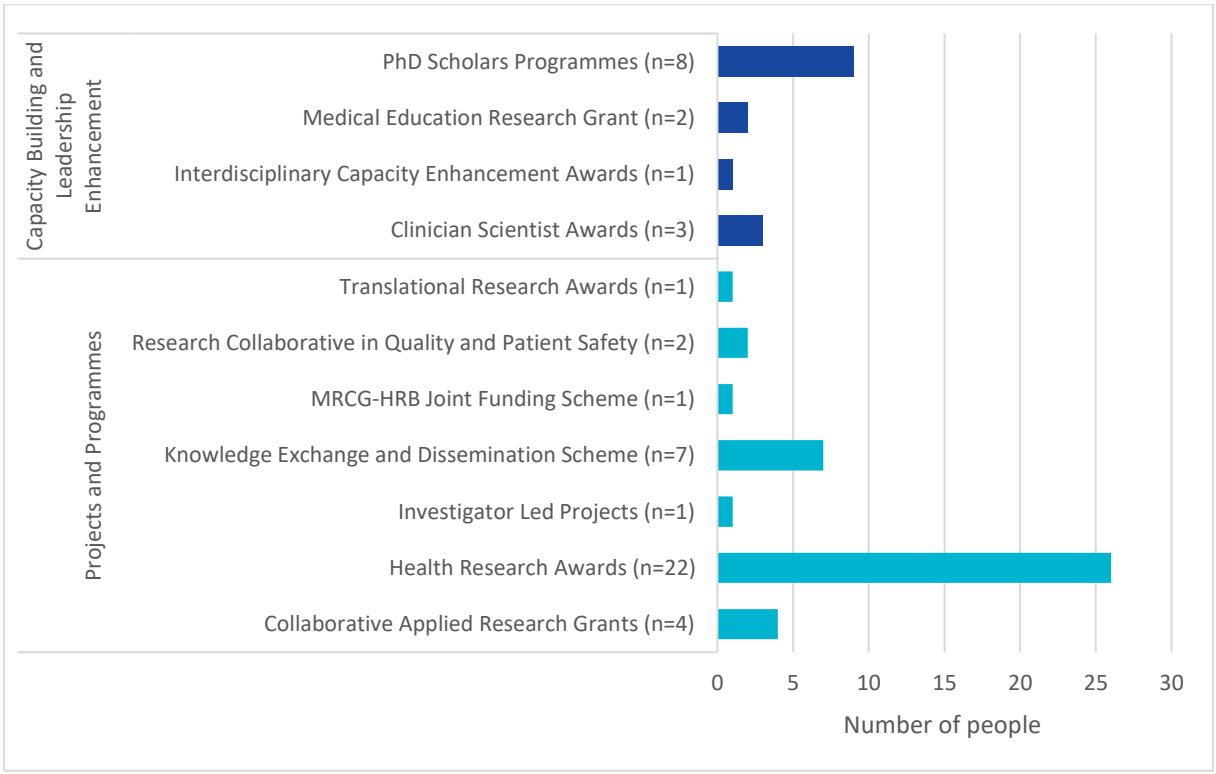


Figure 5.9: Type of award and scheme from which people moved to the private sector following their employment on HRB-funded awards, 2018–19

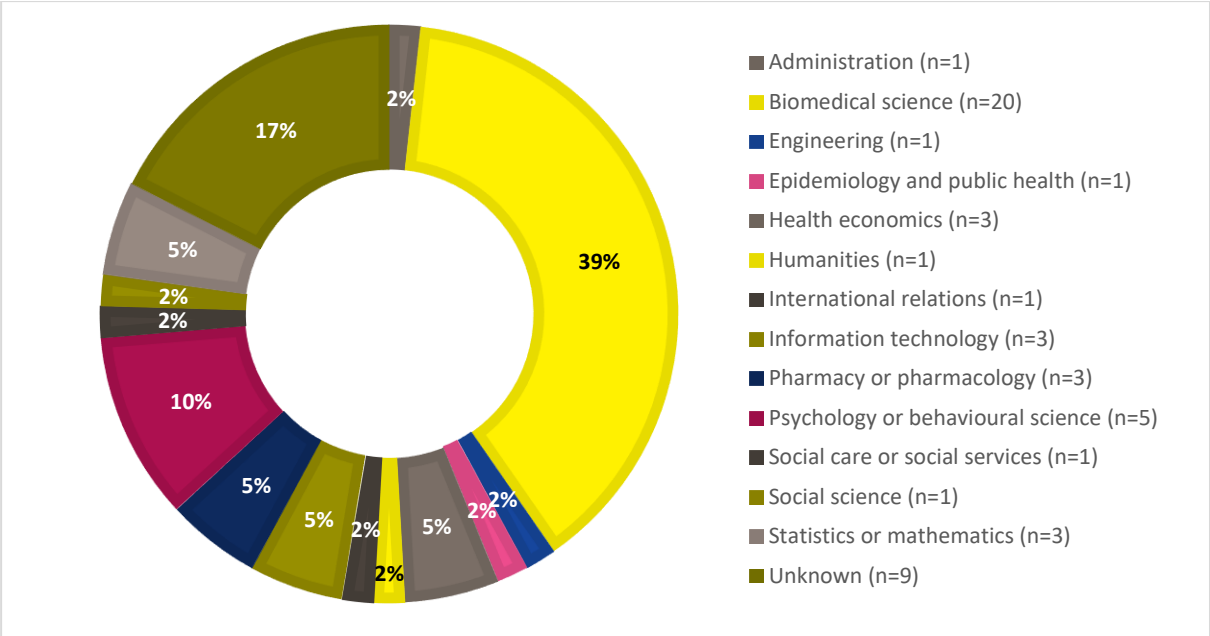


Figure 5.10: Professional background of personnel who moved into the private sector following their employment on HRB-funded awards, 2018–19

5.3.2 Location of employment

Figure 5.11 and Table 5.7 examine the country of current employment for personnel supported by HRB awards that completed in 2018–19. As might be expected, most personnel (94%, n=391) are employed in the Republic of Ireland. The most common overseas locations were the United Kingdom, including Northern Ireland (n=21); the United States of America and Canada (n=11); Europe (n=12); Australia and New Zealand (n=10); and Asia (n=3).

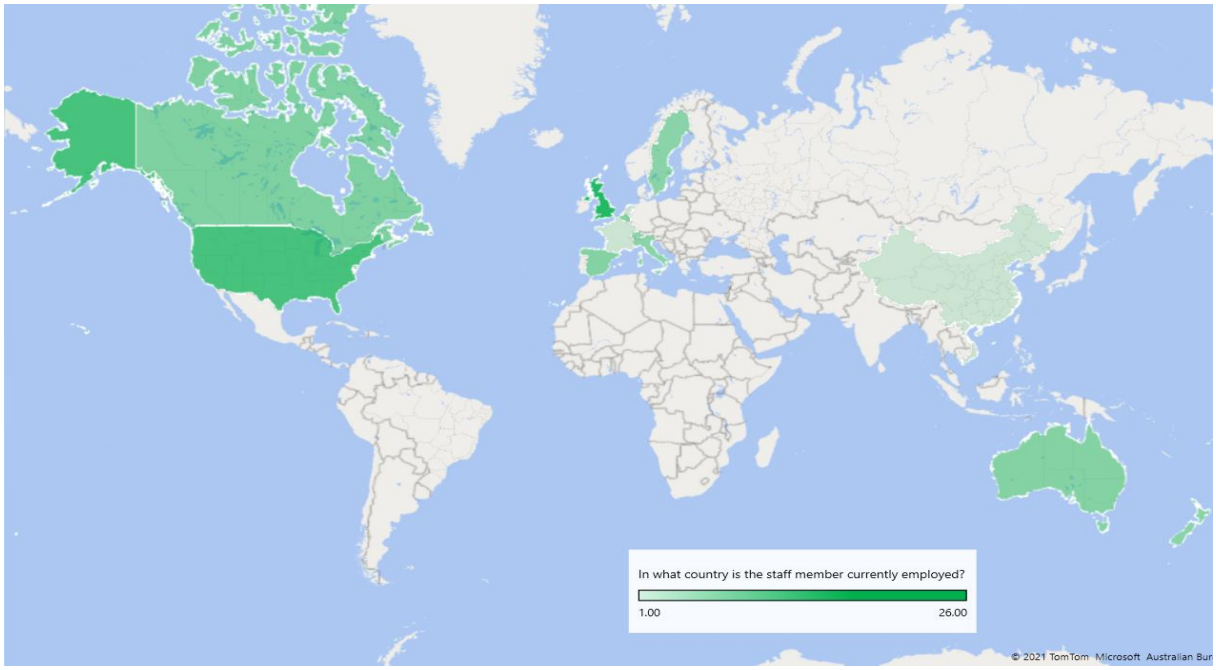


Figure 5.11: Map of current overseas employment for personnel supported by HRB awards, 2018–19

Table 5.7: Location and share of personnel in overseas employment who previously worked on HRB awards that ended in 2018-19

Country of employment	Number of personnel	Percentage of total
United Kingdom	19	32.2%
United States of America	9	15.3%
Australia	8	13.6%
Spain	3	5.1%
France	3	5.1%
Switzerland	2	3.4%
Canada	2	3.4%
Belgium	2	3.4%
New Zealand	2	3.4%
Northern Ireland	2	3.4%
Singapore	1	1.7%
Italy	1	1.7%
Unknown*	1	1.7%
Vietnam	1	1.7%
Sweden	1	1.7%
South Africa	1	1.7%
China	1	1.7%
Total	**59**	

*Numbers include one unknown location.

Table 5.8 provides a comparison of countries of employment for personnel previously employed on HRB-funded awards between 2008-09 and 2018–19. It is evident that the proportion of researchers staying in Ireland or Northern Ireland has increased over that time, while those moving to North America, has decreased over time. The proportion moving to Australia and New Zealand has remained relatively stable. The share of researchers moving to Spain and France has increased, while the proportion moving to other European countries has decreased since 2014–15. The proportion moving to China/other Asian countries has increased very slightly over time.

Table 5.8: Location and share of personnel in overseas employment who previously worked on HRB awards that ended between 2010–11 and 2018–19

Country of employment	2018–19	2016–17	2014–15	2012–13	2010–11
Ireland	94.0%	81.5%	80.8%	71.3%	77.5%
United Kingdom and Northern Ireland	6.7%	8.5%	6.0%	4.5%	5.7%
United States of America	2.0%	5.2%	3.9%	4.3%	4.6%
Other European countries	0.9%	2.1%	2.3%	0.7%	0.0%
Australia and New Zealand	2.2%	0.3%	1.0%	2.1%	2.1%
China	0.2%	0.3%	0.0%	0.0%	0.4%
Canada	0.4%	1.2%	0.5%	0.0%	1.8%
Spain	0.7%	0.3%	1.0%	0.0%	1.1%
France	0.7%	0.0%	1.0%	1.2%	4.6%
Other Asian countries	0.7%	0.3%	0.5%	1.2%	0.4%
Germany	0.0%	0.0%	1.6%	0.5%	0.0%
Africa	0.2%	0.0%	0.8%	2.1%	1.8%
Unknown	0.2%	0.0%	0.5%	11.8%	0.4%

5.4 Research awards, research prizes and recognition

Award holders whose awards completed in 2018–19 were asked if they, or any members of their HRB-funded team, had received any awards, prizes, or recognition related to their research during the period of the award. Awards to and recognition of HRB award holders indicates the quality and potential impact of HRB-funded research – as perceived by the award holders' peers – both nationally and internationally.

In this context, it was encouraging that 44% of award holders reported that either they or a member of their team received at least one type of award, prize, or recognition, and 324 awards or other types of recognition were reported in total. Of the 75 award holders that reported awards, prizes, or recognition, 51 were awarded 1–3 honours, nine received 4–6 honours, 14 received 7–16 honours, and the PhD Scholars Programmes award holder reported 49 honours, prizes, or awards. As a comparison, similar proportion of award holders funded by the Medical Research Council (MRC) reported receiving personal recognition (53%).

The type of award or recognition reported by HRB researchers is shown in Figure 5.12. The most common form of recognition was a research prize, medal, or other acclaim (54%, n=175). This category included, for example, travel awards and bursaries, and prizes for best paper or poster at a national or international scientific conference. HRB award holders were also invited to contribute as keynote speakers (9%, n=29), invited to sit on scientific advisory or peer review committees (10%, n=32), and appointed to editorial boards of journals or book series (6%, n=20).

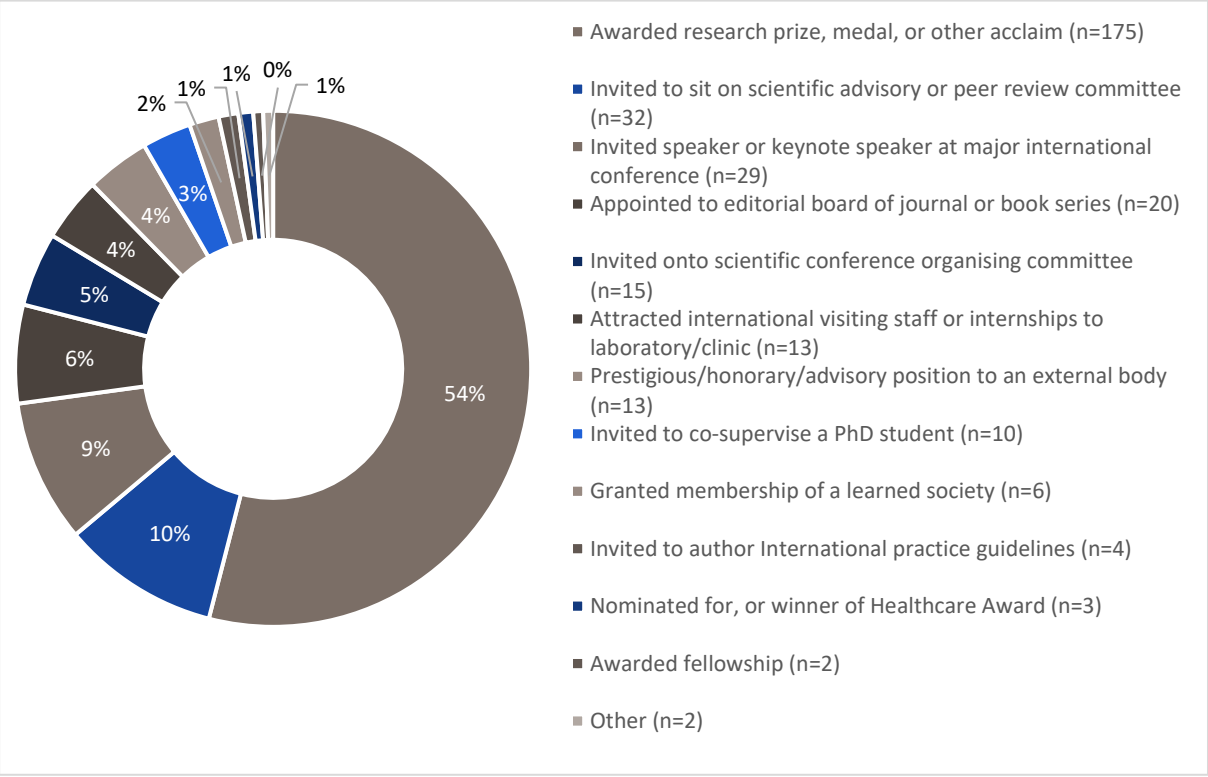


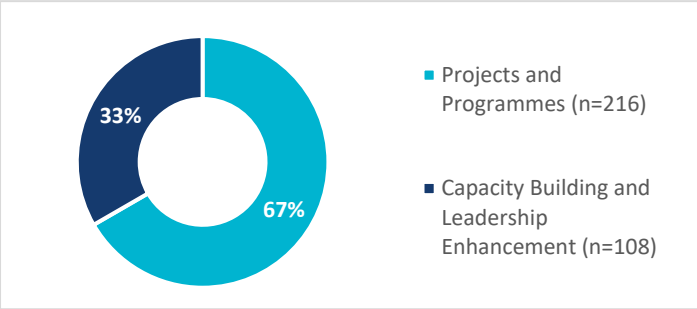
Figure 5.12: Number of awards, research prizes, and recognition reported by HRB award holders, by type, 2018–19

There were 13 prestigious, honorary, and advisory positions assigned to HRB-funded award holders and 13 international visits to laboratories or clinics as a result of the HRB-funded awards. The award holders reported three incidences of Health Service Executive Healthcare Award nominations/prizes.

It is important to note that there may be some underreporting by award holders in this section of the report, as a total of 212 invited speaker addresses and 31 keynote presentations were reported in the figures relating to scientific dissemination in Chapter 4.

5.4.1 Distribution of awards and recognition, by award type

Figure 5.13 looks at the number of awards and recognitions received by HRB award holders by award type. It shows that Projects and Programmes awards accounted for 67% of all reported awards, prizes, and peer recognition, with 6.7 honours reported per €1 million spend. Capacity Building and Leadership Enhancement awards accounted for 33% of reported awards and received 6.5 honours per €1 million spend.



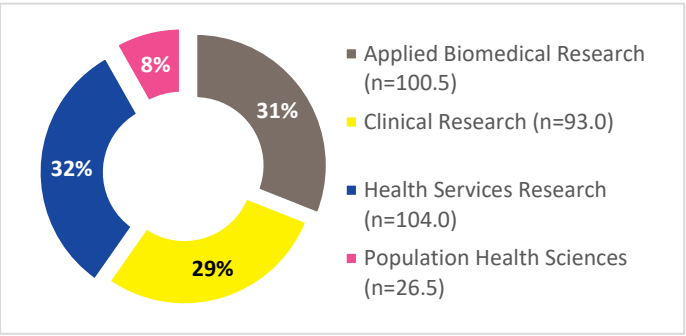
Number of awards/prizes/recognition per €1 million spend	
Projects and Programmes	6.7
Capacity Building and Leadership Enhancement	6.5

Figure 5.13: Research awards, research prizes, and recognition, per award type and productivity per €1 million spend, 2018–19

5.4.2 Distribution of awards and recognition by broad research area

Figure 5.14 looks at the number of awards and recognitions by broad research area. It shows that awards classified as Health Services Research accounted for 32% of the recognition (n=104) received, with 5.2 honours per €1 million spend. This was significantly different to 2016–17, when Health Services Research accounted for only 13% of the honours received. This was followed closely by Applied Biomedical Research awards, which accounted for 31% (n=100.5) of reported recognition and 8.7 honours per €1 million spend.

Clinical Research accounted for 29% (n=93) of the total awards and recognition, with 7.2 honours per €1 million spend. Population Health Sciences, while accounting for 8% of the total awards (n=26.5) (the lowest number of awards by broad research area), was nonetheless quite productive, with 5.3 honours per €1 million spend. All of these outputs showed a slight decrease from the number reporting in 2016–17.



Number of awards/prizes/recognition per €1 million spend	
Applied Biomedical Research	8.7
Clinical Research	7.2
Health Services Research	5.2
Population Health Sciences	5.3

Figure 5.14: Research awards, research prizes, and recognition, per broad research area and productivity per €1 million spend, 2018–19

5.4.3 Comparison with Medical Research Council outputs

It is interesting to compare the types of awards and recognition being obtained by HRB award holders with those obtained by MRC award holders in 2018–19. While the categories used by both organisations are not completely compatible, there is enough commonality to make some comparisons, as shown in Figure 5.15.

Figure 5.15 shows that while not all categories of awards and recognition were included in the MRC report, the types of awards and recognition that HRB and MRC award holders attract are very similar, despite the different scales and remits of these organisations. HRB award holders received a relatively greater percentage of research prizes, medals, or other acclaim, while a higher proportion of MRC award holders were invited to speak or to give keynote presentations at international conferences. However, as previously mentioned, there may be some underreporting by HRB award holders in this section, as a total of 212 invited speaker addresses and 31 keynote presentations were reported in figures relating to scientific dissemination. In Chapter 4.

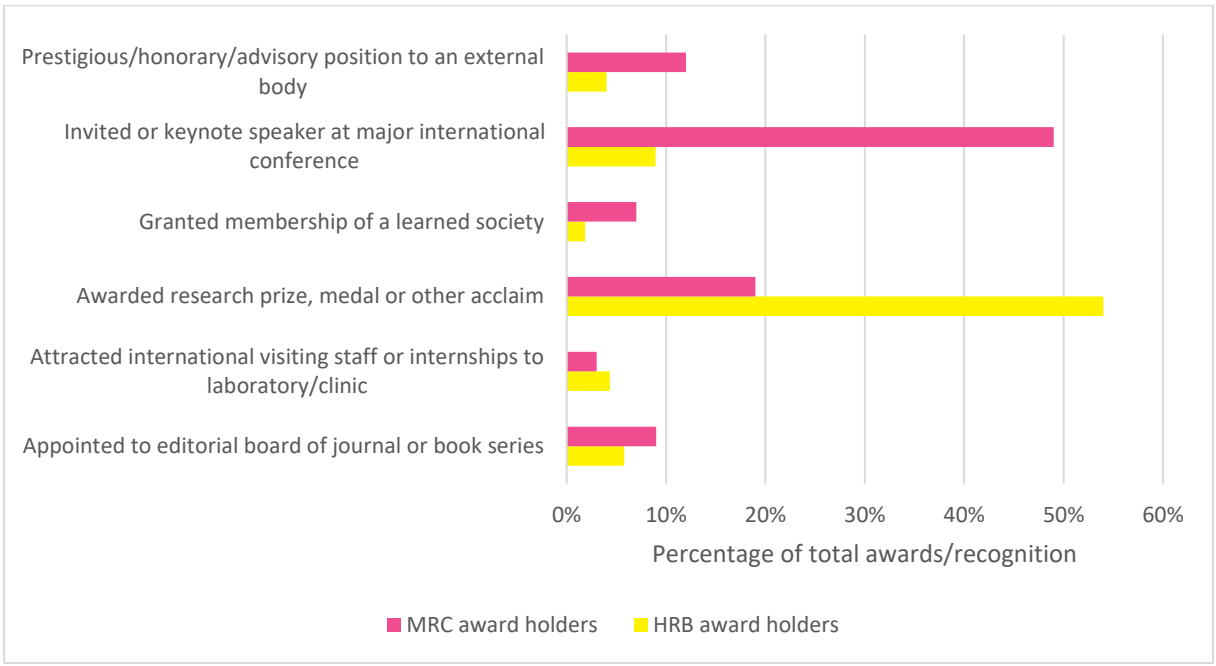


Figure 5.15: Comparison of HRB and MRC research awards, research prizes, and recognition, 2018–19

5.5 Examples of types of research awards, research prizes, and recognition outputs

Table 5.9 provides some examples of the types of research awards and recognition outputs reported by award holders associated with HRB awards that completed in 2018–19.

Table 5.9: Examples of types of research awards, research prizes, and recognition received by HRB award holders, 2018–19

Scheme	Award type	Type of award/prize/recognition	Details
Applied Partnership Awards	Projects and Programmes	Awarded research prize, medal, or other acclaim	Dr Marie Therese Cooney awarded 2nd prize for poster presentation at 3rd National Patient Safety Office Conference: Communication for Patient Safety in October 2018.
Collaborative Applied Research Grants	Projects and Programmes	Invited to sit on scientific advisory or peer review committee	Professor Cara Martin was invited to sit on the Steering Group for the Scottish Human papillomavirus (HPV) Archive.
Collaborative Applied Research Grants	Projects and Programmes	Invited to sit on scientific advisory or peer review committee	Professors John O'Leary and Cara Martin were invited to sit on the Royal College of Physicians of Ireland Expert Advisory Screening Group in 2018, following the CervicalCheck Screening Programme crisis.
Health Research Awards	Projects and Programmes	Awarded fellowship	Professor James O'Gara was awarded the Fellowship of the International Society of Antimicrobial Chemotherapy, 2019.
Health Research Awards	Projects and Programmes	Awarded research prize, medal, or other acclaim	Philip O'Gorman, a PhD student, was awarded the Young Investigator Bursary for an oral presentation at the 2019 European Association for the Study of the Liver (EASL) Annual Meeting.
Translational Research Awards	Projects and Programmes	Awarded research prize, medal, or other acclaim	The RCSI Tissue Engineering Research Group won Research Lab of the Year (2017) at the Irish Laboratory Awards.
Health Research Awards	Projects and Programmes	Awarded research prize, medal, or other acclaim	Dr Gonzalez Vazquez was awarded the prestigious New Investigator Recognition Award at the 2019 Orthopaedic Research Society Annual Meeting.
Health Research Awards	Projects and Programmes	Appointed to editorial board of a journal or book series	Professor James O'Donnell was invited to join the editorial board of *Scientific Reports*.
Health Research Awards	Projects and Programmes	Invited speaker or keynote speaker at major international conference	Professor Molly Byrne was an invited speaker at the 2015 British Association for Cardiac Prevention and Rehabilitation Annual Conference, Manchester, England.
Knowledge Exchange and Dissemination Scheme	Projects and Programmes	Awarded research prize, medal, or other acclaim	Dr Gerry Molloy was awarded an NUI, Galway President's Award for Research Excellence (Early Stage Researcher Award) in 2018. A supporting noted that the "Knowledge Exchange and Dissemination Scheme (KEDS) activity completed in this project "provides an excellent example of how he has engaged multiple stakeholders in his research including patients, healthcare professionals and researchers to translate his research into impact in healthcare training".

Scheme	Award type	Type of award/prize/recognition	Details
Health Research Awards	Projects and Programmes	Attracted international visiting staff or internships to laboratory/clinic	A visiting fellow from Manchester, Dr Karolina Stepien, worked on the Galactosaemia project (July 2017 to March 2018).
Project Development Grant	Projects and Programmes	Awarded research prize, medal, or other acclaim	Dr Orlaith Cormican won a Health Service Executive (HSE) Open Access Award 2018 (Cancer Control Programme)
Knowledge Exchange and Dissemination Scheme	Projects and Programmes	Nominated for, or winner of, a healthcare award	The HRB Mother and Baby Clinical Trial Network's exhibition 'CREATE: The Art of Pregnancy, Birth and Beyond' was nominated in the Patient Education Project of the Year category at the 2019 Irish Healthcare Awards.

6 Collaborations and leveraged funding

The development of research collaborations and partnerships with national and international researchers, charities, policymakers, and health bodies is an important indicator of the quality and potential future impact of HRB-funded research. The development of collaborations is also vital to the leveraging of research funding from exchequer and non-exchequer sources.

Summary of research collaboration and partnership outputs, 2018–19, compared to previous reporting periods

Research collaborations and leveraged funding	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Research collaborations and partnerships						
Total number of academic collaborations, partnerships, or networks	396	399	413	278	415	384
Percentage of academic collaborations with health bodies	9%	16%	19%	14%	10%	N/A*
Average number of academic collaborations, partnerships, or networks per €1 million spend	8.0	8.5	7.5	6.3	7.6	8.5
Further funding leveraged						
Number of additional research awards leveraged	174	200	180	149	113	117
Total value of leveraged funding	€100.4 million	€57.6 million	€41.8 million	€39.5 million	€34.8 million	N/A
Amount of leveraged funding per €1 spend	€2.02	€1.20	€0.76	€0.89	€0.64	N/A

*N/A – data not collected on this metric in every reporting period

Key findings

Collaborations and partnerships

- 131 (70%) of HRB award holders whose awards ended in 2018–19 reported participation in 396 collaborations/partnerships during the lifetime of their award, of which partnerships, or networks reported, 286 (72%) involved an academic institution and 35 (9%) involved a hospital.
- A significant number of collaborations were established with policy-focused or service delivery-focused health organisations, health charities, or voluntary and community groups.
- The most popular reasons for collaborating with academic or other partners were to conduct joint research, form networks, or access methodological support/advice. Shared data and research findings, and access to research materials, tools, or instruments, as well as access to cohorts, were also deemed important reasons for collaborating.
- The highest proportion of collaboration was found in Projects and Programmes awards and awards classified as Health Services Research.

Leveraged funding

- Almost one-half of awardees were successful in securing additional funding by leveraging their HRB award. This is the same as the proportion of MRC award holders that reported at least one instance of further funding in the same reporting period.
- A total of 174 additional awards were reported by 73 awardees, with a total value to HRB awardees of €100.4 million. This is significantly higher than the €57.6 million recorded in 2016–17. Approximately €70.5 million came from Irish exchequer sources, while €29.9 million came from non-exchequer sources in Ireland and overseas. The amount of non-exchequer leveraged funds received increased from €16.6 million in 2016–17.
- The amount of funding leveraged per €1.00 of HRB investment was €2.02. The 2018–19 and 2016–17 reporting periods are the two instances in since the 2008-2009 reporting period where the amount leveraged has exceeded the original HRB investment. Furthermore, €2.03 leveraged per €1.00 invested in 2018–19 is almost double the return reported in 2016–17.
- Projects and Programmes awards accounted for 78% of all leveraged awards and 91% of the total amount leveraged, representing a return on investment of €2.86 for every €1.00 spend. This is a significant increase compared to the €1.45 leveraged per €1.00 spend in 2016–17.
- Applied Biomedical Research awards accounted for 32% of all leveraged awards, followed by Clinical Research with 31% of all leveraged awards. These research areas returned €3.85 and €3.30, respectively, for every €1.00 invested.

6.1 Development of research collaborations

From the 170 analysed awards completed in 2018–19, 131 award holders (77% of total) reported participating in a total of 396 collaborations during the lifetime of their HRB award. Of these collaborations, 280 (70%) were newly established collaborations or partnerships, while 116 (30%) were existing collaborations or partnerships. The average number of collaborations per award was 2.3.

Figure 6.1 illustrates the trend in research collaborations from 2008–09 to 2018–19. The actual number of collaborations has fluctuated over the reporting periods, since this is dependent on the types of awards that are reported in each period. Despite dips reported in 2012–13 and 2016–17, the average number of collaborations is generally stable, with between 1.9 and 2.3 collaborations per award. The biggest discrepancy was in the 2016–17 reporting period, which reported an average of 1.5 collaborations per award.

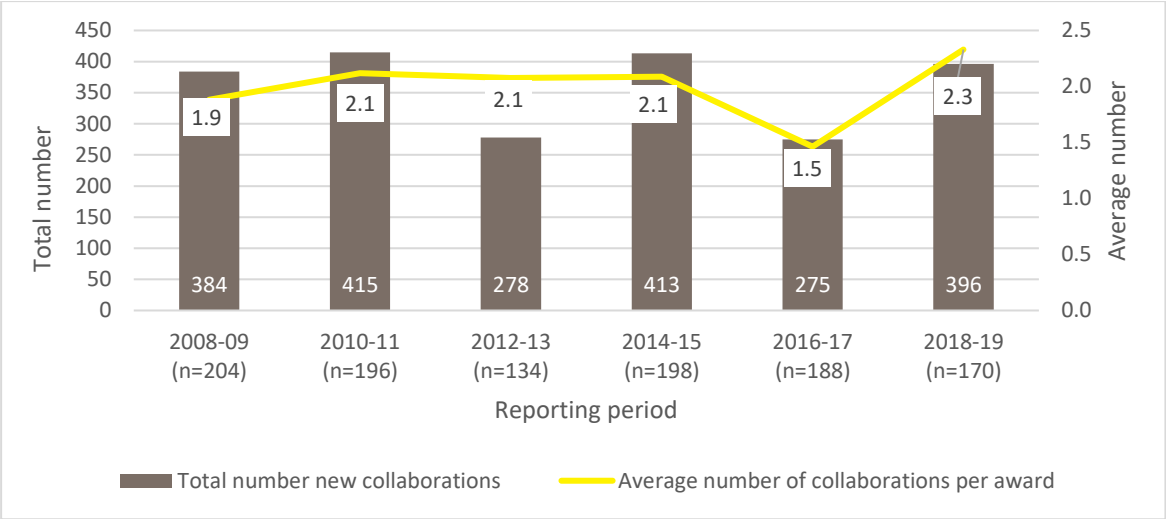


Figure 6.1: Comparison of research collaborations by HRB award holders, 2008–09 to 2018–19

6.1.1 Distribution of collaborations by type

A breakdown of the 396 collaborations reported on, by type of collaboration, is provided in Figure 6.2. As shown, almost three-quarters (72%) of all collaborations reported involved an academic researcher, based either in Ireland or overseas.

Many award holders reported collaborations with health service providers, either hospital-based clinicians or allied health professionals, based in Ireland and overseas. It should be noted that 'international' in terms of company description refers to the type of company (e.g. a multinational company based either in Ireland or elsewhere), while 'national' in terms of company description refers to Irish-owned companies.

Given that the HRB seeks to impact on policy and practice, it was positive to note that a significant number of collaborations were established with policy-focused or service delivery-focused health bodies, health charities, and voluntary and community groups.

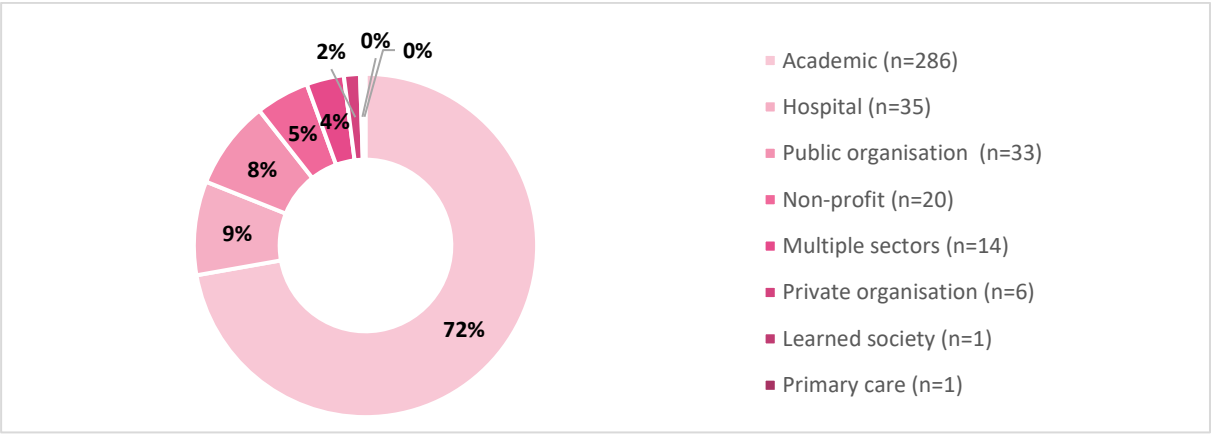


Figure 6.2: Breakdown of collaborations formed, per type, 2018–19

Figure 6.3 examines the collaborations in greater detail. Most of the hospital, non-profit, and public sector collaborations were based in Ireland. The national public organisation collaborations include the National Immunisation Office; the National Cancer Registry Ireland; the Irish Platform for Patient Organisations, Science and Industry (IPPOSI); the National Cancer Control Programme; the Medical Council of Ireland; Health Intelligence Unit at the HSE; the Health Products Regulatory Authority (HPRA); and the Economic

and Social Research Institute. The national non-profit organisation collaborations include the Centre for Effective Services, the Irish Hospice Foundation, the Alzheimer Society of Ireland, and Down Syndrome Ireland.

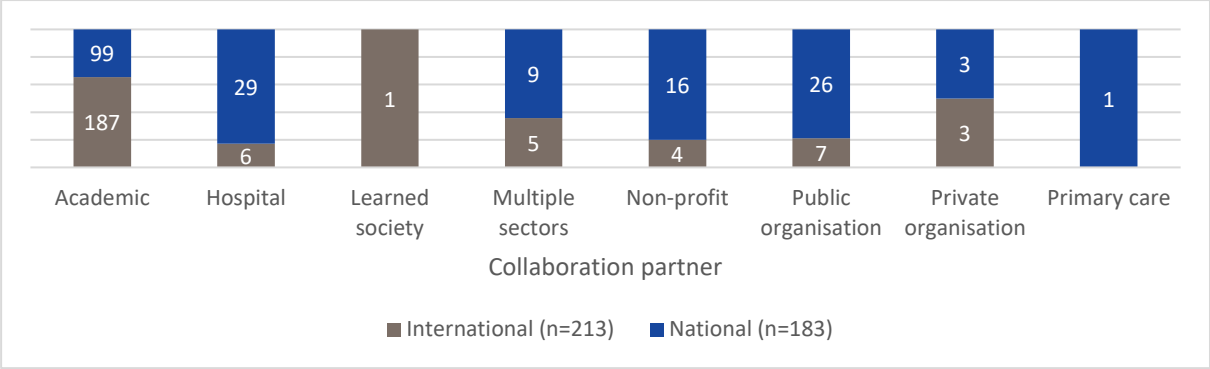


Figure 6.3: Breakdown of number of collaborations by international or national status, 2018–19

Responses reported as 'multiple sectors' include cross-sector collaboration. To quote one researcher:

> In the first year of [the] project, the PI was in contact with the HSE's National Dementia Office (NDO), who were planning to develop a set of dementia-friendly hospital ward design guidelines. Following discussions, it was agreed that our HRB research project could be elevated to include the proposed NDO work, and thus create national-level guidelines. This was agreed with HSE Estates, the NDO and the CEUD and supported via these organisations as well as the broader Steering Committee.

Another example of a 'multiple sectors' response provided by an award holder was as follows:

> This project has led to the formation of a clinical-academic working group partnership, which in turn has developed an infrastructure around MRI [magnetic resonance imaging] data analysis techniques and expertise, that was previously not available in Ireland. Research working group meetings are held every six weeks, with more formal meetings with international collaborators 1–2 times per year. This group continues to generate research outputs as evidenced by publications in preparation and new grant funding.

6.1.2 Purpose of collaborations

Figure 6.4 sets out the reasons cited by award holders when asked about the aim of their collaboration with another group or organisation. It is important to note when interpreting these data that award holders could choose more than one reason; this explains the total of 961 reasons provided within the context of the 396 collaborative relationships. The most popular reason reported for collaborating was access to support, advice, tools, instruments, cohorts, or datasets (42%, n=399), followed by networking and sharing research findings (24%, n=234). Other important reasons for collaboration included joint research with other academic organisations (22%, n=209), placement of students and programme coordination (10%, n=99), as well as access to biobanking infrastructure (2%, n=20).

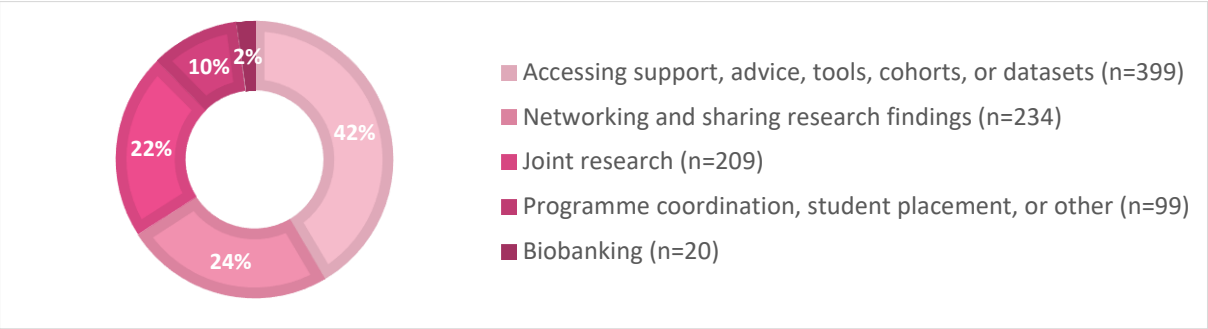


Figure 6.4: Cited reasons for participating in collaboration, 2018–19

6.1.3 Distribution of collaborations, by award type

Analysis of collaboration activity by award type for the 170 awards that completed in 2018–19 is presented in Figure 6.5. Overall, there was an average of 2.3 collaborations established per award. This relates to an overall average productivity of 8 collaborations per €1 million spend, which is consistent with 2016–17 figures. As per previous reporting periods, the number and cost of collaborations varied widely depending on the award type. Projects and Programmes awards accounted for the highest proportion of collaborations (62%) with 247 in total. Capacity Building and Leadership Enhancement awards accounted for 35% (n=138), followed by Infrastructure and Networks awards (3%, n=11). There was a broad array of collaborators in Projects and Programmes and Capacity Building and Leadership Enhancement awards, whereas the Infrastructure and Networks award collaborated mainly with academic and public organisation partners.

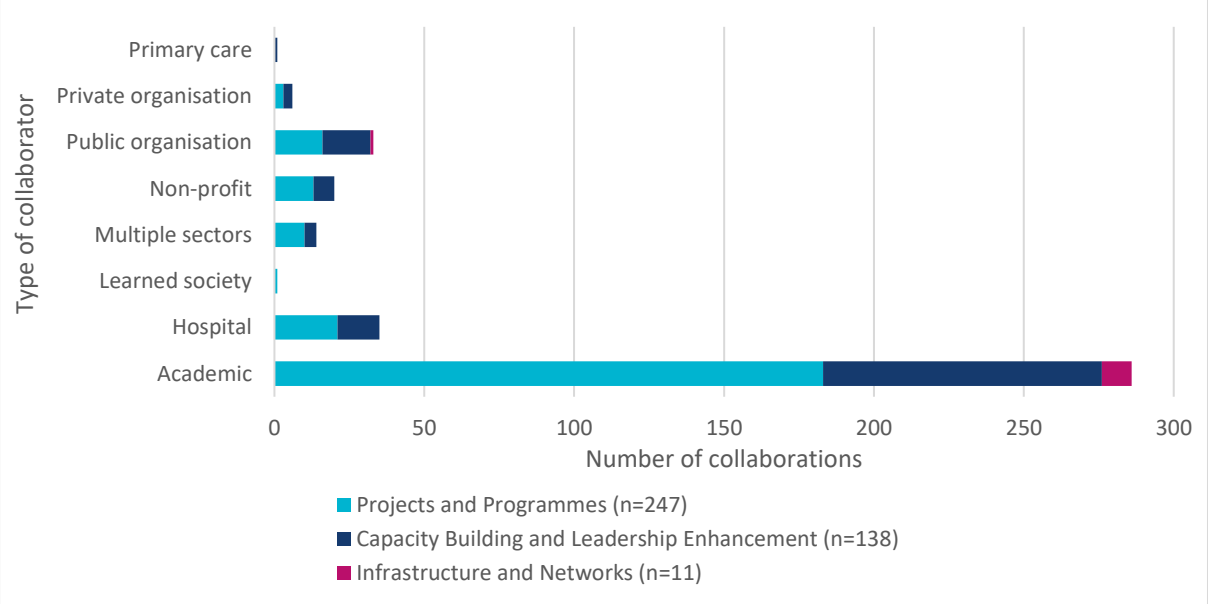


Figure 6.5: Type of collaboration established, per award type, 2018–19

The majority of Projects and Programmes awards reporting collaborations across the academia, hospital, learned society, non-profit, and private sectors were Health Research Awards (n=121), followed by KEDS awards (n=48). MRCG-HRB Joint Funding Scheme and Collaborative Applied Research Grants awards account for 27 collaborations each. In terms of Capacity Building and Leadership Enhancement awards, the PhD Scholars Programmes award reported 69 collaborations, while Research Training Fellowships for Healthcare Professionals awards reported 27 collaborations; collaborations under both awards spanned

academia and the private and public sectors. The Infrastructure and Networks award holder collaborated with academic and public organisations.

Table 6.1 outlines the total number of collaborations and productivity per award type. Projects and Programmes awards engaged in 7.7 collaborations per €1 million spend, Capacity Building and Leadership Enhancement awards engaged in 8.3 collaborations per €1 million spend, and Infrastructure and Networks awards reported 14.5 collaborations per €1 million spend.

Table 6.1: Number of collaborations and productivity, per award type, 2018–19

Award type	Total number of collaborations	Percentage of total collaborations	Collaborations per €1 million spend
Projects and Programmes	247	62%	7.7
Capacity Building and Leadership Enhancement	138	35%	8.3
Infrastructure and Networks	11	3%	14.5

6.1.4 Distribution of collaborations, by broad research area

Figure 6.6 looks at the types of collaborations established by broad research area. Academic collaborations occurred in all four broad research areas. As expected, hospital collaborations were mainly under awards classified as Applied Biomedical Research, Clinical Research, and Health Services Research. A large proportion of Health Services Research award-related collaborations were also with public organisations (n=23.0) and non-profit organisations (n=12.5).

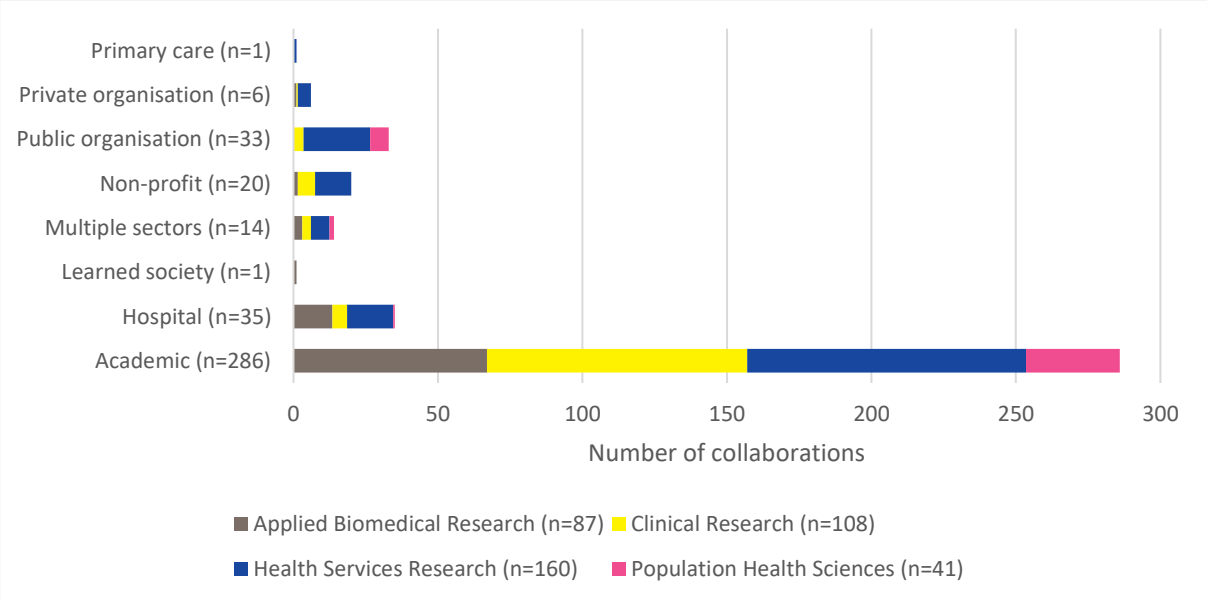


Figure 6.6: Type of collaboration, per broad research area, 2018–19

Table 6.2 outlines the total number of collaborations and productivity per broad research area. Interestingly, Population Health Sciences awards accounted for the lowest number of collaborations overall, but these awards were still productive, as award holders collaborated with five partners per €1 million spend. Health Services Research award holders accounted for the highest proportion of collaborations (40%, n=160) and were very productive, with eight collaborations per €1 million spend. Clinical Research award holders accounted for 27% (n=108) of collaborations and had 8.3 collaborations

per €1 million spend. Applied Biomedical Research award holders had 87 collaborations, accounting for 22% of the total number of collaborations, and 7.6 collaborations per €1 million spend. These figures show the high level of partnership and collaboration that took place across the HRB awards that finished in 2018–19.

Table 6.2: Number of collaborations and productivity, per broad research area, 2018–19

Broad research area	Total number of collaborations	Percentage of total collaborations	Collaborations per €1 million spend
Applied Biomedical Research	87	22%	7.6
Clinical Research	108	27%	8.3
Health Services Research	160	40%	8.0
Population Health Sciences	41	10%	5.0

6.1.5 Distribution of collaborations by country

Figure 6.7 illustrates the 21 countries with which HRB award holders reported collaborating. Overall, the 396 collaborations and partnerships were divided into 183 national (46%) and 213 international (54%) collaborations by award holders whose funding completed in 2018–19.

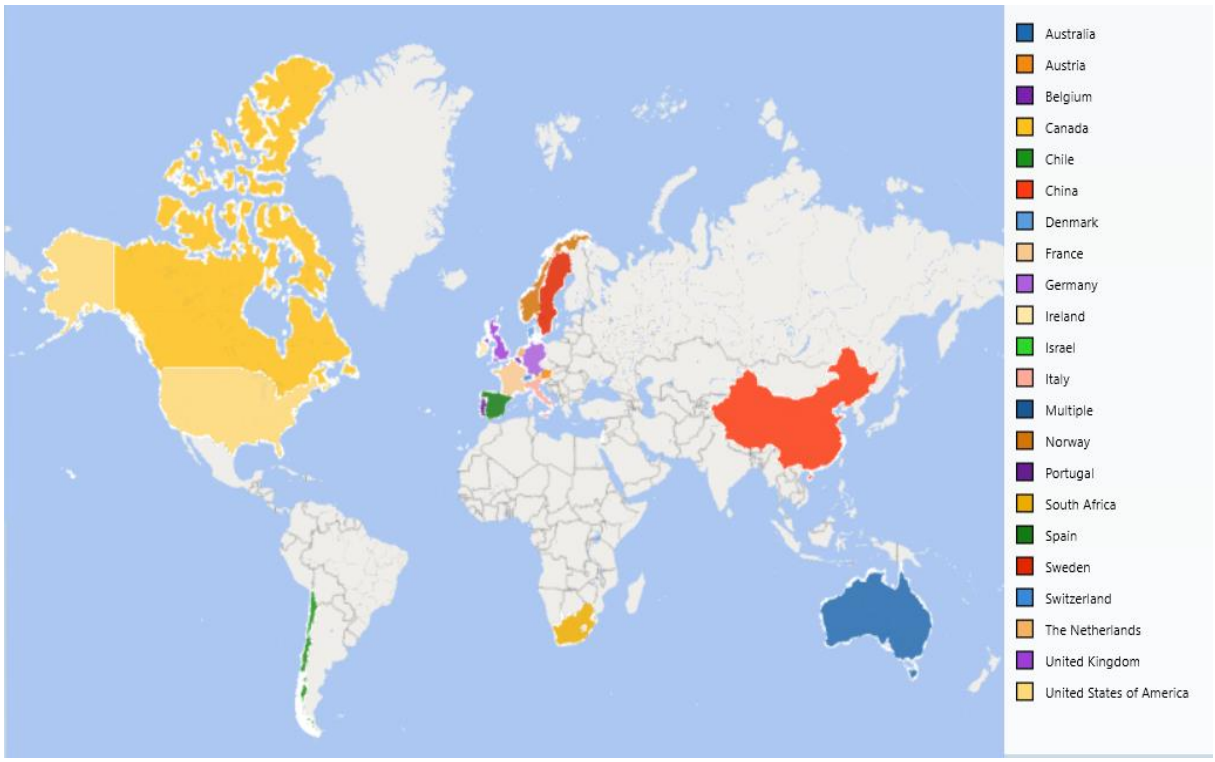


Figure 6.7: Map of collaborations established by HRB award holders, 2018–19

The national collaborations highlight the diverse network of relationships and alliances involving HRB award holders that exists across the Republic of Ireland. In addition, the extent of international collaboration highlights the truly global face of the HRB and the reputation of HRB award holders reflected by their ability to collaborate and partner on the international stage. It also demonstrates the far-reaching effect of the HRB's investment in health research.

Many of these international collaborations were with partners located in the United Kingdom (18%, n=73) and North America (15%, n=58), with 40 partners being located in the United States of America and 18 in Canada. Following these countries, the Netherlands was the most popular location, with 14 collaborations reported (4%). Germany was the site of 11 collaborations (3%) and Belgium had nine (2%). In total, European partners (outside of the Republic of Ireland and the United Kingdom) accounted for 69 collaborations (17%).

Table 6.3: Breakdown of international collaborations, 2018–19

Country	Number of collaborations or partnerships	Percentage of total
Republic of Ireland	184	46%
United Kingdom	73	18%
United States of America	40	10%
Canada	18	5%
The Netherlands	14	4%
Germany	11	3%
Belgium	9	2%
Sweden	7	2%
Australia	7	2%
France	6	2%
Denmark	5	1%
Spain	5	1%
Italy	4	1%
Norway	4	1%
Switzerland	2	1%
Chile	1	<1%
Israel	1	<1%
South Africa	1	<1%
China	1	<1%
Portugal	1	<1%
Multiple*	1	<1%
Austria	1	<1%
Total	**396**	

*Multiple countries included the Careers Research and Advisory Centre (CRAC) PhD Programme, which has multiple global partners and was included as a partner for the PhD Scholars Programmes award.

6.2 Further funding leveraged

From the HRB awards that completed in 2018–19, a total of 73 awardees reported obtaining 174 additional awards because of research findings derived in whole or in part from the original HRB award. From the total investment of €49.5 million, the total value of leveraged monies by HRB award holders was €100.4 million.

The amount of funding leveraged per €1.00 of HRB investment in awards completing in 2018–19 was €2.03. This is the second consecutive reporting period in which the amount leveraged exceeded the

original HRB investment, and the amount is almost double the €1.20 leveraged per €1.00 in 2016–17. The €100.4 million is made up of €70.5 million (58%) from the Irish exchequer and €29.9 million (42%) from non-exchequer and international sources. This distribution is consistent with previous reporting periods.

Table 6.4 shows the number and value of these 174 additional leveraged awards according to their (national and international) funding source, while Table 6.5 compares leveraged funding sources across reporting periods. In terms of European Union (EU) and other collaborative awards, funding may have been awarded based on participation (rather than primary leadership) of the PI within a wider research consortium, and the amounts shown in these cases, consistent with all leveraged figures in this chapter, reflect the allocation to the PI as opposed to the total value of the award.

Overall, almost one-half (43%) of award holders were successful in securing additional funding by the end of grant (EOG) of their HRB award, consistent with previous reporting periods. This is also similar to the MRC-reported figure of 50%.

Table 6.4: Number and value of awards leveraged by HRB award holders, 2018–19

Source of funding	Number of awards	Percentage of total amount leveraged	Value of leveraged funding
Exchequer (€70,501,243)			
HRB	53	15.6%	€15,627,090
Science Foundation Ireland	16	48.3%	€48,469,291
Enterprise Ireland	6	3.5%	€3,544,175
Irish Research Council	15	1.7%	€1,697,235
HSE	7	1.0%	€1,033,797
Organisation for medical professionals*	2	0.1%	€59,202
Government department	2	0.1%	€70,453
Non-exchequer (€29,895,699)			
EU Framework programme	23	14.8%	€14,821,856
Charity – national	11	0.6%	€651,750
Charity – international	9	1.9%	€1,873,748
EU – other programmes	7	7.3%	€7,294,580
International funding agency	6	2.7%	€2,759,266
Industry – international	6	1.6%	€1,647,500
Co-funded with international partners	3	0.6%	€612,693
Health and social care provider	3	0.2%	€153,454
University – national	2	0.0%	€30,000
Industry – national	2	0.1%	€50,852

*Irish College of General Practitioners and Medical Council of Ireland

Leveraged exchequer funding, which accounted for €70.5 million (70.2% of total leveraged funding), came primarily from Science Foundation Ireland, the HRB, Enterprise Ireland, the Irish Research Council, and the HSE. Funding from Government departments, and organisations for health professionals is also present. In Table 6.5, the category 'Other – national' captures awards that were reported as funding from medical organisations, namely the Medical Council of Ireland and the Irish College of General Practitioners. These proportions are broadly similar to the sources of leveraged funding reported by MRC award holders, with 64% of leveraged funding arising from the public and academic sector and 41% from the private sector.

Interestingly, the proportion of funding changed compared to previous reporting periods, with Science Foundation Ireland providing the largest amount of funding (€48,469,291) to a total of 16 awards; in previous years, HRB funding generated the largest amount of leveraged exchequer funding. While the number of awards funded by the HRB in this reporting period was more than triple that of Science Foundation Ireland awards, the value of the Science Foundation Ireland awards far exceeded that of the HRB awards. Examples of large investments awarded to HRB-funded personnel by Science Foundation Ireland include funding for the Advanced Material and BioEngineering Research Centre Phase 2 (AMBER), for the Centre for Research of Medical Devices (CURAM), and for the FutureNeuro Centre.

Table 6.5: Comparison of value of awards leveraged by HRB-funded award holders, 2010–11 to 2018–19

Source of funding	2018–19	2016–17	2014–15	2012–13	2010–11
Exchequer (€70,501,243)					
HRB	€15,627,090	€15,084,255	€11,570,015	€10,804,174	€6,448,756
Science Foundation Ireland	€48,469,291	€17,394,215	€11,154,158	€5,603,990	€12,669,935
Enterprise Ireland	€3,544,175	€257,000	€1,348,515	€671,927	€515,326
Irish Research Council	€1,697,235	€1,779,790	€541,149	€626,127	€540,108
Other – national (includes the HSE, Government departments, medical organisations*)	€1,163,452	€6,479,205	€0	€178,000	€0
Non-exchequer (€29,895,699)					
EU Framework Programmes	€14,821,856	€2,576,300	€4,474,408	€13,916,028	€0
EU – other	€7,294,580	€7,089,013	€3,667,851	€0	€6,681,534
Charity – national	€651,750	€2,306,352	€3,400,661	€954,711	€3,703,952
Charity – international	€1,873,748	€201,262	€1,106,247	€1,319,366	€716,271
Other – national	€153,454	€507,851	€2,542,994	€2,677,343	€443,411
Other – international	€3,371,959	€573,000	€1,093,348	€1,155,509	€1,772,659
Industry – national	€50,852	€542,610	€54,800	€587,579	€791,823
Industry – international	€1,647,500	€2,230,931	€479,800	€55,180	€184,000
Philanthropic	€0	€561,684	€325,000	€130,000	€0
Total	**€100,366,942**	**€57,583,467**	**€41,758,946**	**€38,679,934**	**€34,467,775**

*Irish College of General Practitioners and Medical Council of Ireland

New sources of funding were also explored by the award holders whose awards ended in this reporting period, such as the HSE and the Medical Council. These awards spanned the Clinical Research, Health Services Research, and Population Health Sciences areas. This may reflect the growing position of health research in the healthcare landscape in Ireland. With the establishment of the HSE Research and Development Office and the publication of the *HSE Action Plan for Health Research 2019-2029* [9], it is envisaged that further integration and research opportunities will arise in the future.

Non-exchequer funding, which accounted for €29.9 million (29.8%) of total leveraged funding, primarily resulted from EU Framework and other EU funding programmes (22.2%). This funding success may reflect the considerable resources that the HRB has invested in promoting, encouraging, and supporting Irish health researchers to participate in EU funding programmes. It also highlights the success of HRB-funded researchers on an international stage. The largest award was €5.9 million from the EU Horizon 2020 programme for NEPHSTROM (Novel Stromal Cell Therapy for Diabetic Kidney Disease). The remaining non-exchequer funding was sourced from other international funding agencies (2.7%), international and

national charities (2.5%), international industry (1.6%), with the remaining 1.8% coming from universities, national industry, and health and social care providers.

6.2.1 Distribution of leveraged funding, by award type

The number of awards leveraging funding, distributed by award type, is shown in Figure 6.8. These figures should be interpreted with caution, as some award holders may not yet have submitted applications for further funding by the EOG stage.

Of the 73 awardees that leveraged additional funding, 60 awardees reported between one and three additional awards, 9 awardees reported between four and six additional awards, and 4 awardees reported between seven and twelve additional awards. Overall, the value of individual leveraged awards varied greatly, from €10,000 to develop a postgraduate diploma in cancer genetics, to €41.3 million from Science Foundation Ireland to establish a Centre for Research in Medical Devices.

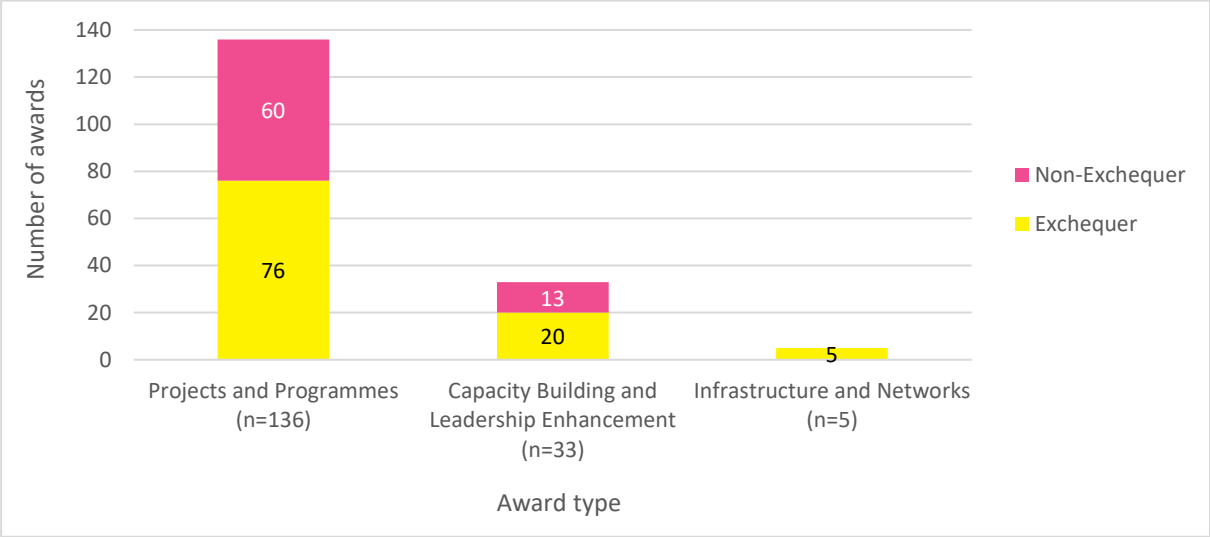


Figure 6.8: Number of additional research awards leveraged, per award type, 2018–19

As shown in Table 6.6, Projects and Programmes awards accounted for 78% (n=136) of all leveraged awards and 91% of the total value leveraged. This represented 4.2 awards leveraged per €1 million spend, representing a return on investment of €2.86 for every €1.00 invested. Capacity Building and Leadership Enhancement awards accounted for 19% of the total number of leveraged awards and represented 8% of the total value of leveraged awards. This represented two awards leveraged per €1 million invested and a return on investment of €0.48 per €1.00 spent.

Infrastructure and Networks awards accounted for 3% of leveraged awards and made up 1% of the total value of leveraged funding. This represented 6.6 awards leveraged per €1 million invested and a return on investment of €0.89 per €1.00 spent. This is an increase in this award type from the return of €0.48 per €1.00 spend reported in 2016–17.

Table 6.6: Comparison of number and value of leveraged awards and productivity, per award type, 2018–19

Award type	Total value of awards leveraged	Value of leveraged awards secured per €1 million invested	Number of awards leveraged per €1 million invested
Projects and Programmes (n=136)	€91,694,796	€2,856,536	4.2
Capacity Building and Leadership Enhancement (n=33)	€8,026,747	€480,644	2.0
Infrastructure and Networks (n=5)	€675,399	€888,683	6.6

6.2.2 Distribution of leveraged funding, by broad research area

Figure 6.10 looks at the amount of leveraged funding obtained by broad research area and its value per €1 million spend, while Figure 6.11 looks at the distribution of funding sources across the broad research areas. These figures should be interpreted with caution, however, as some award holders may not yet have submitted applications for further funding by the EOG stage.

Table 6.7 shows that 43% of all leveraged funding was associated with awards classified as Clinical Research, and 44% was associated with awards classified as Applied Biomedical Research. This represented 4.1 and 4.8 awards per €1 million invested, respectively, and a return on investment of €3.3 and €3.9 per €1.00 invested. This was similar to 2016–17, when it was reported that Applied Biomedical Research was the research area that leveraged the largest amount of funding. Population Health Sciences accounted for 7% of the leveraged funding, leveraging an average of 4.2 awards per €1 million invested and a return on investment of €1.37 per €1.00 invested. Health Services Research accounted for 6% of leveraged funding, 2.2 awards per €1 million invested, and the lowest return on investment, at €0.32 per €1.00 invested.

It is notable that while Health Services Research received the highest proportion of HRB funding (40%; see Figure 2.4), this research area achieved the lowest amount of leveraged funding. This may be due in part to the nature of the research, and to the fact that the PhD Scholars Programmes which accounts for the largest share of this area, funds postgraduate researchers These awards are not expected to leverage large amounts of funding.

Table 6.7: Value of leveraged award and productivity, per broad research area, 2018–19

Broad research area	Total value of awards leveraged	Value of leveraged awards secured per €1 million invested	Number of awards leveraged per €1 million invested
Applied Biomedical Research (n=55.0)	€44,320,003	€3,853,913	4.8
Clinical Research (n=53.5)	€42,908,701	€3,300,669	4.1
Health Services Research (n=44.5)	€6,342,550	€318,721	2.2
Population Health Sciences (n=21.0)	€6,825,689	€1,365,138	4.2

Figure 6.9 shows that additional funding was leveraged across all broad research areas. Clinical Research and Applied Biomedical Research were represented across most funding sources and accounted for most

of the funding from Science Foundation Ireland, EU Framework Programmes, other EU programmes, international industry, and international charity. Health Services Research was represented across almost all sources, with HRB being the biggest funding source, and accounted for most of the funding from other international funding agencies and philanthropic organisations. Population Health Sciences was represented mainly in funding from HRB, Enterprise Ireland, and to a lesser extent Science Foundation Ireland, other EU programmes, national industry, national universities and Government departments.

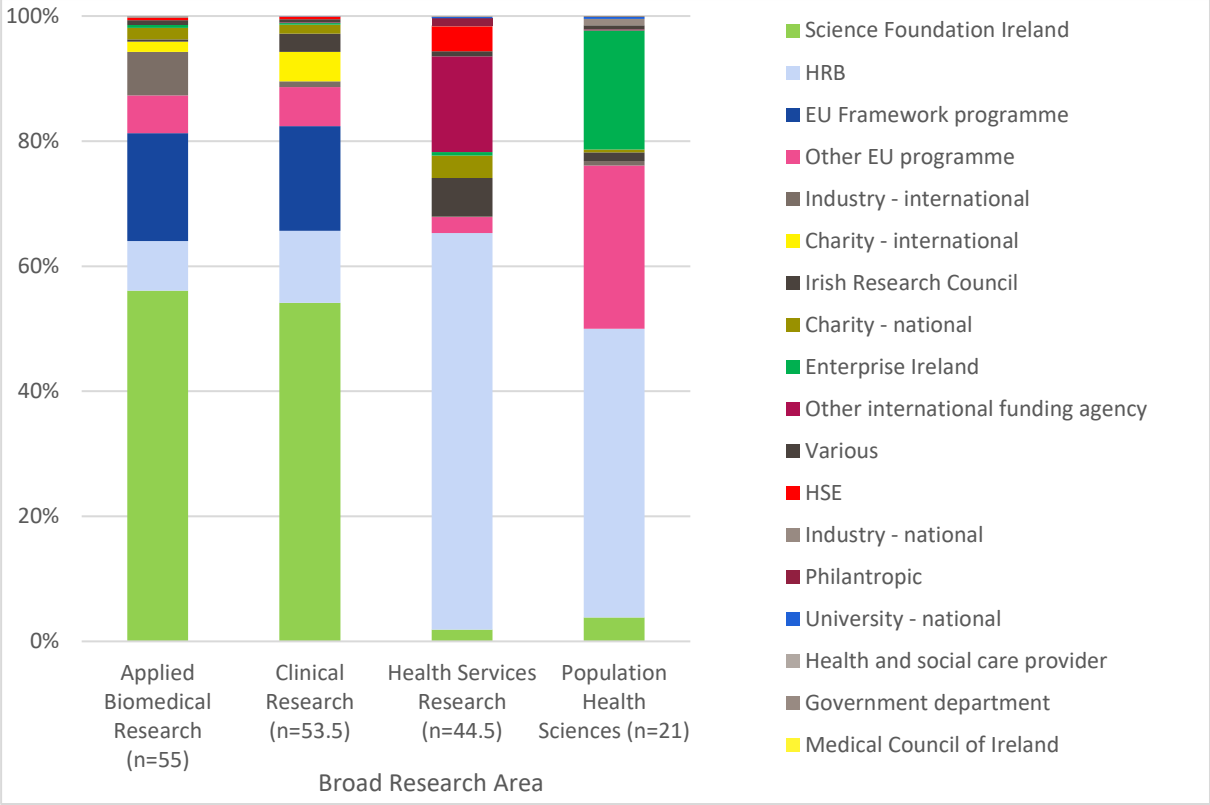


Figure 6.9: Source of funding, per broad research area, 2018–19

6.3 Examples of leveraged funding

Table 6.6 provides examples of the types of leveraged funding secured by holders of awards that completed in 2018–19.

Table 6.8: Examples of leveraged funding, 2018–19

Award	Award type	Source of funding	Title of award/Description
Collaborative Applied Research Grants	Projects and Programmes	HSE	PRIMERA (Promoting Research and Innovation in Mental hEalth seRvices for fAmilies)
Collaborative Applied Research Grants	Projects and Programmes	HRB	The LinKT (Linking into Knowledge Translation) project: connecting, integrating, and translating evidence to make a difference for families
Collaborative Applied Research Grants	Projects and Programmes	Charity – international	Enhancing social emotional health and well-being in the early years: A community-based randomised controlled trial (and economic evaluation) of the Incredible Years (IY) Infant and Toddler Parenting Programmes (the E-SEE project).

Award	Award type	Source of funding	Title of award/Description
Collaborative Applied Research Grants	Projects and Programmes	Industry – international	Equivalency Study of Clinician and Self Collected Samples for Cervical Cancer Screening Protocol No. MULTI HPV 463
Collaborative Applied Research Grants	Projects and Programmes	HRB	Enhancing the Evidence Base for Cost-Effectiveness Analysis in Ireland: Building Improvements from the Intervention-Specific to System-Wide Levels
Translational Research Awards	Projects and Programmes	EU Framework programme	Controlling Cartilage to Bone Transitions for Improved Treatment of Bone Defects and Osteoarthritis
Health Research Awards	Projects and Programmes	HSE	To do additional work with the Integrated Care Programmes for Older People (ICPOP). This allowed us to co-fund a researcher for a short period of time to carry out an in-depth case study into the ICPOP. A journal article has been submitted and multiple presentations have been given in relation to this work.
Cancer Prevention Fellowship Programme	Capacity Building and Leadership Enhancement	Science Foundation Ireland	Functional application of genomic variants to deliver personalised strategies for pancreatic cancer patients
Translational Research Awards	Projects and Programmes	Science Foundation Ireland	CURAM Centre for Research in Medical Devices
Health Research Awards	Projects and Programmes	EU Framework programme	MEL-PLEX (Exploiting MELanoma disease comPLEXity to address European research training needs in translational cancer systems biology and cancer systems medicine)
Health Research Awards	Projects and Programmes	EU Framework programme	H2020-MSCA-ITN-2017 GlioTrain (Exploiting GLIOblastoma intractability to address European research TRAINing needs in translational brain tumour research, cancer systems medicine, and intergrative multi-omics)
MRCG-HRB Joint Funding Scheme	Projects and Programmes	EU Framework programme	Identification of Histone deacetylase (HDAC) inhibitors as novel therapeutic drugs for inherited retinal degenerative diseases.
Joint Programme in Neurodegenerative Diseases	Projects and Programmes	Charity – international	A Randomised Controlled Study of Psychological intervention in Amyotrophic Lateral Sclerosis (ALS) to Address the Significant and Complex Mental Health Needs of Caregivers.

7 Informing policy and practice

Translating research into improved policies and practices is a strategic driver for the HRB. This translation occurs in many ways, but engagement – communicating and exchanging information and expertise – between researchers, the public, and policy-makers is crucial. Indicators that HRB award holders are working to achieve outputs and outcomes in this realm include efforts to ensure that research evidence can contribute to policy development and improvements in clinical practice, and contribute evidence to, or be actively involved in, clinical guideline development, curriculum development, and regulation.

Summary of policy and practice outputs, 2018–19, compared to previous reporting periods

Health policy and clinical practice outputs/influences	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Total number of policy and practice outputs	190	187	105	127	99	84
Percentage of awards reporting policy and practice outputs	43.0%	44.9%	26.8%	38.0%	24.0%	20.0%
Average number of policy and practice outputs per €1 million spend	3.8	3.8	1.9	2.9	1.8	0.9

Key findings

- Overall, the number of awards reporting policy and practice outputs continues to increase each year, with 190 policy and practice outputs reported in 2018–19.
- The most common approach to disseminating research results in the policy and clinical practice spheres was to present findings to relevant stakeholders (policy-makers, health managers, etc.) through seminars, workshops, and face-to-face meetings.
- The likelihood of a PI seeking to influence policy or clinical practice was strongly associated with the type of research being undertaken, with Health Services Research and Population Health Sciences being the most productive research areas in terms of outputs per €1 million spend. This is consistent with trends in previous reporting periods.
- Award holders employed a range of influencing strategies in order to achieve specific impacts, with particular emphasis on influencing the development of policy and informing product/ service/ programme development and evaluation.
- From 2008 to 2019, the average share of awards reporting at least one instance of a policy and practice output is 33%. This is higher than the 25% of MRC award holders who reported policy influences over a similar time frame.

7.1 Health policy and practice outputs and influences

One of the HRB's core objectives is to encourage the uptake of evidence generated through HRB research investment in the development of policy and the improvement of clinical and public health practice. Therefore, a key metric in terms of assessing the potential impact of HRB-funded research relates to outputs and activities that have the potential to influence health policy, clinical practice, and patient care.

Award holders can ensure that the evidence generated by their HRB-funded research can influence policy and practice in many ways, including through:

- Publication of reports, guidelines, policy briefs, handbooks, etc. that are targeted at health policy-makers or practitioners
- Interactions with research beneficiaries/users in the health policy or clinical practice sectors (e.g., hosting meetings or seminars)
- Advisory roles or expert group memberships (e.g., guideline committee or policy development group)
- Instances of their HRB-funded research being cited in key clinical or health policy documents, and
- Research findings being used to inform the education or training of health professionals or policy-makers.

HRB award holders appear to be increasingly active in this regard, continuing the trend of previous reporting periods. In total, award holders whose awards completed in 2018–19 reported 190 policy and practice outputs from 71 awards (42% of all awards ending in 2018–19).

When examining long-term trends from 2008 to 2019, the average proportion of awards reporting at least one instance of a policy and practice output in each period is 33%. This is higher than the 25% of MRC award holders who reported policy influences within a similar time frame. Furthermore, the number of policy and practice outputs per €1 million spend has increased since reporting commenced, from 0.9 outputs per €1 million spend reported in 2008–09 to 3.8 outputs in 2018–19.

7.1.1 Distribution of policy and practice outputs by type

Table 7.1 shows the breakdown of the reported policy and practice outputs and influences by subtype in 2018–19. A common approach that award holders took to disseminating their research results in the policy and clinical practice spheres was to present their findings to relevant stakeholders (policy-makers, health managers, etc.) through seminars, workshops, and face-to-face meetings. This approach accounted for 48% (n=91) of all outputs reported, similar to the 2016–17 reporting period. Influencing the training or education of health professionals and/or policy-makers (13%, n=25), fulfilling an advisory role or becoming a member of a policy committee (8%, n=16), or publishing in a specialised medical or health publication (5%, n=10) were also cited as key activities.

Table 7.1: Breakdown of policy and practice outputs, per type, 2018–19

Output/influence subcategory	Number of outputs	Percentage of total outputs
Hosted or presented research findings at a stakeholder seminar or workshop (i.e., for policy-makers, health managers, key users)	91	48%
Influenced training or education of health professionals and/or policy-makers	25	13%
Advisory role on, or member of, a policy committee	16	8%
Coverage in specialised medical or health publications (e.g., *Irish Medical Times*)	10	5%
Published a policy report/brief or booklet	9	5%
Published practice/treatment guidelines/standards	6	3%
Published or updated a Cochrane systematic review as part of HRB-funded research	5	3%

Output/influence subcategory	Number of outputs	Percentage of total outputs
Research featured in a newsletter, or on the website, of a professional body	5	3%
Submitted evidence to a government review group or national consultation process	5	3%
Submitted evidence to, or was a member of, a clinical/best practice guideline committee	4	2%
Citation in clinical guidelines	4	2%
Citation in a systematic review	4	2%
Citation in a clinical review	3	2%
Citation in other policy documents	3	2%
Total	**190**	**100%**

The results emerging from HRB-funded awards demonstrated an increase in the number of citations of HRB-funded research in influential policy and clinical practice documents such as clinical guidelines, clinical reviews, policy documents, and government reports. Figure 7.1 shows the key policy and practice outputs grouped under five key categories.

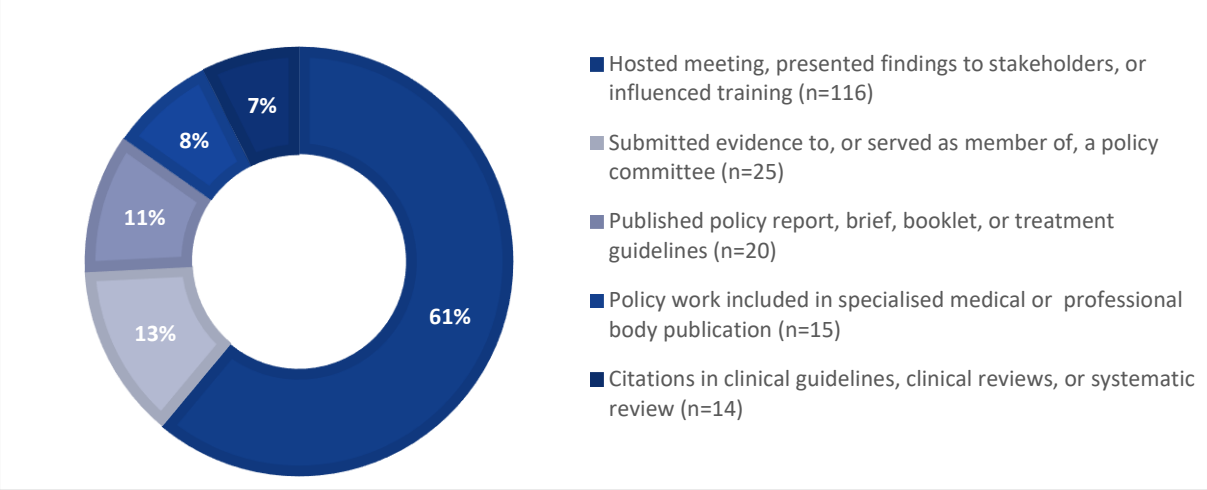
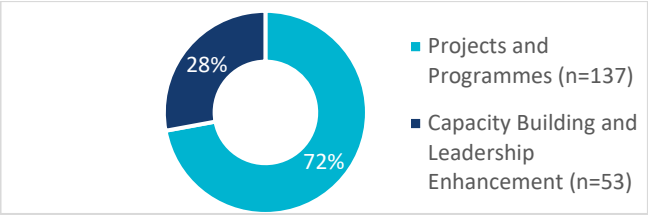


Figure 7.1: Types of policy and practice outputs, grouped into five key categories, 2018–19

7.1.2 Distribution of policy and practice influences by award type

In terms of the distribution of policy and practice outputs across award types, Figure 7.2 shows that Projects and Programmes awards accounted for 72% of all reported policy and clinical practice outputs (n=137) and were the most productive, with 4.3 outputs per €1 million spend. This is consistent with 2016–17, when 4.7 outputs were noted per €1 million spend on Projects and Programmes awards. Capacity Building and Leadership Enhancement awards accounted for 28% of outputs reported and resulted in 3.2 outputs per €1 million spend, which is higher than the 2.2 outputs per €1 million spend recorded in 2016–17. There were no policy and practice outputs recorded for the single Infrastructure and Networks award ending in 2018–19.



Number of reported policy and practice outputs per €1 million spend	
Projects and Programmes	4.3
Capacity Building and Leadership Enhancement	3.2

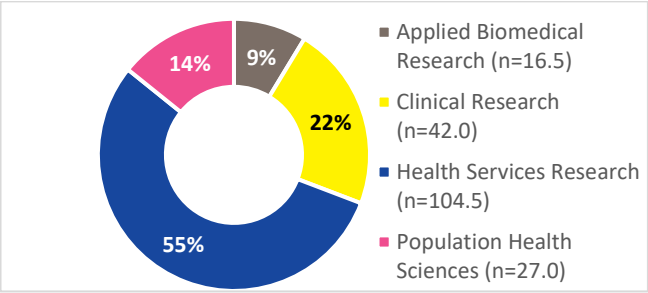
Figure 7.2: Share of policy and practice outputs and productivity, per award type, 2018–19

7.1.3 Distribution of policy and practice influences, by broad research area

The likelihood of a PI seeking to influence policy or clinical practice will, to a large extent, depend on the type of research being undertaken. Clinical Research, Population Health Sciences, and Health Services Research areas might be expected to be more productive than Applied Biomedical Research in terms of attempting to influence policy or clinical practice.

This is verified in Figure 7.3, which shows that these three broad research areas accounted for 91% of all policy and clinical practice influences. However, this distribution was somewhat different when the number of outputs per €1 million spend was considered. Using this metric, Population Health Sciences had the highest number of outputs per €1 million spend, with 5.4, a pattern consistent with 2016–17. Health Services Research produced the most outputs (n=104.5, 55%) and had 5.3 outputs per €1 million spend. Surprisingly, awards classified as Clinical Research (which might be expected to produce considerable clinical practice outputs) produced only 3.2 outputs per €1 million spend. This trend is, however, consistent with the 2016–17 reporting period.

Awards classified as Applied Biomedical Research were the least productive in terms of policy and practice outputs, accounting for 1.4 outputs per €1 million spend. This is not an entirely surprising result, since these types of awards are more focused on outputs in the categories of knowledge production and capacity building, rather than in the categories of influencing policy and clinical practice.



Number of reported policy and practice outputs per €1 million spend	
Applied Biomedical Research	1.4
Clinical Research	3.2
Health Services Research	5.3
Population Health Sciences	5.4

Figure 7.3: Policy and practice outputs and productivity, per broad research area, 2018–19

Figure 7.4 examines the distribution of policy and practice influence across the broad research areas by type of influence. This shows that holders of awards classified as Health Services Research used all mechanisms available to them – particularly that of hosting or presenting their research findings at stakeholder workshops and seminars, and meeting with policy-makers, health managers, and other key service users to discuss the implications of their research findings. This mechanism was also the most popular mechanism used by award holders in Clinical Research and Population Health Sciences seeking to influence developments in policy or clinical practice, although award holders in these broad research areas used the wider range of mechanisms to a lesser extent. Award holders in Clinical Research also used the publication of policy briefs and the presentation of results to stakeholders in order to influence policy

and clinical practice, while Population Health Sciences award holders reported many instances of influencing the training and education of healthcare professionals and/or policy-makers.

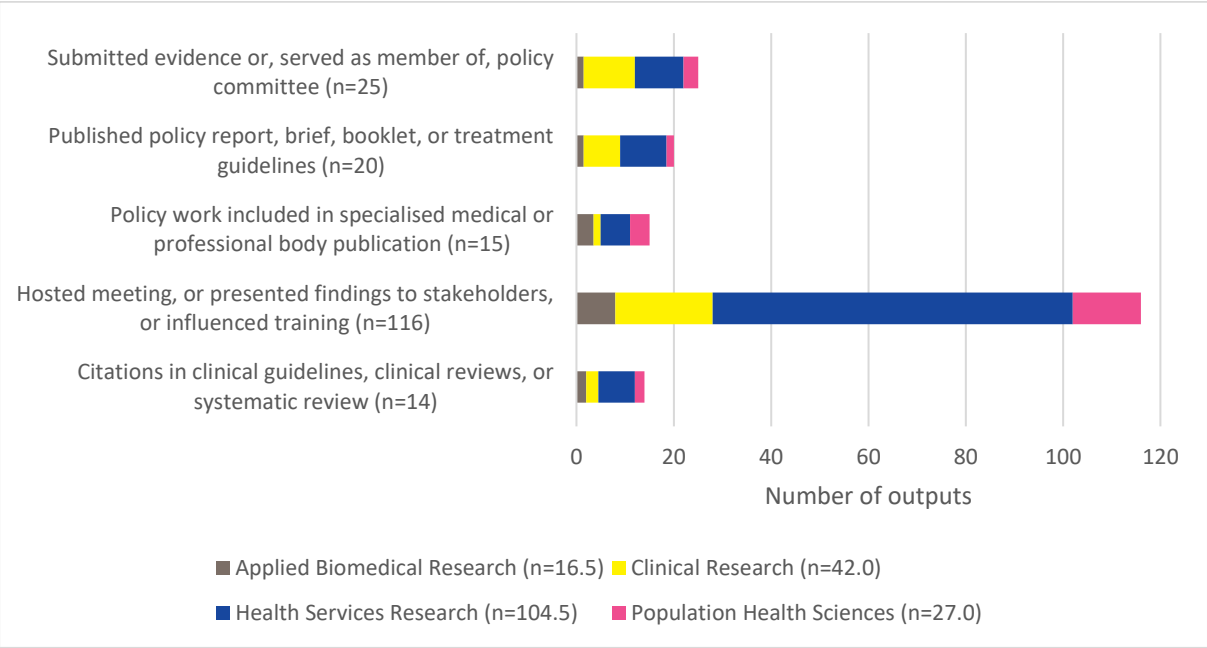


Figure 7.4: Types of policy and practice outputs, per broad research area, 2018–19

7.1.4 Distribution of policy and practice influences, by scheme

Table 7.2 captures the number of policy and practice outputs reported by individual schemes and examines the total number of outputs as a proportion of the total number of awards ending in 2018–19.

The primary focus of HRB-funded research investment is on the generation of opportunities for improved healthcare delivery and better health outcomes, and on the generation of research evidence in order to inform policy and improve clinical practice. Table 7.2 demonstrates the realisation of this objective broken down by scheme. The average number of outputs per award was 2.7, with 42% of all funded awards generating at least one policy and practice output.

Table 7.2: Distribution of policy and practice outputs, per scheme, 2018–19

	Number of policy and practice outputs, 2018–19	Total number of awards reporting policy and practice outputs, 2018–19	Total number of awards funded per scheme, 2018–19	Average number of outputs per award, 2018–19	Percentage of awards in each scheme generating policy and practice outputs, 2018–19
Applied Partnership Awards	2	2	2	1.0	100%
Applied Research Projects in Dementia	3	3	3	1.0	100%
Cancer Prevention Fellowship Programme	0	0	2	0.0	0%
Clinician Scientist Awards	3	1	1	3.0	100%
Cochrane Training Fellowships	5	5	15	1.0	33%
Collaborative Applied Research Grants	28	4	4	7.0	100%

	Number of policy and practice outputs, 2018–19	Total number of awards reporting policy and practice outputs, 2018–19	Total number of awards funded per scheme, 2018–19	Average number of outputs per award, 2018–19	Percentage of awards in each scheme generating policy and practice outputs, 2018–19
Health Research Awards	49	23	61	2.1	38%
HRB Trials Research Methodology Network	0	0	1	0.0	0%
Interdisciplinary Capacity Enhancement Awards	4	1	2	4.0	50%
Investigator Led Projects	1	1	2	1.0	50%
Joint Programme in Neurodegenerative Diseases	0	0	2	0.0	0%
Knowledge Exchange and Dissemination Scheme	41	17	38	2.4	45%
Medical Education Research Grants	13	2	2	6.5	100%
MRCG-HRB Joint Funding Scheme	7	2	9	3.5	22%
National SpR/SR Academic Fellowship Programme	3	2	2	1.5	100%
Project Development Grant	3	2	3	1.5	67%
Research Collaborative in Quality and Patient Safety	0	0	2	0.0	0%
Research Leader Awards	3	1	1	3.0	100%
Research Training Fellowships for Healthcare Professionals	18	6	15	3.0	40%
Translational Research Awards	3	2	3	1.5	67%
PhD Scholars Programmes	4	1	1	4.0	100%
Total	**190**	**71**	**170**	**2.7**	**42%**

Table 7.3 provides a breakdown of the type of policy and practice outputs reported per scheme. The highest number of policy and practice outputs were from Health Research Awards (n=49, 26%), the Knowledge Exchange and Dissemination Scheme (n=41, 22%), Collaborative Applied Research Grants (n=28, 15%), and Research Training Fellowships for Healthcare Professionals (n=18, 9%). The Health Research Awards and Collaborative Applied Research Grants produced outputs in all five key categories of policy and practice outputs. Overall, schemes that produced more than one output were strongly focused on the broad research areas of Health Services Research or Population Health Sciences.

Notably, 100% of the Clinician Scientist Awards, Collaborative Applied Research Grants, Medical Education Research Grants, National SpR/SR Academic Fellowship Programme, Research Leader Awards, and PhD Scholars Programmes awards that ended in 2018–19 reported policy and practice outputs. The schemes that did not have a high proportion of awards reporting evidence of policy and practice outputs were as expected, such as the short-term Knowledge Exchange and Dissemination Scheme awards, methodology awards, and awards focused on generating research capacity.

Table 7.3: Types of policy and practice outputs, per scheme, 2018–19

Scheme	Hosted meeting,, presented findings to stakeholders , or influenced training	Submitted evidence to, or served as a member of, a policy committee	Published policy report, brief, booklet, or treatment guidelines	Policy work included in specialised medical or professional body publication	Citations in clinical guidelines, clinical reviews, or systematic reviews	Total
Health Research Awards	23	13	5	4	4	**49**
Knowledge Exchange and Dissemination Scheme	33	1	4	3		**41**
Collaborative Applied Research Grants	18	2	1	5	2	**28**
Research Training Fellowships for Healthcare Professionals	10	4		1	3	**18**
Medical Education Research Grants	7	1	4	1		**13**
MRCG-HRB Joint Funding Scheme	4	1		1	1	**7**
Cochrane Training Fellowships	2		3			**5**
PhD Scholars Programmes	4					**4**
Interdisciplinary Capacity Enhancement Awards	3	1				**4**
Applied Research Projects in Dementia	2	1				**3**
Research Leader Awards					3	**3**
Translational Research Awards	3					**3**
Project Development Grant	2	1				**3**
Clinician Scientist Awards	1		1		1	**3**
National SpR/SR Academic Fellowship Programme	1		2			**3**
Applied Partnership Awards	2					**2**
Investigator Led Projects	1					**1**
Total	**116**	**25**	**20**	**15**	**14**	**190**

7.2 Potential impacts on policy and practice

Award holders were asked not only about how they attempted to inform policy or clinical practice through various dissemination strategies, but also about the potential impact of this work and how they hoped that these activities might inform or underpin policy and/or practice.

Table 7.4 shows the types of potential impacts on policy and practice selected by award holders. This illustrates that the most common impacts award holders hoped to achieve through their activities were to inform policy development (21%, n=39), inform product/service/programme development and evaluation (19%, n=36), and inform clinical care pathways and/or clinical practice guidelines (19%, n=36). Following this, award holders reported their efforts to underpin improvements in quality and patient safety (9%, n=18); in access to, and delivery of, services (9%, n=17); in health and well-being (7%, n=13); and in quality of life of patients, family, and caregivers (5%, n=10).

Table 7.4: Potential impacts of policy and practice outputs identified by HRB award holders, 2018–19

	Number of potential impacts	Percentage of total potential impacts
Inform policy development	39	21%
Inform product/service/programme development and evaluation	36	19%
Inform clinical care pathways and/or clinical practice guidelines	36	19%
Underpin improvements in quality and patient safety	18	9%
Underpin improvements in access to, and delivery of, services	17	9%
Underpin improvements in health and well-being	13	7%
Underpin improvements in quality of life of patients, family, and caregivers	10	5%
Underpin clinical care/health system configuration models	9	5%
Underpin financing and resource allocation decisions	5	3%
Inform regulatory/legislative developments	3	2%
Underpin strategies resulting in efficiencies and cost savings	2	1%
Underpin equity in service delivery	2	1%
Total	**190**	**100%**

To examine these figures further, Figure 7.5 outlines the influencing/dissemination strategies used by award holders in order to achieve their desired impact.

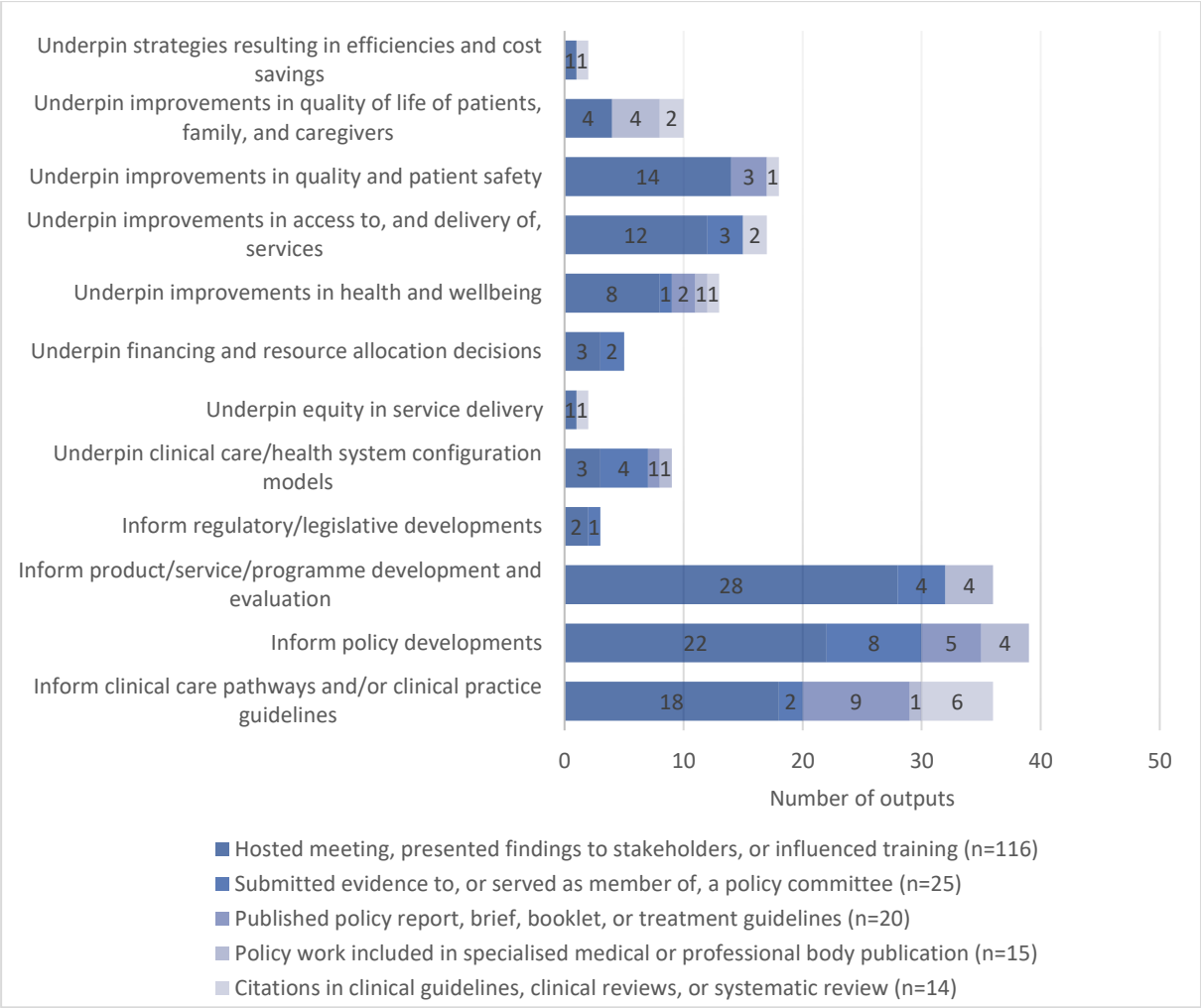


Figure 7.5: Influencing strategies used by HRB award holders to achieve desired policy and practice impacts, 2018–19

7.3 Examples of policy and practice influences

Table 7.5 provides some examples of the types of policy and practice outputs reported for this metric by award holders whose awards completed in 2018–19.

Table 7.5: Examples of policy and practice outputs, 2018–19

Scheme	Type(s) of policy and practice output(s)	Potential impact	Details of policy/practice output(s)
Health Research Awards	Policy work included in specialised medical or professional body publication	Inform policy development	Research on inherited retinal disorders and gene therapies. Focused on the importance of genetic diagnosis and the development of gene therapies for a group of heterogeneous Mendelian disorders with approximately 300 genes implicated to date.
Health Research Awards	Submitted evidence to, or served as a member of, a policy committee	Inform policy development	Professor Mary Cannon was a member of the Youth Mental Health Taskforce and helped to write the 2017 Taskforce report: https://www.gov.ie/en/publication/117

Scheme	Type(s) of policy and practice output(s)	Potential impact	Details of policy/practice output(s)
			520-national-youth-mental-health-task-force-report-2017/
Health Research Awards	Hosted meeting, presented findings to stakeholders, or influenced training	Underpin financing and resource allocation decisions	Award holder engaged with policy-makers who are directly involved in decisions around resource allocation in the Irish healthcare system and who are responsible for the implementation of Sláintecare. Key stakeholder seminar was attended by the Secretary General of the Department of Health and the Chief Executive Officer of the HSE.
Health Research Awards	Submitted evidence to, or served as a member of, a policy committee	Inform regulatory/legislative developments	Award holder submitted evidence to inform, educate, and discuss advance care directives and the Let Me Decide Study.
Health Research Awards	Hosted meeting, presented findings to stakeholders, or influenced training	Inform policy development	Award holder met with the Minister of State for Primary Care, Mental Health and Disability in order to inform policy development.
National SpR/SR Academic Fellowship Programme	Hosted meeting, presented findings to stakeholders, or influenced training	Inform clinical care pathways and/or clinical practice guidelines	Award holder participated in the National Cancer Control Programme's Hereditary Cancer Oversight Group.
Research Leader Awards	Citations in clinical guidelines, clinical reviews, or systematic reviews	Inform clinical care pathways and/or clinical practice guidelines	Award holder contributed to the NICE guideline [NG89]: Venous thromboembolism in over 16s: reducing the risk of hospital-acquired deep vein thrombosis or pulmonary embolism.
Research Training Fellowships for Healthcare Professionals	Hosted meeting, presented findings to stakeholders, or influenced training	Inform clinical care pathways and/or clinical practice guidelines	Dr Amanda Drury met with clinical, policy, and advocacy stakeholders in St James's Hospital, Tallaght University Hospital, the National Cancer Control Programme, and patient advocacy groups to disseminate the key results of The Cost of Survival Study and to identify opportunities for collaboration in order to develop and evaluate the complex intervention that was developed based on the results of The Cost of Survival Study.
Translational Research Awards	Hosted meeting, presented findings to stakeholders, or influenced training	Inform clinical care pathways and/or clinical practice guidelines	Experience with cardiac magnetic resonance imaging has made this the imaging modality of choice in patients with anterior ST-elevated myocardial infarction (STEMI) in preference to echocardiogram within 48 hours of hospital admission.

8 Non-academic engagement activities and PPI

Engaging with audiences outside of academia is an important part of the research process. Wider dissemination of research findings to non-scientific audiences is vital for improving the public understanding of complex research topics, for recruiting patients to clinical trials and engaging the public in the design and conduct of research, and for communicating the benefits and value of health research to non-scientific stakeholders. Involving patients, carers and the public in the conception, design, analysis, and reporting of research activity adds considerable value and relevance and increases the potential for uptake of the evidence generated.

Summary of non-academic engagement and PPI outputs, 2018–19, compared to previous reporting periods

Activity type	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Non-academic engagement						
Total number of non-academic engagement activities	473	531	258	188	122	N/A
Percentage of award holders reporting non-academic engagement activity	60%	71%	48%	50%	35%	N/A
Average number of non-academic engagement activities per €1 million spend	9.5	11.2	4.7	4.6	2.2	N/A
Average number of non-academic engagement activities per award	2.8	2.8	1.3	1.4	0.6	N/A
Public and patient involvement (PPI)						
Percentage of awards reporting PPI activities	45.0%	21.9%	N/A	N/A	N/A	N/A
Number of PPI activities reported	575	354	N/A	N/A	N/A	N/A

* N/A indicates that these engagement outputs were not included in the survey for that reporting period.

Key findings

- Sixty per cent of award holders reported 473 non-academic engagement outputs.
- Participation in workshops, open days or similar activities, and presentations to non-academic audiences were the most popular forms of engagement. A similar distribution is evidenced in MRC data. There was an increase in award holders reporting the use of online publications and blogs to disseminate their research findings.
- Projects and Programmes awards were the most productive award types in terms of engagement outputs per €1 million spend (12.4), and Population Health Sciences was the most productive broad research area in terms of engagement outputs per €1 million spend (13.2).
- From 2010 to 2019, the average number of award holders reporting non-academic engagement activity was 53%, which is similar to the 64% reported by MRC award holders.
- In terms of PPI in research, 80 award holders (45% of total) reported 575 PPI activities during the period of their research project. This is a significant increase from the figures reported in the 2016–17 reporting period.

8.1 Non-academic engagement outputs

When asked if they had engaged in wider dissemination of their research to non-academic audiences through various fora, 102 (60%) of all award holders reported 473 outputs in this area. The average number of outputs per award was 2.8, consistent with 2016–17. This metric has increased since 2010–11, when an average of 0.6 activities per award were reported. Fifty-five award holders reported between 1 and 3 engagement activities, twenty-two award holders reported between 4 and 6 engagement activities, sixteen award holders reported between 7 and 10 engagement activities, and seven award holders reported between 11 and 21 engagement activities. Two award holders of a Translational Research Award and a Collaborative Applied Research Grant reported 22 and 27 engagement activities, respectively.

When examining trends from 2010–11 to 2018–19, the average number of award holders reporting non-academic engagement activity in each reporting period was 53%, which is slightly less than the 64% reported by MRC award holders.

8.1.1 Distribution of non-academic engagement outputs, by type

Table 8.1 provides a breakdown of non-academic engagement outputs by type. This shows that participation in non-academic workshops, open days, and presentations to various non-academic audiences, including schoolchildren, were the most popular forms of communication, accounting for 47.5% of non-peer dissemination outputs (n=225). This is consistent with reporting trends in previous years.

Disseminating research findings in traditional media, including local, regional, national, and international press, radio, and TV interviews press releases and press conferences, international press coverage and coverage in popular magazines accounted for 31.9% of dissemination outputs. Online engagement via social media, blog posts, and the launching or ongoing updating of websites accounted for 13.1%, while the production and publication of plain English material and videos/documentaries accounted for 7.3% of dissemination activities.

Table 8.1: Breakdown of non-academic engagement activities, by type, 2018–19

Engagement activity	Number of outputs	Percentage of total outputs
Hosted a discussion or presentation in a workshop, at an open day, or similar (non-academic)	204	43.1%
Coverage in online and print newspapers/magazines (national and international)	88	18.6%
Digital and social media contribution (non-academic blog or Facebook/Twitter engagement)	60	12.7%
Coverage on radio and TV (national and international)	39	8.2%
Plain English material (e.g., information booklet/newsletter)	26	5.5%
Press release, press conference, or response to a media query	24	5.1%
School or university event or a discussion on HRB-funded research	21	4.4%
Production and dissemination of a video and/or documentary	9	1.9%
Website launch and/or ongoing web page updates	2	0.4%
Total	**473**	**100%**

Table 8.2 and Figure 8.1 show the 10-year trend of non-academic dissemination activities from 2010 to 2019, inclusive. This shows that the use of presentations to, or interactions with, patients, charities,

students, and advocacy groups has remained popular over all reporting periods and has become more common since 2014–15.

Table 8.2: Comparison of engagement activities, 2010–11 to 2018–19

Type of activity	2018–19 (N=473)	2016–17 (N=532)	2014–15 (N=258)	2012–13 (N=188)	2010–11 (N=122)
Presentation to/interactions with patients, charities, students, advocacy groups, or the general public	43.1%	36.2%	27.9%	36.7%	34.1%
Coverage in local, regional, national, or international general press	18.6%	20.9%	27.5%	28.8%	56.1%
Digital and social media contribution (non-academic blog or Facebook/Twitter engagement)	12.7%	12.1%	6.2%	0.5%	0.0%
Coverage on radio or TV (national or international)	8.2%	11.3%	10.4%	9.6%	7.3%
Press release, press conference, or response to a media query	5.1%	10.0%	11.6%	8.5%	2.4%
Plain English material (e.g., information booklet/newsletter)	5.5%	5.1%	9.3%	13.3%	0.0%
Production and dissemination of a video and/or documentary	1.9%	0.0%	0.0%	0.0%	0.0%

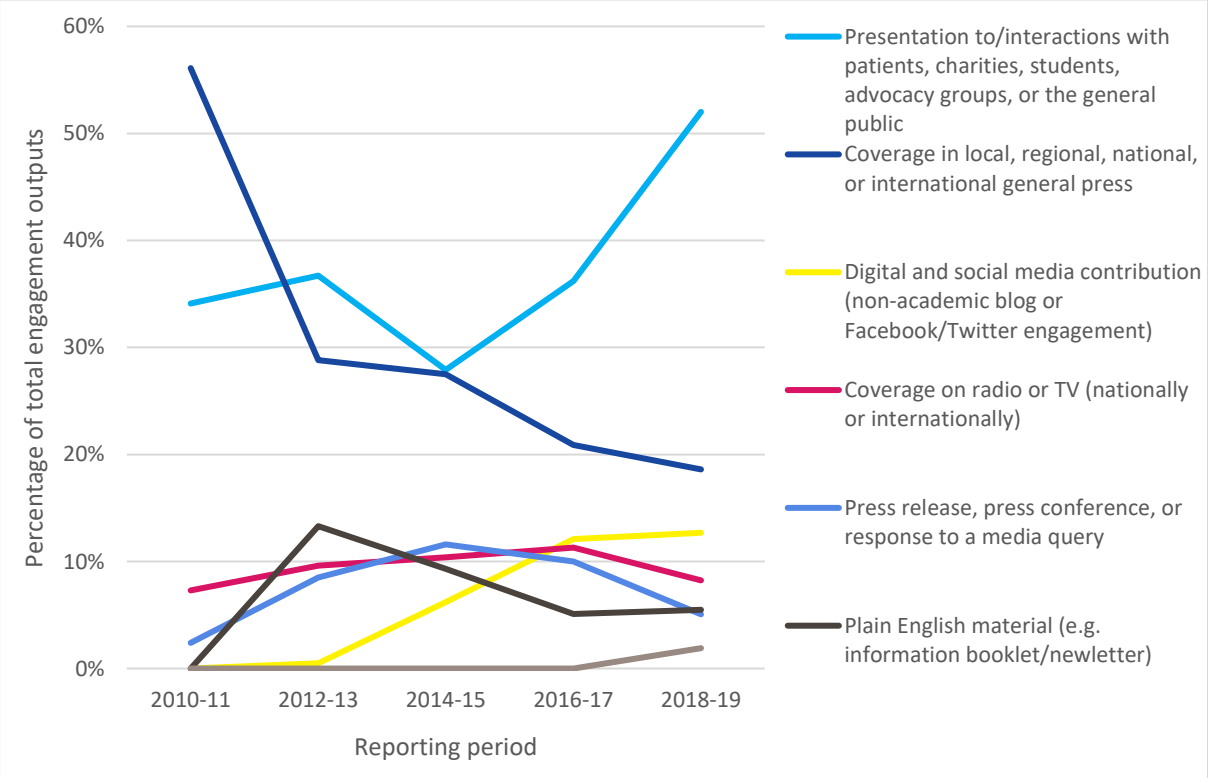


Figure 8.1: Comparison of non-academic engagement activities, 2010–11 to 2018–19

Interestingly, a decrease in engagement with traditional media, including coverage in local, regional, national, and international press and radio, and a rise in online media publications, such as social media, blog posts, and dedicated website use, is evident since 2010–11. This trend appears to have plateaued, with similar proportions of award holders reporting the use of online media for dissemination of research activities in both the 2018–19 and 2016–17 reporting periods (12.7% and 12.1%, respectively).

There has also been an increase in the use of digital media such as videos and documentaries in this reporting period, which are novel media for dissemination (1.9%, n=9).

Figure 8.2 shows the target audience of dissemination events reported by HRB award holders according to the media type. This shows that the public was by far the most common target audience, with all media types being utilised to reach this audience, particularly in-person discussions, presentations, and workshops. The use of press releases and videos/documentaries was recorded by the award holders as being targeted at the public.

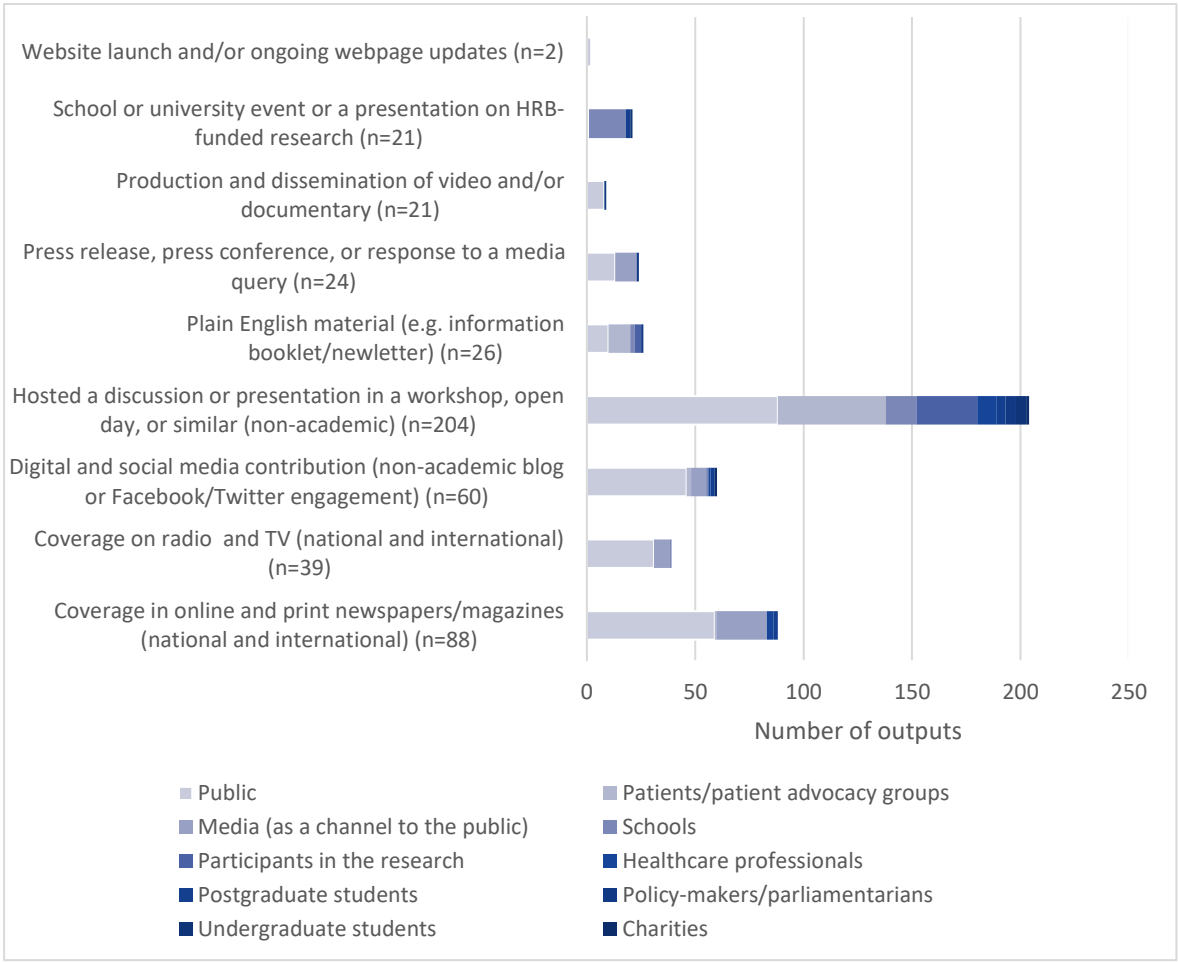
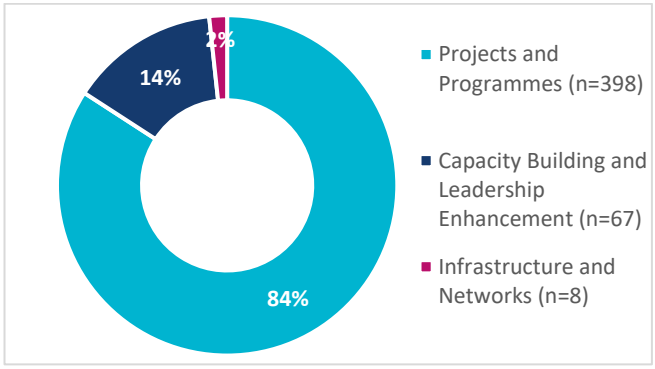


Figure 8.2: Target audience for non-academic engagement output, per media type, 2018–19

8.1.2 Distribution of non-academic engagement outputs, by award type

The distribution of engagement outputs broken down by award type and number of outputs per €1 million spend is shown in Figure 8.3. Projects and Programmes awards, which accounted for 84% of engagement activities (n=398), were the most productive in terms of public engagement, with 12.4 outputs per €1 million spend. Capacity Building and Leadership Enhancement awards accounted for 14% of engagement outputs but were considerably less productive than Projects and Programmes awards, with 4.0 engagement activities per €1 million spend. The Infrastructure and Networks award was very

productive, with 10.5 outputs per €1 million spend. This award accounted for 2% (n=8) of the total number of engagement outputs recorded in 2018–19.



Number of reported public/patient engagement outputs per €1 million spend	
Projects and Programmes	12.4
Capacity Building and Leadership Enhancement	4.0
Infrastructure and Networks	10.5

Figure 8.3: Non-academic engagement outputs and productivity, per award type, 2018–19

The distribution of engagement outputs broken down by media type and by award type is shown in Figure 8.4.

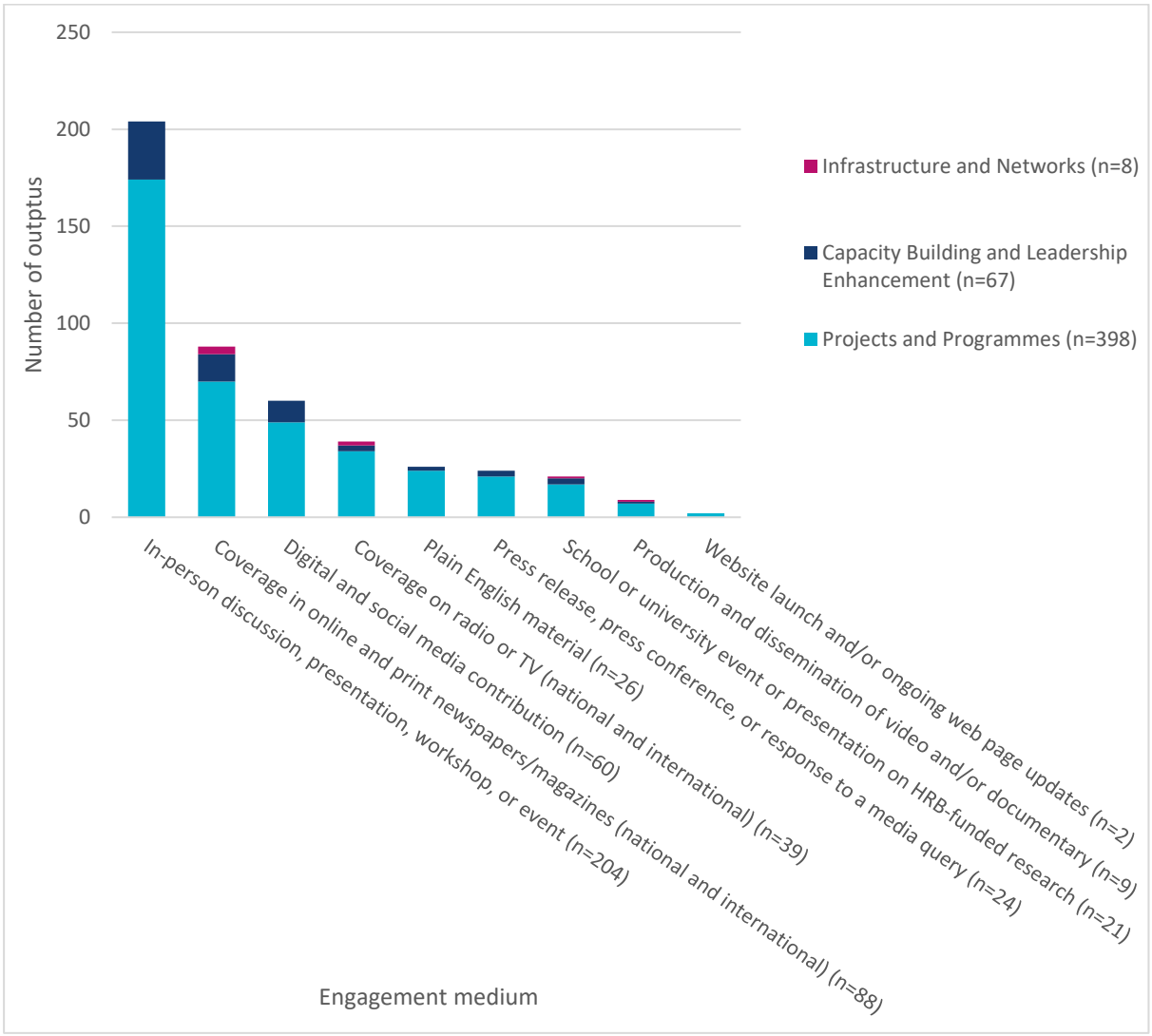


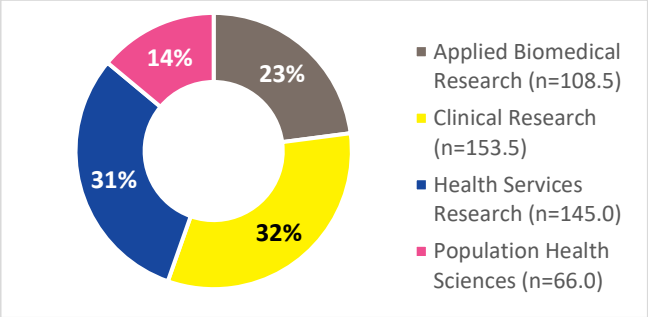
Figure 8.4: Non-academic engagement outputs, per media and award type, 2018–19

Projects and Programmes awards employed all types of media in order to disseminate research findings to non-academic audiences, with presentations to, or interactions with, patients, charities, students, advocacy groups, or the public being the most popular medium of dissemination. Coverage in local, regional, or national press accounted for the same level of engagement as social media and online dissemination among Projects and Programmes awards, while coverage in local, regional, or national press was more popular for Capacity Building and Leadership Enhancement and Infrastructure and Networks and Infrastructure and Networks awards.

8.1.3 Distribution of non-academic engagement outputs, by broad research area

The percentage distribution of non-academic engagement outputs and number of outputs per €1 million spend across the broad research areas is shown in Figure 8.5, while the distribution of dissemination outputs broken down by media type and by broad research area is shown in Figure 8.6.

Figure 8.5 shows that Population Health Sciences awards were the most productive, with 13.2 per €1 million spend, but made up only 14% of the total number of recorded activities (n=66). This is not surprising given the nature of this research, and it is heartening to see these awards achieving a high level of non-academic engagement. Applied Biomedical Research and Clinical Research awards accounted for 23% and 32% of outputs and for 9.4 and 11.8 engagement activities per €1 million spend, respectively. Health Services Research awards accounted for 145 of the total number of activities but was the least productive, with 7.3 outputs per €1 million spend.



Number of reported public/patient engagement outputs per €1 million spend	
Applied Biomedical Research	9.4
Clinical Research	11.8
Health Services Research	7.3
Population Health Sciences	13.2

Figure 8.5: Non-academic engagement outputs and productivity, per broad research area, 2018–19

In terms of the type of dissemination outputs award holders used, by broad research area, Figure 8.6 shows that in-person events were the most commonly used dissemination outputs by all broad research areas.

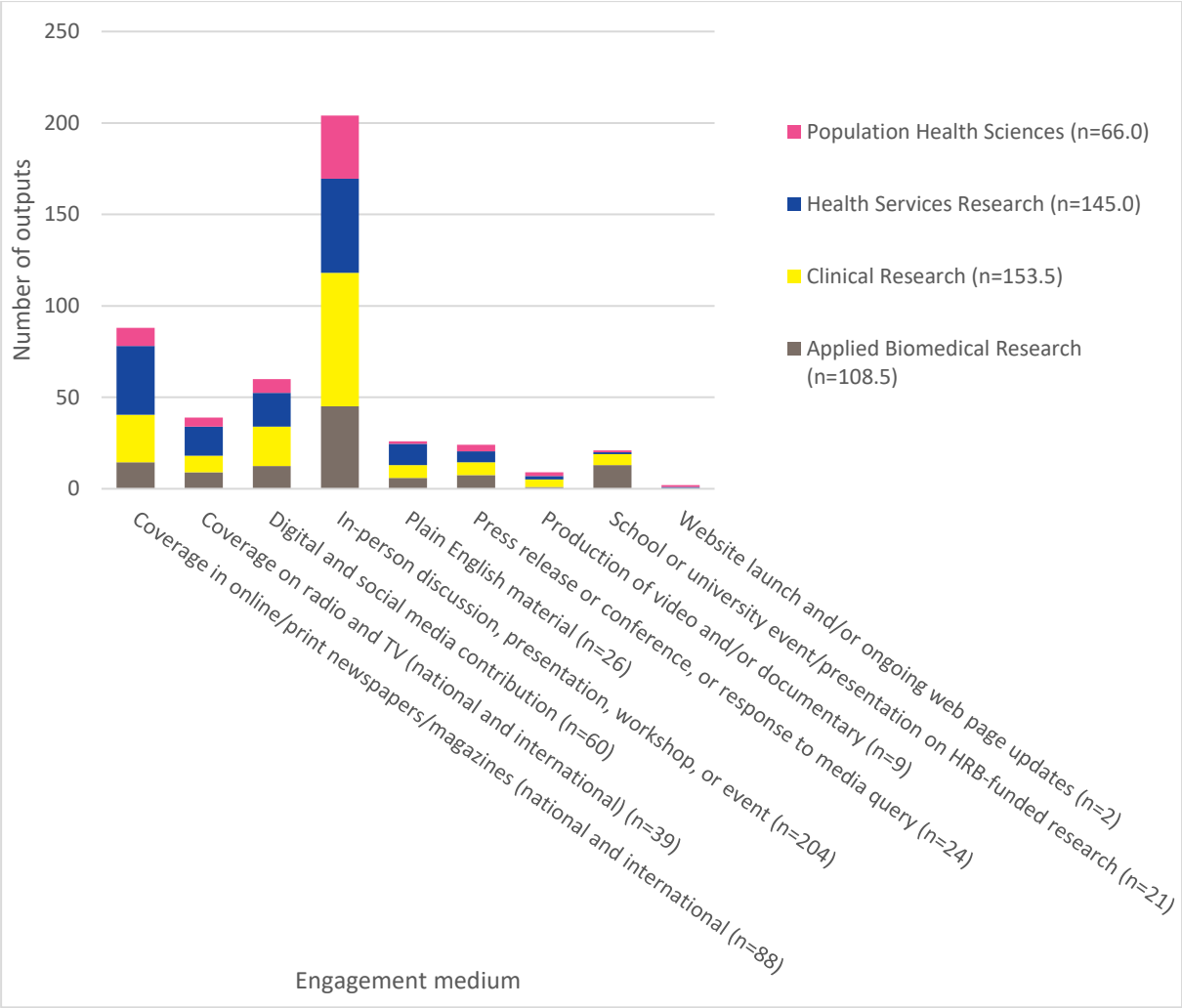


Figure 8.6: Non-academic engagement outputs, per media type and broad research area, 2018–19

8.2 Examples of non-academic engagement activities

Table 8.3 provides some examples of the types of non-academic engagement activities that HRB-funded award holders and their teams used in order to communicate the results of their research beyond the scientific community.

Table 8.3: Examples of non-academic engagement outputs, 2018–19

Scheme	Type of non-academic engagement	Description of engagement activity
PhD Scholars Programmes	Digital and social media contribution (non-academic blog or Facebook/Twitter engagement)	Frank Moriarty. Warning over inappropriate prescribing of meds. Irishhealth.ie 22 March 2017. http://www.irishhealth.com/article.html?id=25742
PhD Scholars Programmes	Coverage in online and print newspapers/magazines (national and international)	Frank Moriarty. Prescription risk for older people. Irish Examiner, 22 March 2017. http://www.irishexaminer.com/ireland/prescription-risk-for-older-people-445827.html
Health Research Awards	Production and dissemination of a	Under the associated Knowledge Exchange and Dissemination Scheme, we produced and launched a

Scheme	Type of non-academic engagement	Description of engagement activity
	video and/or documentary	medical documentary, *Mood Atlas*, which conveys the content of this grant to a public audience; it won the Best Medical Documentary award at the Sci-On Film Festival and is still touring.
Collaborative Applied Research Grants	Coverage on radio and TV (national and international)	Various interviews on national radio, including RTE Radio 1 and Newstalk (e.g. a debate on Drivetime in January 2020 with Dr Fergal Hickey of Irish Association of Emergency Medicine on the future of smaller emergency departments).
Health Research Awards	School or university event or a discussion on HRB-funded research	Dr Shane Deegan visited a local school, the Jesuit Primary school in Galway, on 1 December 2018. Shane visited the 6th class (11–12-year-olds), where he described his research area and showed the children cells under the microscope as well as how to pipette.
Health Research Awards	Digital and social media contribution (non-academic blog or Facebook/Twitter engagement)	All our research outputs are highlighted through the Trinity Academic Gastroenterology Group (TCD TAGG) Twitter account (@TAGGTCD).
Health Research Awards	Hosted a discussion or presentation in a workshop, at an open day, or similar (non-academic)	'Living with Dementia: The Unforgettable truth', by Dr William Molloy, UCC Alzheimer's Society, Tuesday March 20th, 2018, University College Cork.
Health Research Awards	Hosted a discussion or presentation in a workshop, at an open day, or similar (non-academic)	Presented research related to CHARMS at two events at the Croí Heart and Stroke Centre to public audiences (including patients) on the topic of sexual issues and cardiovascular disease.
Knowledge Exchange and Dissemination Scheme	Hosted a discussion or presentation in a workshop, at an open day, or similar (non-academic)	We have collaborated with the Irish Neonatal Health Alliance (INHA) and its representative Mandy Daly in order to avail of the INHA's expertise in patient engagement and research.
Joint Programming Initiative in Neurodegenerative Diseases	Plain English material (e.g. information booklet/newsletter)	A booklet titled *Cognitive and Behavioural Changes in Motor Neuron Disease; A Guide for Families* was launched as part of this grant. This booklet was informed by the expertise of the Irish ALS Research Group and the clinical team based in Beaumont Hospital, as well as by thematic analysis of the feedback from the series of meetings mentioned above. This booklet is aimed at the carers and families of people with ALS/motor neurone disease (MND).
Research Training Fellowships for Healthcare Professionals	Coverage on radio and TV (national and international)	Radio interview with George Hook on Newstalk on8 November 2018 about the Adolescent Brain Development (ABD) study, as well as findings from the project and other ABD study findings.
Research Training Fellowships for Healthcare Professionals	Hosted a discussion or presentation in a workshop, at an open day, or similar (non-academic)	Presentation to St. Mary's College (Rathmines) Parents Association: September 2018, TITLE: Promoting mental health & resilience in young people.

8.3 Public and patient involvement

Recipients of awards that completed in 2018–19 were asked whether they had engaged in specific PPI activities, which were defined in the survey as activities undertaken with (as distinct to on, for, or about) patients or the public, the latter activities being captured under non-academic engagement (Section 8.1).

Among all grants ending in 2018–19, 77 awardees (45% of the total) reported 575 instances of PPI activities. This equates to an average of 7.5 PPI activities per award among those engaging in PPI. This is a significant increase in terms of both the number of award holders engaging in PPI and the number of activities taking place compared to 2016–17, when a total of 354 activities were reported across 22% of the awards. The responses in the 2018–19 reporting period also demonstrate that the community has come to better understand the meaning of PPI, as compared to the non-academic dissemination and engagement activities that were frequently reported interchangeably with PPI activities in the 2016–17 period.

PPI is an important element of health research and the HRB actively requires award holders to include PPI in their activities under an award. With the launch of the PPI Ignite Awards (co-funded by the HRB and the Irish Research Council) in five Irish universities in 2017, and the HRB's continued work to raise awareness of the importance of including PPI in award applications, this increase in PPI, while expected, is still gratifying to see. The increase demonstrates the research community's readiness to implement PPI and the widespread acceptance of its importance in the design, completion, and dissemination of health research.

It is hoped that through the continued efforts of the HRBs public review of grant applications and the PPI coordinators in the university sector; the launch of the co-funded PPI National Network award in 2021 (which secured €5 million in funding); and the ongoing awareness raising among the research community, this work will become an integral part of all HRB-funded awards.

8.3.1 Target audience for PPI activity

Figure 8.7 examines the relative distribution of PPI activities across target audiences. Award holders chose one audience type for each activity and could report multiple activities per award. Figure 8.7 shows that 58% of reported PPI outputs targeted patients and patient advocacy groups, similar to the 2016–17 data. Activities that reported public participants and the relatives of patients as the target audience were also important, accounting for 24% and 18% of activities, respectively.

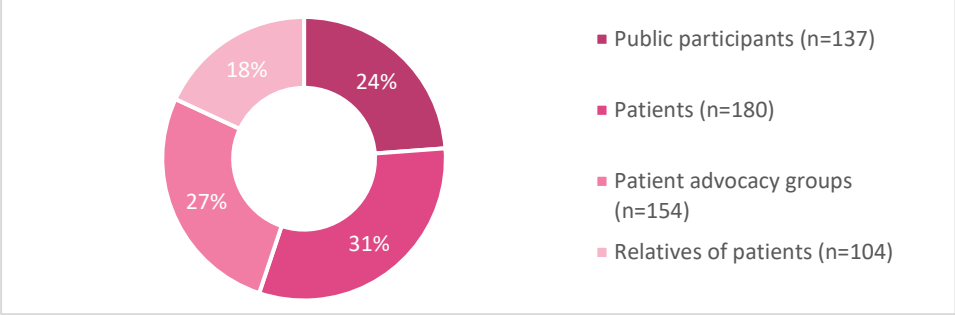


Figure 8.7: Distribution of PPI outputs, per target audience, 2018–19

Awards made in 19 (90%) of the 21 schemes ending in 2018–19 described PPI activities, an increase on the reported activities in the 11 (57%) of 19 schemes ending in 2016–17. Figure 8.8 shows that Knowledge Exchange and Dissemination Scheme awards and Health Research Awards accounted for 55% of all PPI activities (n=318) reported and included all types of target audiences. The remaining 45% of PPI activities

were spread across the other schemes funded. Compared to 2016–17, when Knowledge Exchange and Dissemination Scheme awards and Health Research Awards accounted for 85% of all PPI activities, this shows that higher levels of PPI activities took place across a wider span of HRB-funded awards ending in 2018–19.

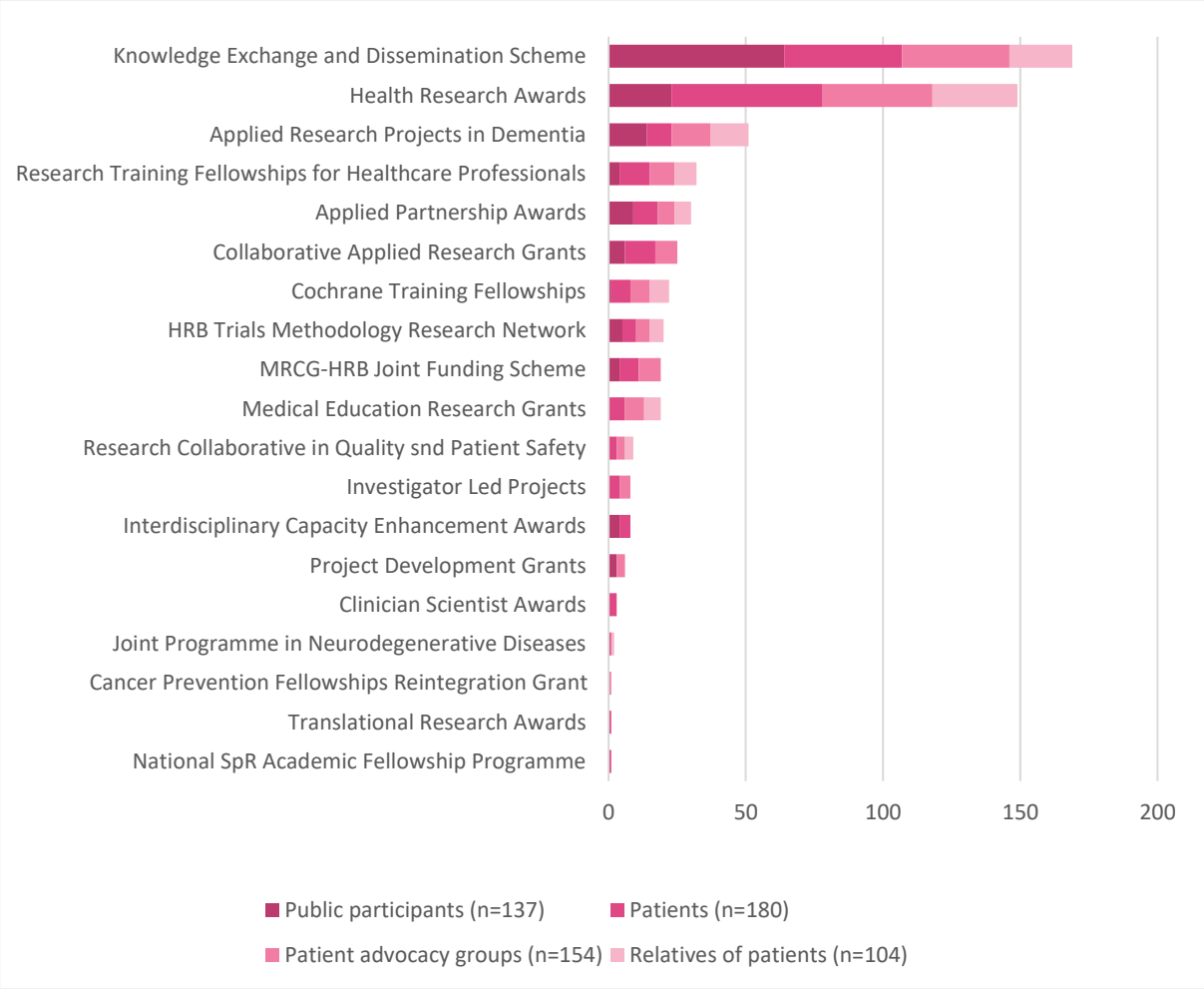


Figure 8.8: Distribution of PPI outputs, per target audience and scheme, 2018–19

8.3.2 Purpose of PPI activities

Award holders were asked to indicate the objectives of their reported PPI engagements. Figure 8.9 shows that the most common reasons cited carrying out for PPI activities were shaping the design of the study (15%, n=85), prioritising/selecting the research topic or research question (12%, n=67), conducting joint research (11%, n=65), acting as co-applicants on award applications and in research awards (11%, n=63), and influencing and/or participating in the dissemination strategy and material preparation (11%, n=62). As shown in Figure 8.9, there was no one objective that emerged as the overwhelmingly most common reason for carrying out PPI activities. It is good to see this range of purposes for PPI activities across the awards.

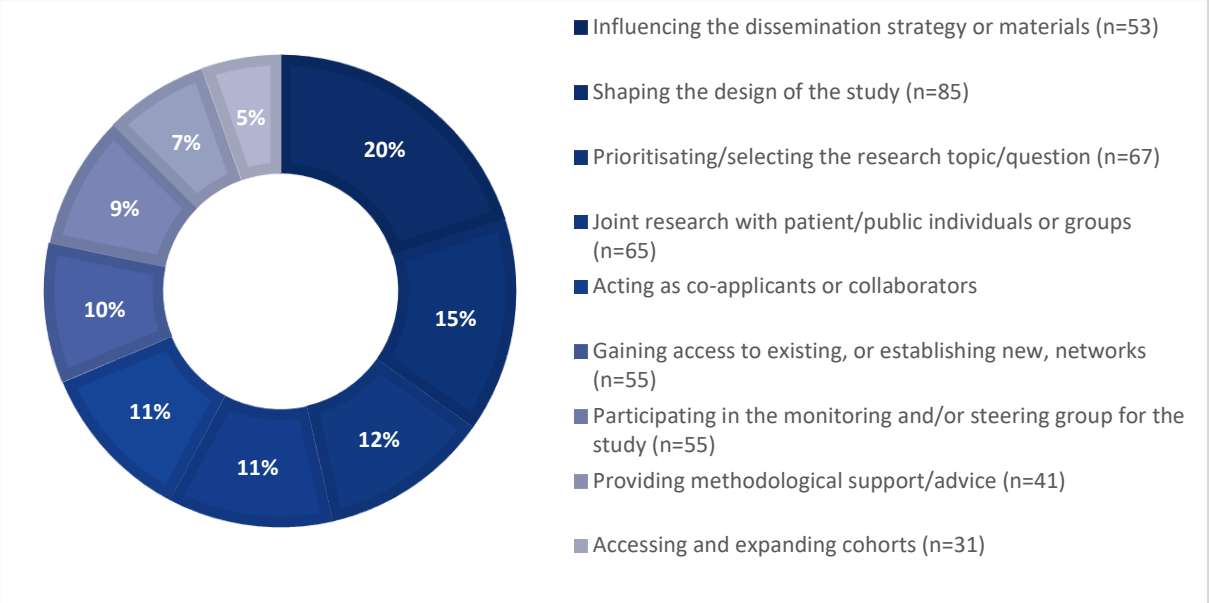


Figure 8.9: Purpose of PPI activities, 2018–19

Figure 8.10 expands on the purpose of the PPI activities and indicates their target audience. Patients, the public, patient advocacy groups, and relatives of patients were targeted relatively equally for the full range of PPI objectives. This again reiterates the welcome embedding of PPI across the HRB-funded awards ending in 2018–19.

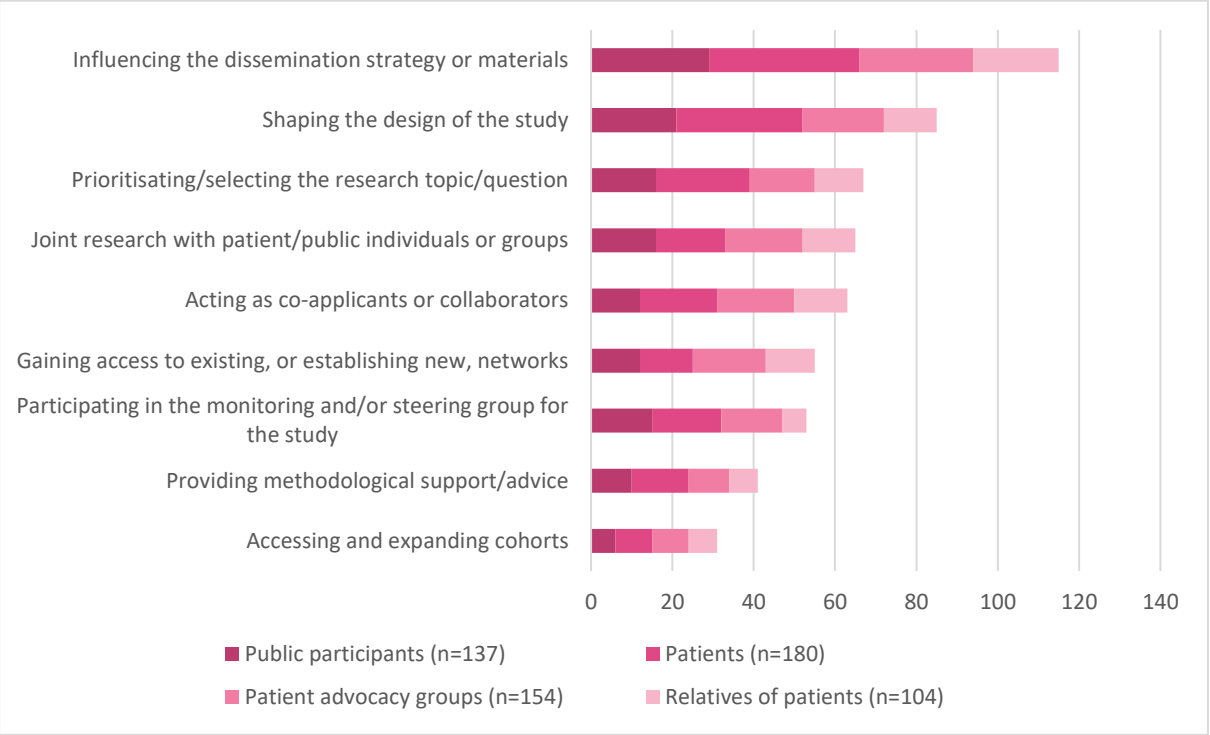


Figure 8.10: PPI activity objectives, per target audience, 2018–19

8.3.3 Distribution of PPI target audience and activities, by award type

The breakdown of PPI activities by award type is outlined in Figure 8.11. Projects and Programmes awards accounted for the largest proportion of PPI activity (82%, n=469).

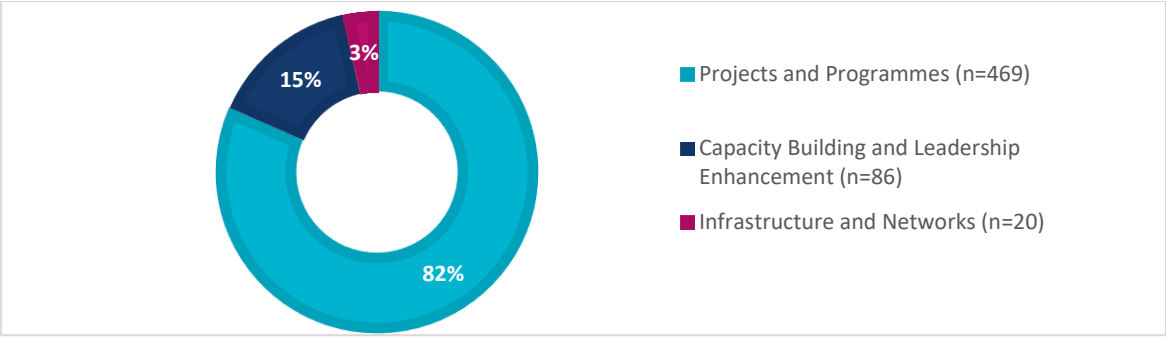


Figure 8.11: Distribution of PPI activity, per award type, 2018–19

Figure 8.12 outlines the breakdown of PPI objectives by award type. Projects and Programmes awards reported all varieties of PPI activity, with shaping the design of the study being the most commonly reported activity (15%) by a small margin. Projects and Programmes were the only award type that reported using PPI to access and expand cohorts. In Capacity Building and Leadership Enhancement awards, the largest proportion of activities had the objective of including members of the public or patients as co-applicants or collaborators (17%), whereas an equal amount of PPI activities were carried out by Infrastructure and Networks awards in order for members of the public or patients to provide methodological advice; act as co-applicants; participate in joint research; prioritise/select the research topic/question; and gain access to existing, or establish new, networks.

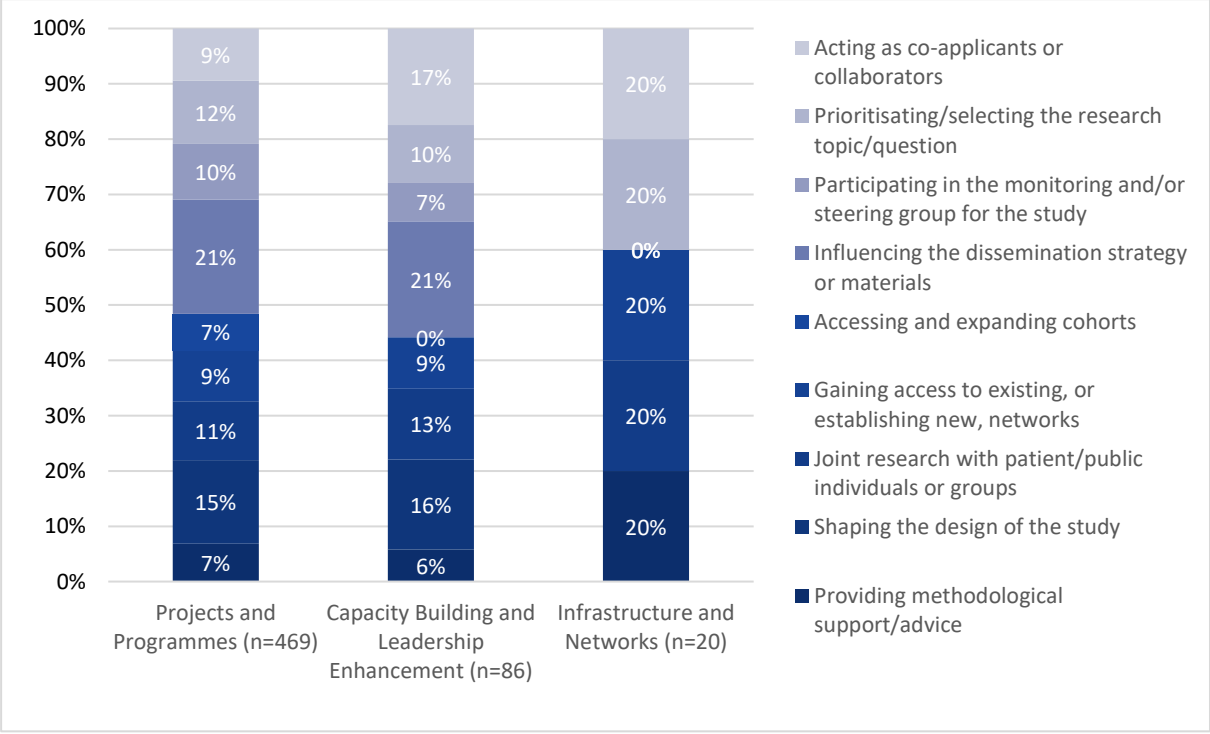


Figure 8.12: Breakdown of PPI activities, per award type, 2018–19

The breakdown of the PPI target audience across award types is shown in Figure 8.13. In general, the target audience was similar across each award type.

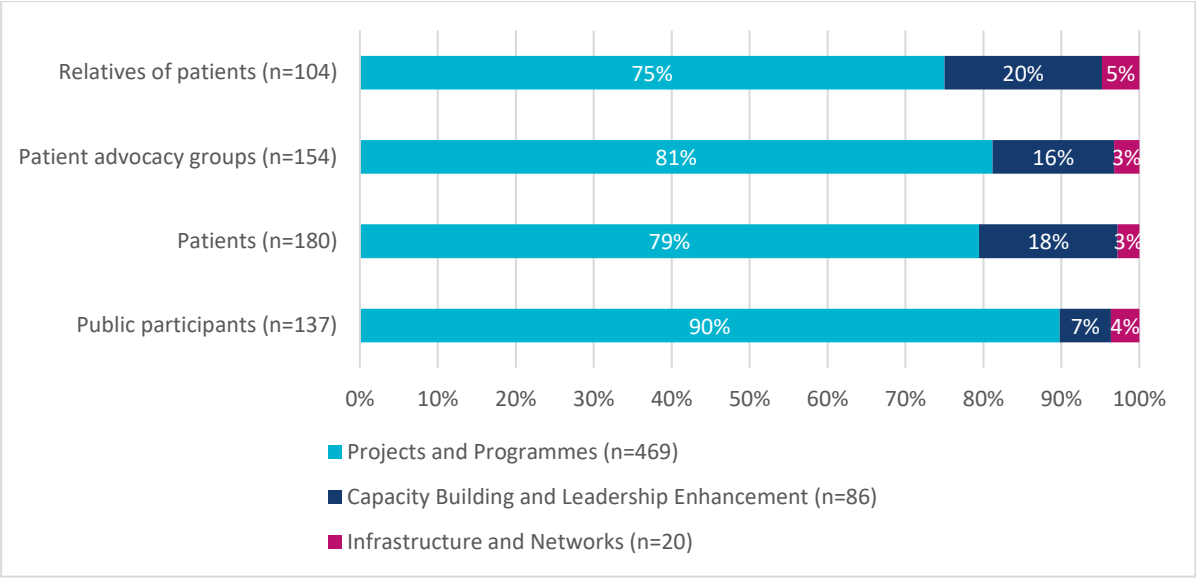


Figure 8.13: Breakdown of PPI target audience, per award type, 2018–19

8.3.4 Distribution of PPI target audience and activities, by broad research area

Distribution of PPI activity across the broad research areas of Applied Biomedical Research, Clinical Research, Health Services Research, and Population Health Sciences is shown in Figure 8.14. Health Services Research accounted for the highest proportion of PPI activity (39%, n=222). This is the first time that Health Services Research awards have reported the highest proportion of PPI activities and is also higher than the 35% (n=69) of PPI activities Health Services Research awards reported in 2016–2017.

Clinical Research accounted for 37% (n=212.0) of PPI activities, followed by Population Health Sciences at 13% (n=77.5) and Applied Biomedical Research at 11% (n=63.5) of all PPI activities.

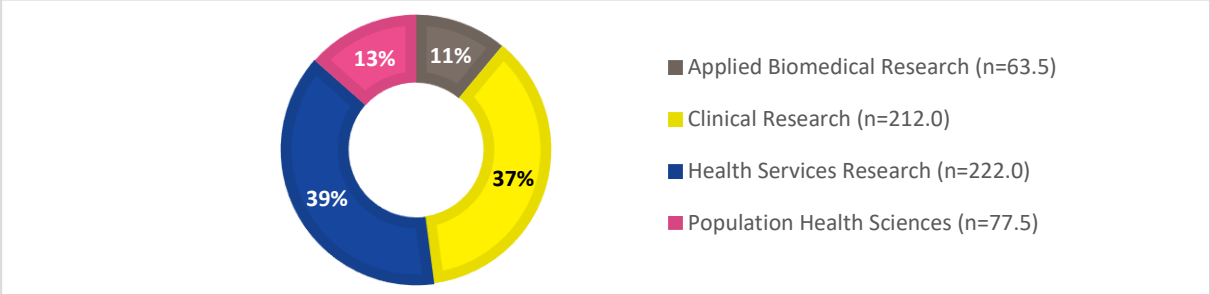


Figure 8.14: Distribution of PPI activity, per broad research area, 2018–19

The breakdown of PPI activities by broad research area is shown in Figure 8.15. Interestingly, this figure shows that each PPI activity was reported by award holders in all four broad research areas. Health Services Research award holders were most likely to engage in PPI activities as joint research ventures, and Clinical Research award holders were most likely to engage in PPI activities for influencing the governance, dissemination strategy or materials, joint research ventures and shaping the design of the study. Population Health Sciences award holders were most likely to engage in PPI to shape the design of the study, influence the dissemination strategy or materials or acting as co-applicants.

Applied Biomedical Research award holders were most likely to engage in PPI activities in order to shape the design of the study, jointly researching with patients/public and for participation in monitoring and/or steering groups for the conduct of the study.

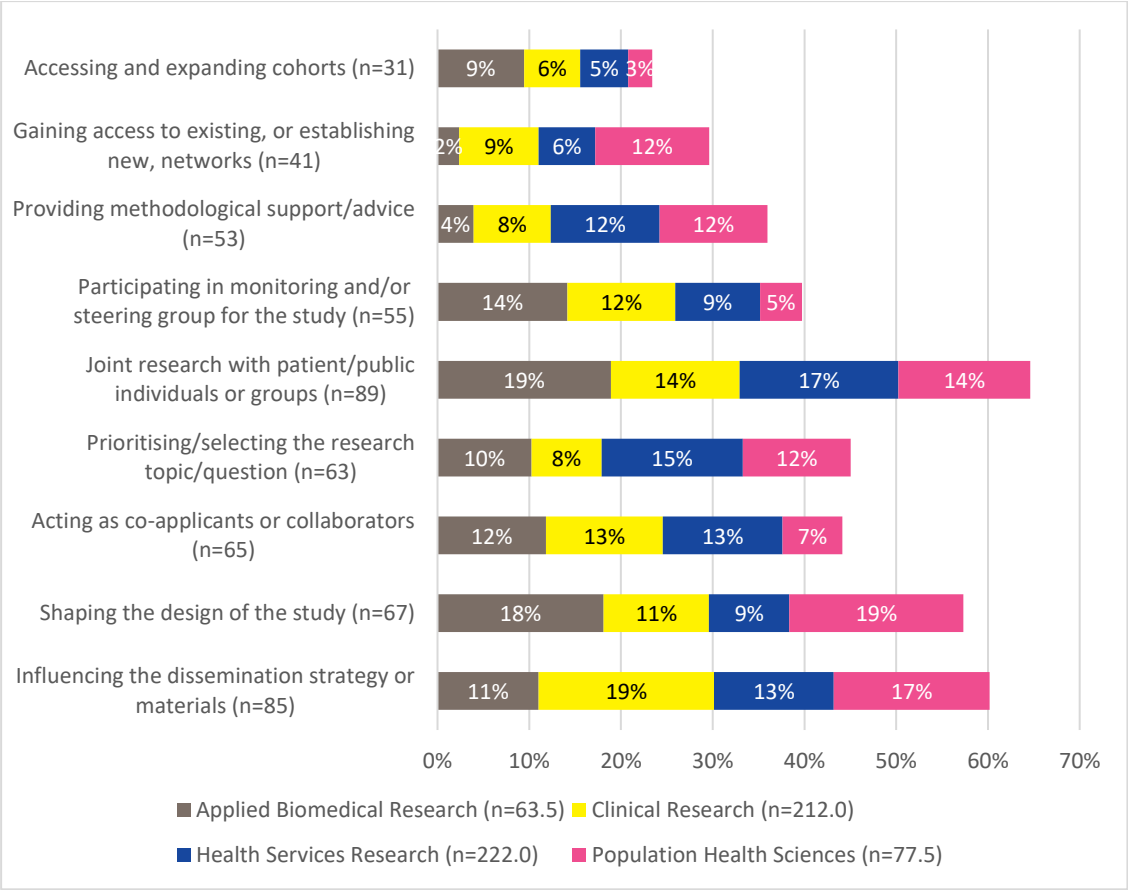


Figure 8.15: Breakdown of PPI activities, per broad research area, 2018–19

Figure 8.16 outlines the distribution of PPI target audiences by broad research area. In general, each research area targeted the full breadth of audiences to a similar extent; however, Health Services Research had the highest level of engagement with public participants (49%).

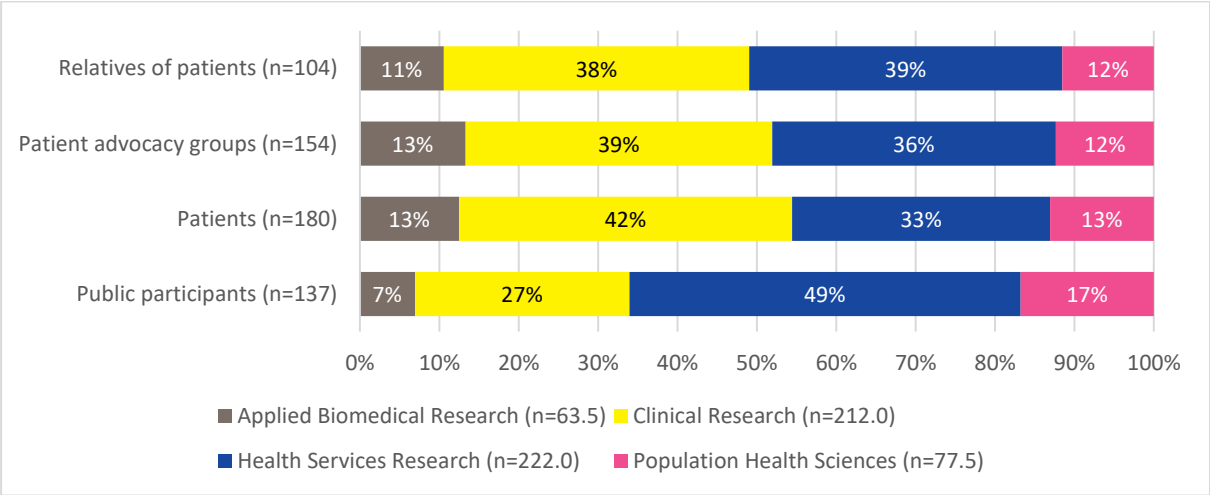


Figure 8.16: Breakdown of PPI target audiences, per broad research area, 2018–19

8.4 Examples of PPI outputs

Table 8.4 provides some examples of PPI outputs reported by award holders whose awards completed in 2018–19.

Table 8.4: Examples of PPI outputs, 2018–19

Scheme	Target audience	Objective	Description
Health Research Awards	Public participants	Prioritising/selecting the research topic/question	A PPI representative was a member of the oversight committee that reviewed and contributed to the original participant information leaflet and study material for ethical approval.
Knowledge Exchange and Dissemination Scheme	Patients	Acting as co-applicants or collaborators	"Ageing with PrIDE follows Mei Lin Yap, a 30-year-old woman with Down syndrome who wants to know what she can do to age in a healthy and happy way. This project involved people with intellectual disabilities in developing ideas; storyboarding the script; acting in the video; and launching the video and the book. Patient advocacy groups and service providers were highlighted in Ageing with PrIDe, and public participants/patients were involved in all areas of the project."
Knowledge Exchange and Dissemination Scheme	Patients	Participating in a monitoring and/or steering group for the study	As part of this project, public participants (including former cancer patients) as well as PPI nurses and the chief executive officer of a cancer charity were part of our management group and were instrumental in helping us devise our approach and execute each aim.
Knowledge Exchange and Dissemination Scheme	Patients	Acting as co-applicants or collaborators	The Irish Haemophilia Society (IHS) is the national patient organisation representing the interests of people with haemophilia, von Willebrand's disease, and other inherited bleeding disorders. The IHS was a co-applicant on this project and was involved in the project application, design, and dissemination. The IHS co-designed the KnowYourFlow website and hosted information on its website. The IHS disseminated information internationally through allied organisations and the European Haemophilia Consortium.
Knowledge Exchange and Dissemination Scheme	Patients	Conducting joint research with patient/public individuals or groups	The award holder held a Youth Advisory Group workshop in collaboration with Youth Work Ireland to assist in the co-design of a new intervention. The workshop aimed to seek adolescents' experiences around communicating with parents and adolescents' opinions on the relevance of proposed targets for an intervention and how acceptable the proposed methods of behaviour change (e.g., mindfulness and relaxation) would be to them if they were to take part in the proposed intervention.

Scheme	Target audience	Objective	Description
MRCG-HRB Joint Funding Scheme	Patient advocacy groups	Gaining access to existing, or establishing new, networks	Vasculitis Ireland Awareness was on the project steering group and was involved in all major research decisions; brokered access to the national vasculitis patient population; and helped design and implement the project's mobile application.
MRCG-HRB Joint Funding Scheme	Patients	Shaping the design of the study	The award holder sought and received feedback from the service user committee in the research site to make the study protocol as convenient and user-friendly as possible. Progress was updated every 6 months on the team website hosted by Trinity College Dublin and the online public trial registration at www.clinicaltrials.gov. A dedicated email address was monitored daily to engage with public queries.

9 Research tools, materials, and methods

One indicator of the extent to which HRB award holders are advancing research within their field both nationally and internationally is the development or application of novel research tools, materials, methodologies, and/or technologies. These may include new biological models, biobanks and datasets, techniques, etc. Although they are usually generated in order to advance the objectives of a specific project, they may be used more widely by other researchers and can facilitate new lines of enquiry or accelerate research in related fields.

Summary of research tools, materials, and methods outputs, 2018–19, compared to previous reporting periods

Development of research tools, materials, and methods	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Total number of new materials/methods developed	116	113	96	112	85 (2011 only)	N/A
Average number of outputs per €1 million spend	2.3	2.4	1.8	2.9	1.6	0.6

Key findings

- Thirty-six per cent of award holders reported the development of one or more novel research materials or methods wholly or partly because of their HRB award.
- The most common type of research material developed was educational and training material, followed by an experimental assay, reagent, or method, and a dataset/database.
- Projects and Programmes awards produced 91% of novel materials or methods.
- The broad research areas of Applied Biomedical Research and Clinical Research accounted for 41% of all novel materials or methods. The most commonly reported outputs for Applied Biomedical Research awards were experimental assays, reagents, or methods, whereas all other research areas reported educational or training materials as their most commonly generated outputs.

9.1 Development of novel research materials or methods

9.1.1 Distribution of novel research materials or methods, by type of output

Of the 170 analysed awards ending in 2018–19, 61 (36%) award holders reported the development of one or more novel research materials or methods wholly or partly because of their HRB award. From a total of 116 outputs, 26 award holders reported more than 1 new research material or method; 3 of these award holders (all Health Research Awards) reported 5 new research materials or methods; and 1 Collaborative Applied Research Grants award holder reported 7 new research materials or methods.

As shown in Table 9.1, the most common type of research material developed was educational and training materials (25%, n=29), followed by novel experimental assays, reagents, or methods (19%, n=22), and new databases or datasets (10%, n=12). The submission of biological samples to a biobank (9%, n=10)

was also a common output. The generation of new or improved research infrastructure and the creation of a new cell line were both recorded an equal number of times (n=6, 5%).

Knowledge Exchange and Dissemination Scheme awards produced the highest number of educational materials (n=21), while Health Research Awards amassed the highest number of experimental assays, reagents, and methods (n=17), and databases/datasets (n=7). Overall, awards in these schemes were the most prolific, producing 49% (n=57) of the total number of outputs.

Table 9.1: Number of new research tools, materials, or methods developed, per type, 2018–19

Type of tool/material/method developed	Number of outputs	Percentage of total outputs
Educational/training material	29	25%
Experimental assay, reagent, or method	22	19%
Database/dataset	12	10%
Biological samples/biobank	10	9%
New or improved research infrastructure	6	5%
Cell line	6	5%
Data handling and control methods	5	4%
Model of mechanisms or symptoms – mammalian in vivo	5	4%
Data analysis technique	4	3%
Research software	3	3%
Computer model/algorithm	3	3%
Model of mechanisms or symptoms – in vitro	3	3%
Physiological assessment or clinical outcome measure	2	2%
Model of mechanisms or symptoms – non-mammalian in vivo	2	2%
Model of mechanisms or symptoms – human	2	2%
Antibody	1	1%
New or expanded cohort	1	1%
Total	**116**	**100%**

Table 9.2 shows the types of research materials and methods developed by HRB award holders from 2010–11 to 2018–19. This decade of data shows the distinct rise in education and training materials in recent reporting periods compared to 2010–11. Conversely, there has been a general decrease in the creation of new databases or datasets and data analysis techniques; biological samples or biobanks; new research software; physiological assessments or clinical outcome measures; and new or expanded cohorts. The generation of experimental assays, reagents or methods, however, has remained constant. These patterns are not surprising given the rise in the funding and number of awards in the broad research areas of Health Services Research and Population Health Sciences in recent years.

Table 9.2: Comparison of the share of research tools, materials, or methods developed, per type, 2010–11 to 2018–19

Type of tool/material/method developed	2018–19	2016–17	2014–15	2012–13	2010–11	Average (2010–2019)
Educational/training material	25%	27%	0%	9%	0%	12%
Database/dataset	10%	13%	14%	20%	18%	15%
Experimental assay, reagent or method	19%	19%	19%	15%	12%	17%
Model of mechanisms or symptoms – mammalian in vivo	4%	7%	0%	0%	0%	2%
Biological samples/biobank	9%	0%	26%	16%	8%	12%
Data analysis technique	3%	5%	4%	13%	12%	8%
New research software	3%	6%	2%	2%	8%	4%
Cell line	5%	3%	0%	0%	6%	3%
Computer model/algorithm	3%	3%	0%	0%	7%	2%
New or improved research infrastructure	5%	0%	6%	8%	8%	6%
Physiological assessment or clinical outcome measure	2%	14%	3%	8%	12%	8%
Model of mechanisms or symptoms – in vitro	3%	2%	0%	0%	0%	1%
New or expanded cohort	1%	2%	12%	0%	0%	3%
Antibody	1%	0%	0%	0%	0%	0%
Animal model of disease	0%	0%	7%	6%	9%	5%

9.1.2 Comparison with Medical Research Council outputs

A comparison of HRB-funded research materials and methods outputs from 2010 to 2019 with those of the Medical Research Council (MRC) over a similar 10-year period is shown in Table 9.3. The areas of most dissimilarity were the development of educational or training materials and the development of databases/datasets, which accounted for 25% and 10% of HRB outputs, respectively, but no MRC outputs. On the other hand, the MRC reported that 51% of its researchers developed in vitro or in vivo models of disease mechanisms or symptoms, while the HRB reported that only 4% of outputs were in this area. This reflects the differing focuses of the HRB's and MRC's research portfolios. For many other research materials/methods, both agencies reported similar output levels.

Table 9.3: Comparison of research tools, materials, or methods developed by HRB and MRC award holders

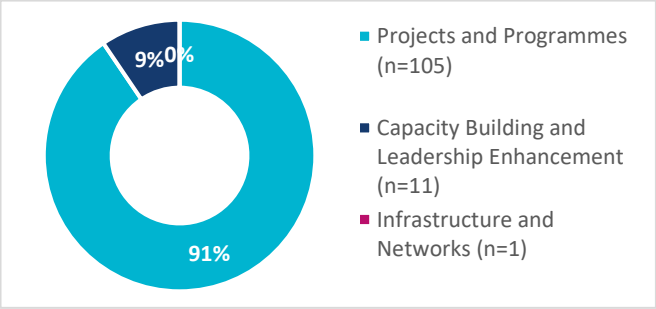
Type of tool/material/method developed*	HRB award holders, 2010–2019	MRC award holders, 2006–2018
Educational/training material	25%	0%
Database/dataset	10%	0%
Experimental assay, reagent, or method	19%	15%
Model of mechanisms, symptoms, or disease (in vitro/in vivo)	4%	51%
Biological samples/biobank	9%	10%
Data analysis technique	3%	3%
New research software	3%	0%
Cell line	5%	4%
Computer model/algorithm	3%	0%
New or improved research infrastructure	5%	10%
Physiological assessment or clinical outcome measure	2%	5%
New or expanded cohort	3%	0%
Antibody	0%	2%

* Some HRB categories combined to align with MRC report

9.1.3 Distribution of research tools, materials, or methods, by award type

Figure 9.1 shows how the development of novel materials/methods was distributed across award types, as well as the overall number of novel materials/methods developed per €1 million spend per award type. As in previous reporting periods, Projects and Programmes awards produced the highest number of novel materials or methods (n= 105, 91%), followed by Capacity Building and Leadership Enhancement awards (n=11, 8%); no novel materials/methods outputs were recorded for Infrastructure and Networks awards.

In terms of the number of novel materials or methods developed per €1 million spend, Projects and Programmes was the most productive, with 3.3 outputs per €1 million spend. Not surprisingly, given the nature of the awards, Capacity Building and Leadership Enhancement awards reported a lower level of productivity with 0.7 outputs per €1 million spend.



Number of novel materials/methods per €1 million spend	
Projects and Programmes	3.3
Capacity Building and Leadership Enhancement	0.7
Infrastructure and Networks	>0.1

Figure 9.1: Novel research tools, materials, or methods, and productivity, per award type, 2018–19

Figure 9.2 provides a breakdown of new materials/methods by award type. Not surprisingly, given that they span all broad research areas, Projects and Programmes awards yielded outputs for all types of new materials/methods. On the other hand, Capacity Building and Leadership Enhancement awards reported

new materials/methods outputs in a narrower range, which included physiological assessment or clinical outcome measures; models of mechanisms or symptoms of disease in humans; experimental assays, reagents, or methods; educational or training materials; databases/datasets; and data handling and control methods. The most commonly reported outputs in this award type were the collection of biological samples and the creation of biobanks.

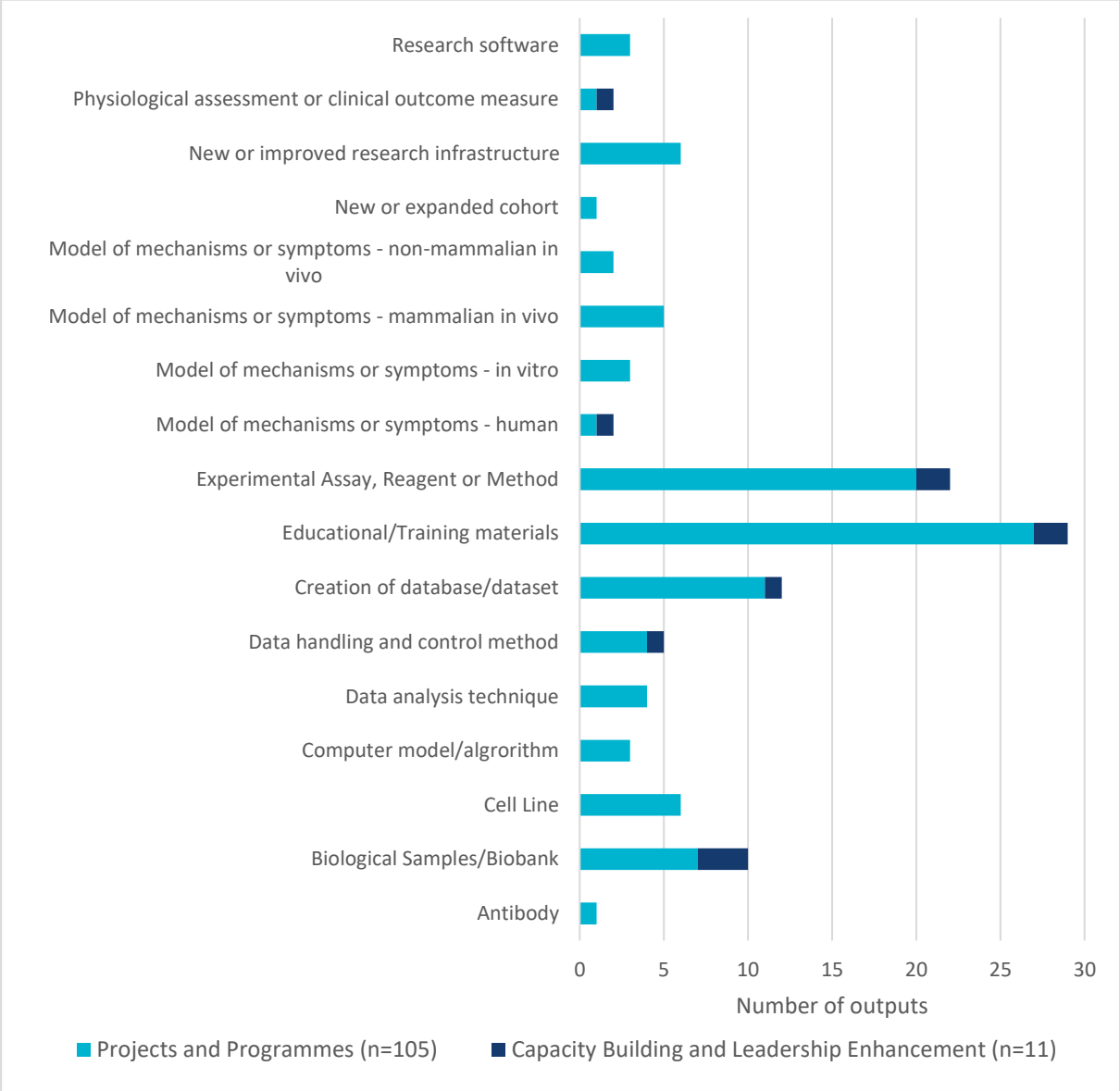


Figure 9.2: Breakdown of new tools, materials, or methods, per award type, 2018–19

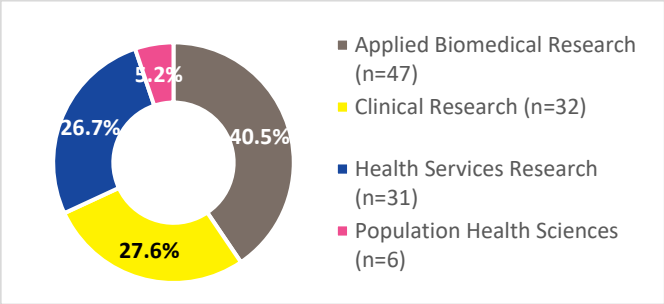
9.1.4 Distribution of tools, materials, and methods, by broad research area

Figures 9.3 and 9.4 show the development of novel materials/methods distributed across the broad research areas, as well as the overall number of novel materials/methods developed per €1 million spend per broad research area.

Awards classified as Applied Biomedical Research and Clinical Research accounted for 41% and 28% of the outputs, respectively. In keeping with the focus of such awards, the most commonly reported outputs for Applied Biomedical Research awards were experimental assays, reagents, or methods (n=11), followed by models of mechanisms or symptoms in mammalian in vivo systems (n=7). Clinical Research, Health

Services Research, and Population Health Sciences award holders all reported educational or training materials as their most common output.

In terms of productivity for this metric, awards within the broad research area of Applied Biomedical Research were the most productive, with 3.4 outputs per €1 million spend, nearly twice those within the broad research area of Clinical Research at 1.8 outputs per €1 million spend. Population Health Sciences awards were considerably more productive than Health Services Research awards, with 2.7 outputs per €1 million spend compared to 1.5 outputs per €1 million spend.



Number of novel tools/materials/methods per €1 million spend	
Applied Biomedical Research	3.4
Clinical Research	1.8
Health Services Research	1.5
Population Health Sciences	2.7

Figure 9.3: Share of novel tools, materials, or methods and productivity, per broad research area, 2018–19

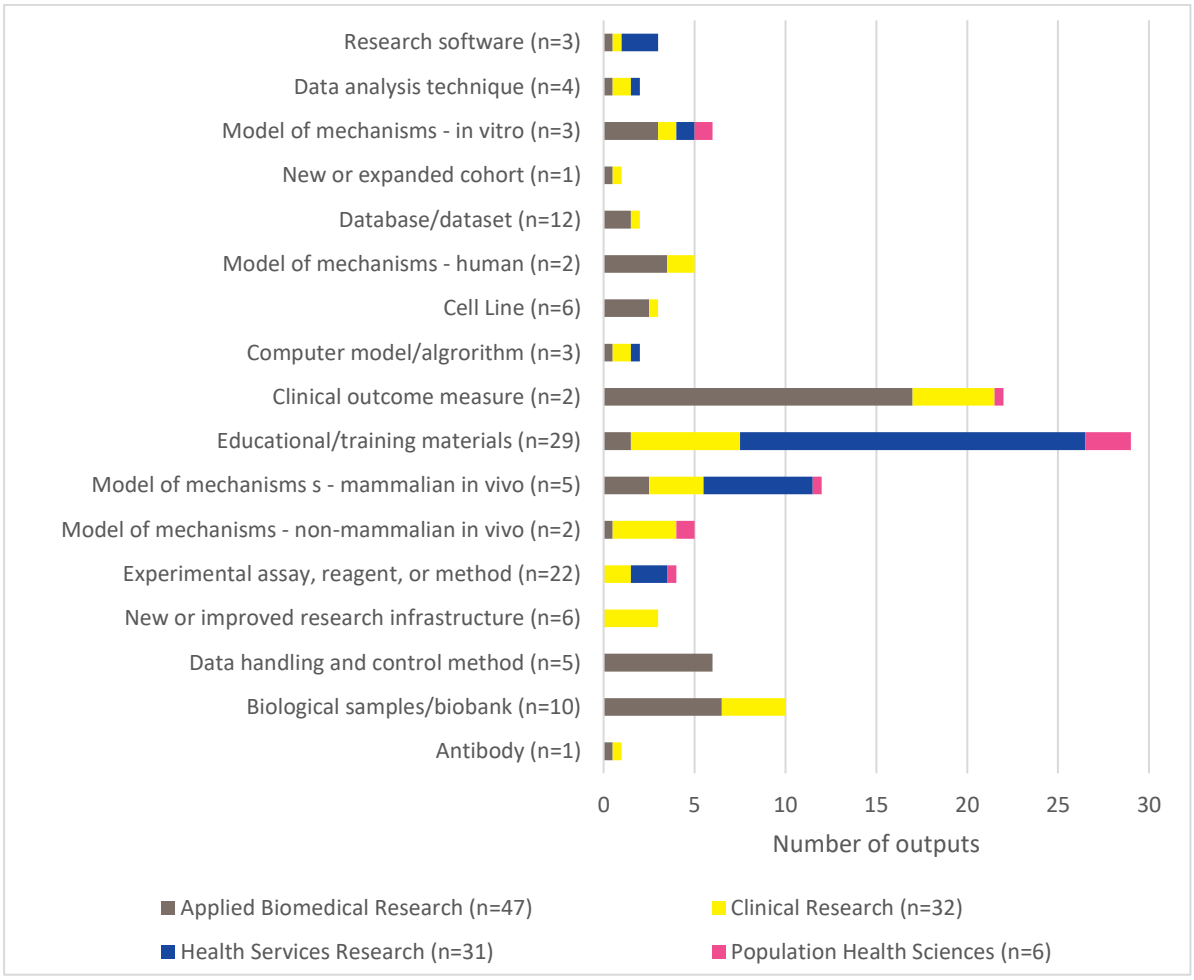


Figure 9.4: Breakdown of new tools, materials, or methods, per broad research area, 2018–19

9.2 Examples of tools, materials and methods developed

Table 9.4 provides some examples of the types of materials and methods developed or refined by HRB-funded award holders whose awards completed in 2018–19.

Table 9.4: Examples of types of tools, materials, or methods developed, 2018–19

Scheme	Type of novel tool/material/method	Description
Health Research Awards	Model of mechanisms or symptoms – mammalian in vivo	Following a period of training with Professor Joey Granger in the University of Mississippi, we learned how to develop the Reduced Uterine Perfusion Pressure (RUPP) rat model of pre-eclampsia. We are now one of only three groups worldwide with the capacity to use this preclinical model to effectively develop new therapeutic agents for potential treatment of pre-eclampsia.
Health Research Awards	Database/dataset	The collation of data on the supply of 10 non-acute healthcare services in Ireland, which are fully available in the project publications, draw together data from diverse data sources and offer a valuable resource for health services research in Ireland. The database shows the supply of services disaggregated by county, allowing comparison across counties and consistency through time in the context of changing Health Service Executive administrative boundaries.
Health Research Awards	Research software	We have developed a MATLAB-based programme for quantifying the vascular integrity of the retina.
Knowledge Exchange and Dissemination Scheme	Educational/training material	We plan to update our department's current web page with educational materials created during this grant. This will raise the profile of our research online, and act as an important communication tool with the public.
Knowledge Exchange and Dissemination Scheme	New or improved research infrastructure	Through this grant, a network of patient groups has been established in order to inform research and patient involvement in research. These groups will inform research moving forward.
Collaborative Applied Research Grants	Research software	We developed electronic data collection tools (using Microsoft Access) to enable children to directly enter responses to Comprehension Purpose Question (CPQ) 8-10 and CPQ 11-14 quality of life questionnaires, attitudes and behaviours questionnaires, and dental anxiety scale.
PhD Scholars Programmes	Educational/training material	An extensive body of educational and training materials was developed through the HRB Scholars Programme. This includes six modules delivered to students in their first year in the programme. In their earlier iteration, these modules were as follows: 1) Individual and Population Health; 2) Health Systems/Policies/Informatics; 3) Evidence Synthesis and Clinical Trials; 4) Applying Research Methods; 5) Hands-On Data Analysis with STATA; and 6) Health Economics and Econometrics. These modules have since been reviewed and significantly evolved under the SPHeRE

Scheme	Type of novel tool/material/method	Description
		programme. In addition to the taught modules, a programme of workshops was delivered under the HRB Scholars Programme. Workshops delivered under the HRB Scholars Programme (2007–2012) include: Career Management Skills Workshop by University College Cork Graduate Office and Writing/Submitting your PhD and Preparing for your Viva by Professor Derek Pugh, Emeritus Professor of Management, Open University Business School.

10 Healthcare innovations

Health research is the basis for many products and innovations in the commercial life sciences, medical technology and biotechnology sectors, as well as for developments in treatment and service innovations in the healthcare sector. Such products and innovations can emerge through new ideas or intellectual property, or the application or enhancement of existing ideas or intellectual property.

Summary of healthcare innovations in the 2018–19 reporting period, compared to previous reporting periods

Healthcare innovations	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Total number of healthcare innovations	57	57	54	43	48	32
Percentage of awards reporting healthcare innovations	24%	22%	21%	25%	21%	15%
Average number of healthcare innovations per €1 million spend	1.4	1.2	1.0	1.0	0.9	0.7

Key findings

- Forty-one award holders reported that their HRB-funded research had either directly led to or contributed to the development of a total of 57 healthcare innovations, and 14 (34%) award holders had already attracted further funding, including one source of funding from industry.
- The most commonly reported healthcare innovation was the creation of films, animations, or videos, followed by non-imaging diagnostic tools, care models/services, and clinical decision support tools.
- Fourteen per cent (n=8) of innovations were in early-stage development, while a further 46% (n=26) were in the later stages of development or were being tested, trialled, or refined as part of the award. Thirty-two per cent (n=18) of innovations had been adopted on a small scale while 7% (n=4) had been adopted on a large scale.
- Projects and Programmes awards accounted for 81% of the total innovations.
- Health Services Research accounted for the largest proportion of innovations by broad research area (42%, n=24.0) compared to Clinical Research (36%, n=20.5), Applied Biomedical Research (17%, n=9.5), and Population Health Sciences (5%, n=3.0).
- From 2008–09 to 2018–19, the average percentage of awards reporting healthcare innovations was 21%, with the highest average number of healthcare innovations recorded in 2018–19, at 1.4 innovations per award. This reflects an upward trend in this metric since 2008 and is higher than the MRC-reported average of 16% of awards reporting healthcare innovations during this period.

10.1 Healthcare innovations

Award holders were asked whether their HRB-funded research directly led to, or significantly contributed to, the development or application of any health-related innovations. Such innovations were defined broadly to include products (e.g., diagnostics, drugs, devices), non-drug interventions, health information

technology (IT) systems, clinical decision support tools, disease management strategies, and clinical care models. Award holders were asked to rank the stage of development of the innovation on the discovery–development continuum and were also asked to provide a description of the innovation.

In total, 41 (24%) of the 170 HRB-funded awards that completed in 2018–19 reported that their HRB-funded research had either directly led to or had contributed to the development of a total of 57 healthcare innovations.

When examining trends from 2008–09 to 2018–19, an average of 21% of awards reported healthcare innovations. This reflects an upward trend in this metric since 2008–09 and is higher than the MRC-reported average of 16% of awards reporting healthcare innovations during this period.

Table 10.1 shows the breakdown of the 57 healthcare innovations by type. The development of a wide range of healthcare interventions was reported, including diagnostic, prognostic, preventative, and therapeutic interventions. The most commonly reported type of healthcare innovation was the creation of films, videos, or animations (21%, n=12). This differs from the previous reporting period of 2016–17, when non-imaging diagnostic tools and therapeutic interventions (new drugs) were the most commonly reported outputs (both n=10). Non-imaging diagnostic tools (16%, n=9) and care models or services (12%, n=7) were the next most commonly reported outputs, while therapeutic or preventative interventions (including medical devices, behavioural risk modification, and new drugs or indications for drug use) and the generation of artefacts (including digital) and new ICT-based technology (such as ICT systems, software, web tools, or applications) each made up 5% (n=3) of the total number of innovations.

The most commonly reported healthcare innovation in MRC awards was the application of a new drug as a therapeutic intervention, highlighting the different strategic priorities between the two agencies.

Table 10.1: Number of healthcare innovations developed, per type, 2018–19

Type of healthcare innovation	Number of outputs	Percentage of total outputs
Film/video/animation	12	21%
Diagnostic tool – non-imaging	9	16%
Care model or service	7	12%
Clinical decision support tool	4	7%
Therapeutic intervention – medical device	3	5%
Preventative intervention – behavioural risk modification	3	5%
Therapeutic intervention – new drug or indication	3	5%
Artefact (including digital)	3	5%
New ICT-based technology (ICT system, software, web tool/application, or e-business platform)	3	5%
Knowledge hub	2	4%
Therapeutic intervention – psychological/behavioural	2	4%
Artwork	1	2%
Prognostic tool (imaging, algorithm, or other)	1	2%
Therapeutic intervention – vaccine or immunotherapy	1	2%
Strategy to manage disease or condition	1	2%
Diagnostic tool – imaging	1	2%
Therapeutic intervention – cell or gene therapy	1	2%
Total	**57**	**100%**

Table 10.2 compares reported healthcareinnovation outputs across HRB reporting periods from 2010–11 to 2018–19. The high percentage of developed outputs classified as care models or services highlights the HRB's drive to facilitate the creation of knowledge that can quickly be adapted to a clinical setting. Diagnostic tools, both imaging- and non-imaging-based, and therapeutic interventions have consistently been strong outputs of HRB-funded research since 2010–11. Since then, a decrease in the generation of preventative interventions and new ICT-based technology has been evident, while the generation of films/videos/animations, knowledge hubs, and artefacts has increased in 2018–19.

Table 10.2: Comparison of healthcare innovations developed, 2010–11 to 2018–19

Type of healthcare innovation	2018–19	2016–17	2014–15	2012–13	2010–11	Average, 2010–11 to 2018–19
Therapeutic interventions*	18%	17%	37%	16%	27%	23%
Film/video/animation	21%	2%	0%	0%	0%	5%
Clinical decision support tool	7%	9%	7%	7%	2%	6%
New ICT-based technology	5%	10%	11%	0%	10%	7%
Care model or service	12%	16%	7%	26%	4%	13%
Diagnostic tool – imaging and non-imaging	18%	19%	20%	18%	21%	19%
Preventative interventions**	5%	23%	10%	30%	25%	19%
Knowledge hub	4%	0%	0%	0%	0%	1%
Prognostic tool	2%	4%	4%	2%	6%	4%
Artefact (including digital)	5%	0%	0%	0%	0%	1%
Artwork	2%	0%	0%	0%	0%	0%
Strategy to manage disease or condition	2%	0%	13%	2%	4%	4%

* Therapeutic interventions include gene or cell therapy, new drugs or drug indications, psychological or behavioural interventions, medical devices, surgery, and vaccines or immunotherapy.

** Preventative interventions include psychological or behavioural modification, nutritional or chemoprevention, physical or biological risk modification.

10.1.1 Comparison with Medical Research Council outputs

Table 10.3 provides a comparison of HRB-funded and MRC-funded healthcare innovations over two similar 10-year periods, from 2010 to 2019 and from 2006 to 2018, respectively. Although the categories do not map directly onto one another, clear differences in innovation outputs are evident, such as the high share of new drugs or drug indications developed by MRC award holders and the high level of care models or services generated by the HRB-funded award holders. Similarities also exist in healthcare innovations generated by the HRB and MRC over the 10-year reporting period, such as the creation of clinical decision support tools and preventative interventions. Artwork; artefacts; films, videos, and animations; and ICT tools were categorised differently in the MRC report and those entries were not comparable to HRB data.

Table 10.3: Comparison of healthcare innovations from HRB and MRC award holders

Type of healthcare innovation	HRB award holders, 2010–2019	MRC award holders, 2006–2018
Artefact (including digital)	1%	N/A*
Artwork	0%	N/A
Care model or service	13%	1%
Clinical decision support tool	6%	5%
Diagnostic tool – imaging	1%	6%
Diagnostic tool – non-imaging	15%	15%
Film/video/animation	5%	N/A
Knowledge hub	1%	N/A
New ICT-based technology	7%	N/A
Preventative intervention – behavioural risk modification	7%	6%
Preventative intervention – medical device	1%	3%
Preventative intervention – nutritional or chemoprevention	1%	2%
Preventative intervention – physical/biological risk modification	2%	1%
Preventative intervention – psychological/behavioural	8%	0%
Prognostic tool	4%	0%
Strategy to manage disease or condition	4%	6%
Therapeutic intervention – psychological/behavioural	1%	5%
Therapeutic intervention – medical device	1%	3%
Therapeutic intervention – cell or gene therapy	4%	6%
Therapeutic intervention – new drug or indication	15%	31%
Therapeutic intervention – surgery	0%	1%
Therapeutic intervention – vaccine or immunotherapy	2%	5%

*NA = Not all metrics collected by the HRB were reported on by the MRC

10.1.2 Stages of development of healthcare innovations

Figure 10.1 plots the stages of development of reported healthcare innovations in 2018–19. The graph is laid out in chronological order of innovation development stages. Fourteen per cent (n=8) of innovations were in early-stage development, while a further 46% (n=26) were in later-stage development or were being tested, trialled, or refined as part of the award. Thirty-two per cent (n=18) of innovations had been adopted on a small scale while 7% (n=4) had been adopted on a large scale.

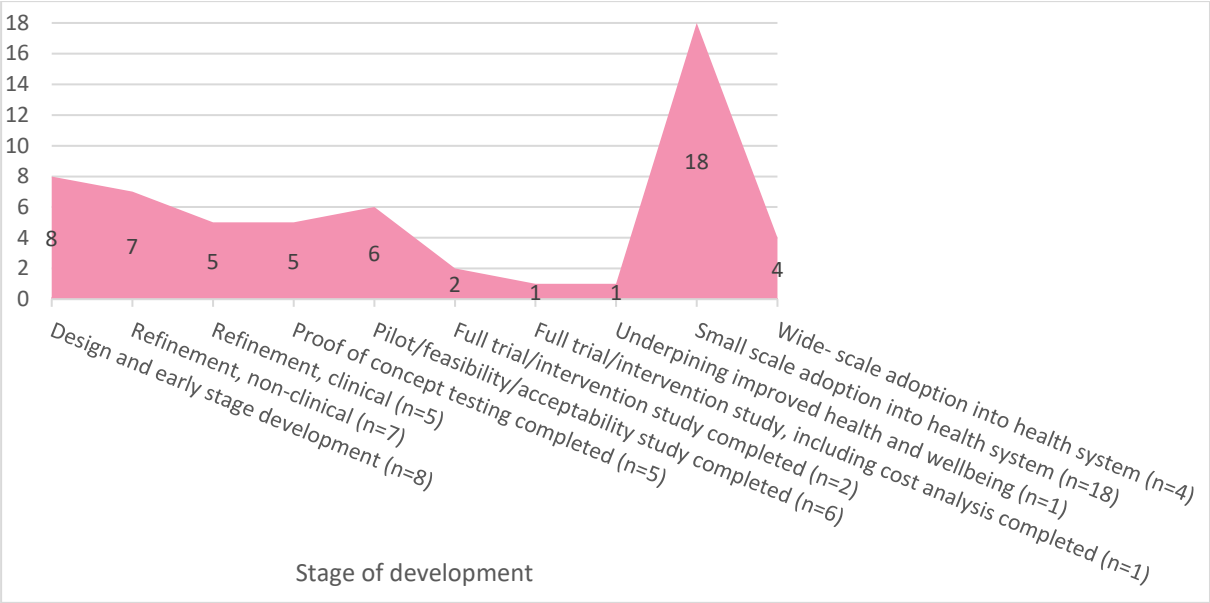
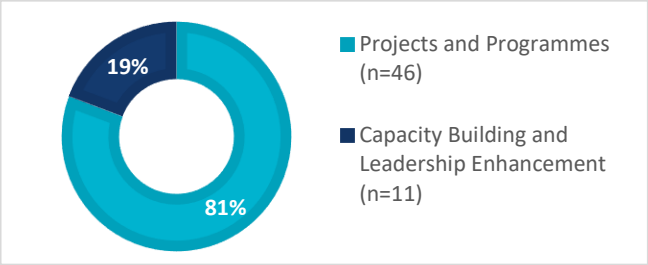


Figure 10.1: Stages of development of healthcare innovations, 2018–19

10.1.3 Distribution of healthcare innovations, by award type

Figure 10.2 shows the share of healthcare innovations by award type and number of outputs per €1 million spend. Figure 10.3 shows the distribution of healthcare innovations across award types.

Projects and Programmes awards accounted for 81% of all reported healthcare innovation outputs and were distributed across all types of innovations reported. In terms of productivity, Projects and Programmes awardees reported 1.4 innovations per €1 million spend, as was also the case in the 2016–17 and 2014–15 reporting periods. Most of these outputs were distributed as films/videos/animations and non-imaging diagnostic tools, as well as care models or services.



Number of healthcare innovation outputs per €1 million spend	
Projects and Programmes	1.4
Capacity Building and Leadership Enhancement	0.7

Figure 10.2: Healthcare innovations and productivity, per award type, 2018–19

Capacity Building and Leadership Enhancement awards accounted for 19% of reported healthcare innovations and had low productivity, at 0.7 outputs per €1 million spend. These outputs were confined to films/videos/animations, non-imaging diagnostic tools, care models or services, clinical decision support tools, diagnostic tools – non-imaging, psychological/behavioural therapeutic interventions, and knowledge hubs.

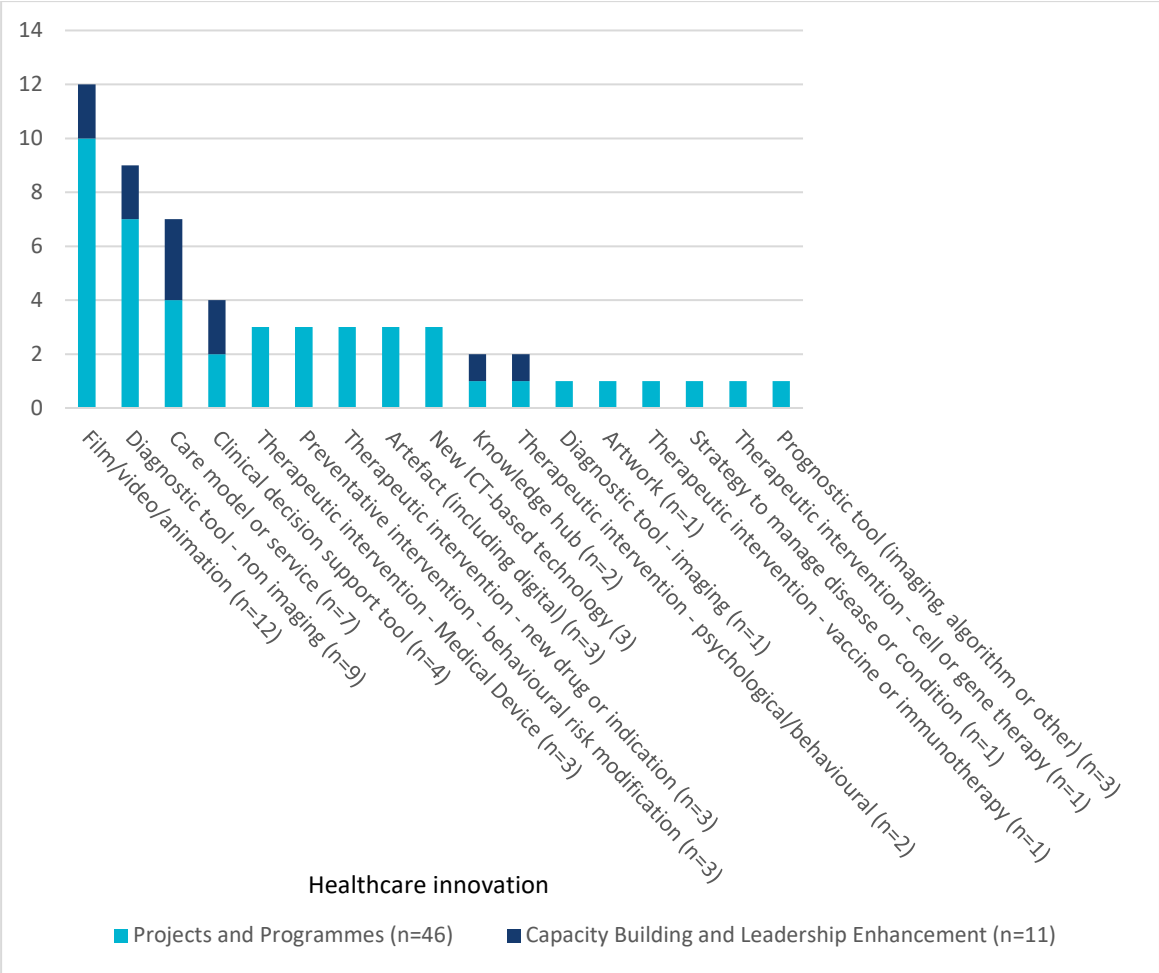


Figure 10.3: Number of healthcare innovations, per innovation type and award type, 2018–19

10.1.4 Distribution of healthcare innovations, by broad research area

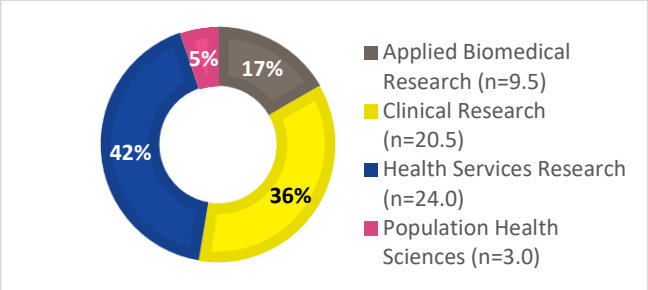
Figure 10.4 shows the distribution of innovations by broad research area and number of innovations in each broad research area per €1 million spend. Figure 10.5 shows the distribution of healthcare innovations across broad research areas.

Of the 57 healthcare innovations reported, 42% (n=24) were from awards classified as Health Services Research awards. These innovations were spread across almost all categories of innovation and accounted for all records of artefacts, knowledge hubs, strategies to manage diseases or conditions, and behavioural risk modification as a preventative therapeutic. Clinical Research accounted for 36% (n=20.5) of the total healthcare innovations and were also spread across most categories of innovation, while significantly fewer innovations came from awards classified as Applied Biomedical Research (17%, n=9.5) and Population Health Sciences (5%, n=3.0).

Applied Biomedical Research innovations were categorised as clinical decision support tools, non-imaging diagnostic tools, new ICT technology, and therapeutic interventions (medical devices, new drugs or drug indications, and vaccines/immunotherapy). Population Health Sciences innovations were reported as artwork, films/videos/animations, and non-imaging diagnostic tools.

Clinical Research was the most productive research area, with 1.6 healthcare innovations per €1 million spend, followed by Health Services Research with 1.2 healthcare innovations per €1 million spend. Applied Biomedical Research awards reported consistent productivity compared to 2016–17, with 0.8

healthcare innovations per €1 million spend. Population Health Sciences awards ending in 2018–19 were slightly more productive than those ending in 2016–17, with 0.6 (up from 0.5 in 2016–17) healthcare innovations per €1 million spend.



Number of healthcare innovation outputs per €1 million spend	
Applied Biomedical Research	0.8
Clinical Research	1.6
Health Services Research	1.2
Population Health Sciences	0.6

Figure 10.4: Healthcare innovations and productivity, per broad research area, 2018–19

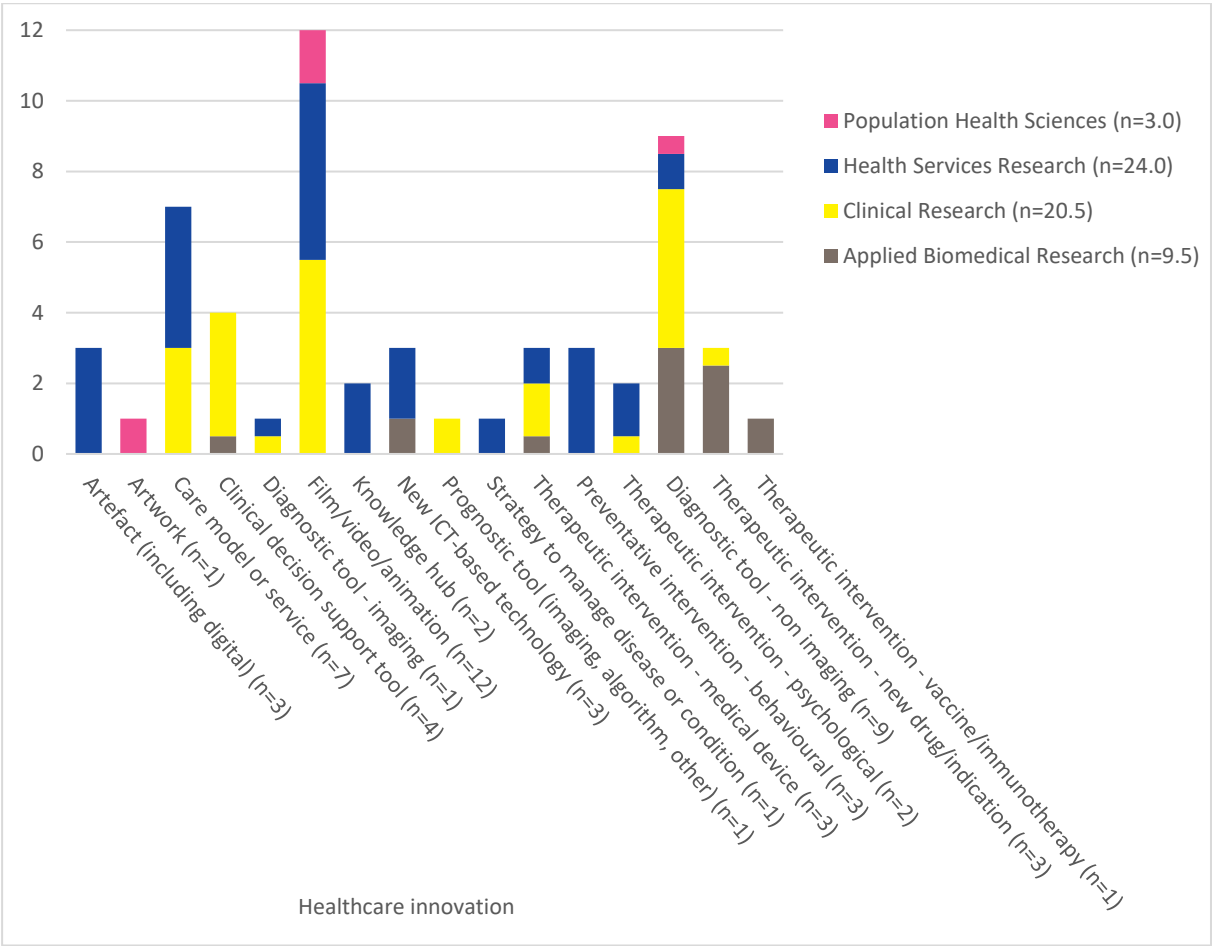


Figure 10.5: Number of healthcare innovations, per innovation type and broad research area, 2018–19

10.1.5 Distribution of healthcare innovation outputs, by scheme

Table 10.4 displays the number of healthcare innovation outputs reported by individual schemes and examines the total number of outputs as a proportion of the total number of awards reporting in 2018–19.

Table 10.4 shows that almost all schemes reporting on this metric had an average of one or more healthcare innovations per award – the overall average was 1.4 healthcare innovations per award. The

most productive awards were the Clinician Scientist Awards, with all awards funded in this scheme reporting healthcare innovations. Two thirds of Project Development Grants and Translational Research Awards reported healthcare innovations, while half of the Applied Partnership Awards, Applied Research Projects in Dementia, Collaborative Applied Research Grants and the National SpR Academic Fellowship Programme awards reported healthcare innovation outputs.

The schemes that reported no healthcare innovations were as expected, as awards under those schemes have clear objectives that do not cover healthcare innovations, such as the production of systematic reviews in the case of the Cochrane Training Fellowships, or the generation of enhanced research capacity in the case of the Research Leader Awards and the Cancer Prevention Fellowship Programme.

Table 10.4: Distribution of healthcare innovations, per scheme, 2018–19

Scheme	Number of healthcare innovations, 2018–19	Number of awards reporting healthcare innovations, 2018–19	Total number of awards per scheme, 2018–19	Average number of healthcare innovations per award, 2018–19	Percentage of awards under each scheme generating healthcare innovations
Applied Partnership Awards	1	1	2	1.0	50%
Applied Research Projects in Dementia	1	1	2	1.0	50%
Cancer Prevention Fellowship Programme	0	0	2	0.0	0%
Clinician Scientist Awards	4	1	1	4.0	100%
Cochrane Training Fellowships	0	0	15	0.0	0%
Collaborative Applied Research Grants	9	2	4	4.5	50%
Health Research Awards	17	15	61	1.1	25%
HRB Trials Research Methodology Network	0	0	1	0.0	0%
Interdisciplinary Capacity Enhancement Awards	0	0	2	0.0	0%
Investigator Led Projects	0	0	2	0.0	0%
Joint Programme in Neurodegenerative Diseases	0	0	2	0.0	0%
Knowledge Exchange and Dissemination Scheme	11	8	38	1.4	21%
Medical Education Research Grants	0	0	2	0.0	0%
MRCG-HRB Joint Funding Scheme	2	2	9	1.0	22%
National SpR Academic Fellowship Programme	1	1	2	1.0	50%
Project Development Grant	3	2	3	1.5	67%
Research Collaborative in Quality and Patient Safety	0	0	2	0.0	0%
Research Leader Awards	0	0	1	0.0	0%
Research Training Fellowships for Healthcare Professionals	6	6	15	1.0	40%
PhD Scholars Programmes	0	0	1	0.0	0%
Translational Research Awards	2	2	3	1.0	67%
Total	**57**	**41**	**170**	**1.4**	**24%**

10.2 Examples of healthcare innovations

Table 10.5 presents some examples of the types of healthcare innovations developed or refined by PIs whose awards completed in 2018–19.

Table 10.5: Examples of healthcare innovations, 2018–19

Award type	Type of innovation	Description
MRCG-HRB Joint Funding Scheme	New ICT-based technology (ICT system, software, web tool/application, or e-business platform)	Developed Epilepsy Ireland's How2tell multimedia educational self-management resources – including an app, video/film, and booklet – on self-disclosure for people with epilepsy, which are available on the Epilepsy Ireland website.
Applied Research Projects in Dementia	Therapeutic intervention – psychological/ behavioural	The Conversational Coaching Intervention aims to improve the communication skills of primary communication partners of people with dementia.
Research Collaborative in Quality and Patient Safety	Diagnostic tool – non-imaging	Developed wearable technologies to reduce the burden of physiological monitoring by nursing staff. The team adapted existing technology in order to produce a range of physiological parameters required for interfacing on an easy-to-use tablet held by the responsible nurse in an emergency department.
Clinician Scientist Awards	Care model or service	The Virtual Consult Service is an innovation that provides healthcare providers with specialist advice on the management of people with risk factors for heart failure and provides regular updates on research relating to the area. It allows interaction on particular cases between specialists and general practitioners.
Research Training Fellowships for Healthcare Professionals	Therapeutic intervention – psychological/behavioural	The OPTIMAL self-management programme is a group-based 6-week programme that is professionally led by occupational therapists and that includes input from a physiotherapist and pharmacist. Each session comprises an interactive educational component and an individual goal-setting component. Topics covered include fatigue management, maintaining mental well-being, physical activity, managing medication, and communication strategies.
Health Research Awards	Artwork	Professor Mary Cannon co-authored *Journey Through the Brain: a colouring book for young people*, which was designed to teach young people about the brain. It was distributed by the Royal College of Surgeons in Ireland and the licence for the Irish-language edition was granted to Foras na Gaeilge.

11 Commercialisation and economic benefits

The primary focus of HRB-funded research investment is on the generation of opportunities for improved healthcare delivery and better health outcomes, and on the generation of research evidence in order to inform policy and improve clinical practice. The successful commercial exploitation, or 'commercialisation', of intellectual property arising from health research can result in economic benefits through job creation and the development of products and services by converting scientific and technological advances into marketable products or industrial processes.

Summary of commercialisation activity, 2018–19, compared to previous reporting periods

Commercial and enterprise activity	2018–19 (N=170 awards)	2016–17 (N=187 awards)	2014–15 (N=198 awards)	2012–13 (N=134 awards)	2010–11 (N=196 awards)	2008–09 (N=204 awards)
Number of filed invention disclosures or disclosures in discussion with Technology Transfer Office (TTO)	11	25	5	20	9	9
Number of patents/copyrights/trademarks filed	7	10	24	16	11	12
Number of licensed technologies developed	2	5	2	5	3	3
Number of start-ups/spin-outs established	2	2	4	2	2	2
Number of academic-industry collaborations established	46	59	58	88	25	10
Number of commercialisation awards secured from Enterprise Ireland	6	2	9	5	4	6

Key findings

- HRB award holders were active in industry collaboration and exploitation of intellectual property arising from health research, with 74 commercial and enterprise outputs reported by 33 award holders (19% of total award holders).
- Eleven award holders had discussed the commercial potential of their work with a university Technology Transfer Office or potential industry partner, seven award holders had filed patents, copyrights, or trademarks and five award holders had secured commercialisation funding from Enterprise Ireland to further develop their ideas.
- Two award holders had negotiated licensing agreements (one exclusive and one non-exclusive royalty-bearing licence), and two start-ups were reported.
- Projects and Programmes awards reported the highest number of commercial outputs (n=27, 95%), representing 0.7 outputs in this category per €1 million spend.
- Applied Biomedical Research and Clinical Research were equally as likely to produce commercial outputs of all types and accounted for almost 80% of all commercial outputs by broad research area (39% each), and both research areas also matched on productivity, with 0.7 outputs per €1 million invested.

- Forty-six instances of new or strengthened academic–industry collaborations were identified by 16 award holders, of which 63% (n=29) were international collaborations.
- Collaboration for the purpose of conducting joint research projects was the most common reason for engaging with industry (35%,). Gaining access to material, cohorts, or datasets (21%), infrastructure or equipment (11%), and networking opportunities (11%), as well as sharing data and/or expertise (11%), were also important reasons for collaboration cited by HRB award holders.

11.1 Commercialisation and enterprise activity

Two increasingly important indicators of the impact of publicly funded research in Ireland are the proportion of research awards producing outputs that can be commercialised, and the level of collaboration between the academic and industrial sectors. HRB-funded award holders were asked if their research findings had commercial potential and, if so, to what extent they had pursued this opportunity in terms of intellectual property protection and commercial routes. Award holders were also asked if they had established any industry collaborations.

11.1.1 Distribution of commercialisation and enterprise outputs, by type

Figure 11.1 shows the distribution of commercialisation outputs by type. Eleven awardees reported that they had discussed the commercial potential of their work with a university TTO or potential industry partner and five award holders had secured commercialisation funding from Enterprise Ireland to further develop their ideas. Seven award holders had filed patents for their research outputs: two were filed in the United States of America (one filed, one pending), two were filed in Europe (one granted, one pending), one was pending under the Patent Cooperation Treaty (PCT) at the time of reporting,[2] and two were granted in all three jurisdictions (the United States of America, Europe, and PCT).

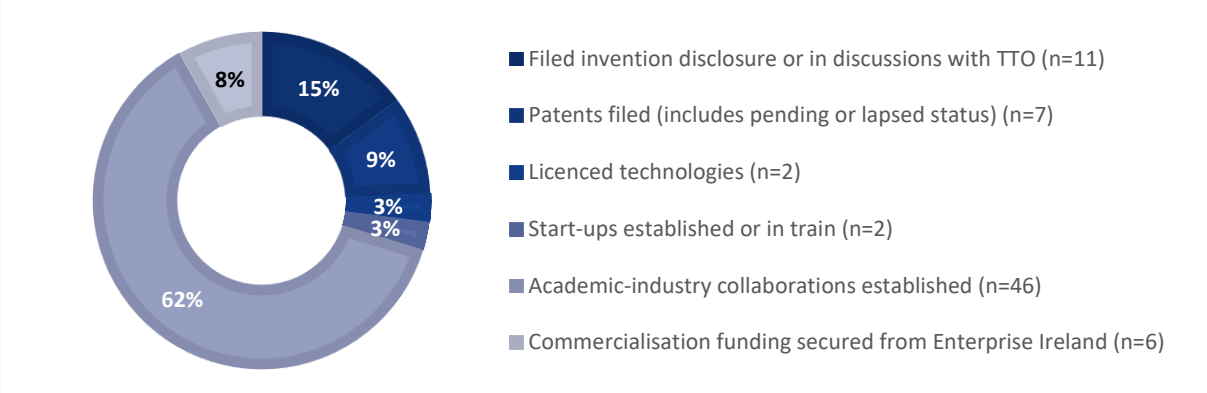


Figure 11.1: Distribution of commercialisation outputs, by type, 2018–19

A summary of the reported outputs for 2018–19 and a comparison with outputs for the previous reporting periods is presented in Table 11.1. HRB award holders were active in this area, with 74 commercialisation and enterprise outputs reported by 33 (19%) award holders. The average number of academic–industry collaborations from 2008 to 2019 is 48.

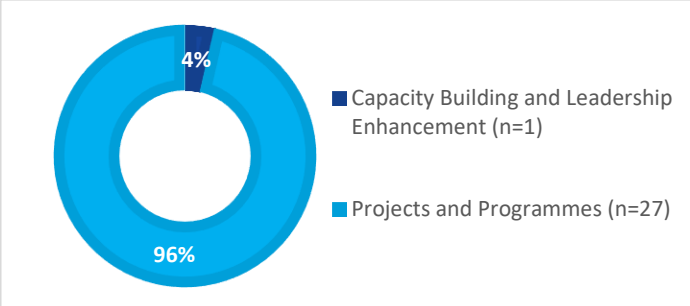
[2] By filing one international patent application under the PCT, applicants can simultaneously seek protection for an invention in 153 countries throughout the world. https://www.wipo.int/pct/en/pct_contracting_states.html

Table 11.1: Comparison of the number of commercialisation outputs, per type, 2008–09 to 2018–19

Output type	2018–19	2016–17	2014–15	2012–13	2010–11	2008–09
Number of filed invention disclosures or disclosures in discussion with TTO	11	25	5	20	9	9
Number of patents filed (includes pending, active, or lapsed trademarks or copyright)	7	10	24	16	11	12
Number of licensed technologies developed	2	5	2	5	3	3
Number of spin-outs/start-ups established or in discussion	2	2	4	2	2	2
Number of academic–industry collaborations established	46	59	58	88	25	10
Number of commercialisation awards secured from Enterprise Ireland	6	2	9	5	4	6
Total	**74**	**103**	**102**	**136**	**54**	**42**

11.1.2 Distribution of commercialisation outputs, by award type

Figure 11.2 shows the proportion of commercialisation outputs by award type, and Figure 11.3 shows the breakdown of commercialisation outputs (i.e., IDFs/TTO discussions, patents, licensed technologies, commercialisation funding and start-ups) for awards that completed in 2018–19 by award type. This shows that the largest number of commercial outputs of all types arose from Projects and Programmes awards (n=27, 96%), representing 0.8 outputs in this category per €1 million spend



Number of commercialisation outputs per €1 million spend	
Projects and Programmes	0.8
Capacity Building and Leadership Enhancement	0.1

Figure 11.2: Distribution of commercialisation outputs, per award type, 2018–19

Figure 11.3 shows that the most commonly reported output was discussions with the TTO, followed by patents, and commercialisation grants. Capacity Building and Leadership Enhancement awards produced one commercial output, resulting in an overall productivity of 0.1 outputs per €1 million spend.

As was the case in the 2014–15 and 2016–17 reporting periods, no commercialisation outputs were reported for Infrastructure and Networks awards.

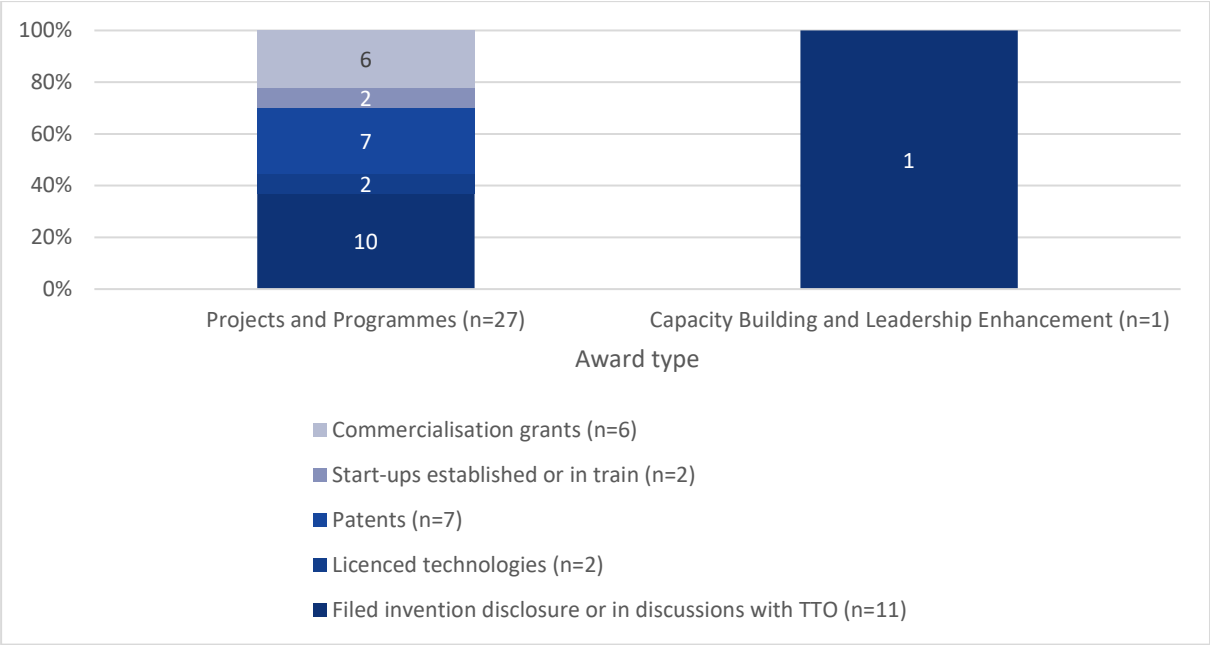
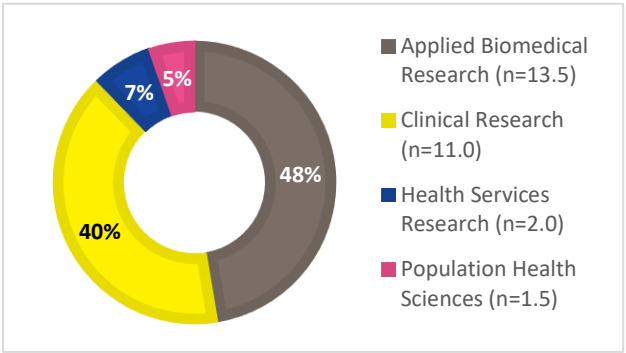


Figure 11.3: Breakdown of commercialisation outputs, per award type, 2018–19

11.1.3 Distribution of commercialisation outputs, by broad research area

The proportion of commercialisation outputs by broad research area is show in Figure 11.4. The distribution of broad research areas in which awards with commercialisation outputs were categorised is shown in Figure 11.5. As might be expected, awards categorised as Applied Biomedical Research and Clinical Research were the most likely to produce commercialisation outputs of all types in the 2018–19 reporting period, , similar to the 2016–17 reporting period. Their productivity was also similar, at 1.2 and 0.8 outputs per €1 million spend. As might be expected, Population Health Sciences and Health Services Research accounted for only 7% and 5% of all commercialisation outputs, respectively, and with a productivity of 0.3 and 0.1 outputs per €1 million spend, respectively.

Awards classified as Applied Biomedical Research and Clinical Research produced all types of commercialisation outputs. Health Services Research and Population Health Sciences contributed to commercialisation grants, TTO interactions or patents filed.



Number of commercialisation outputs per €1 million spend	
Applied Biomedical Research	1.2
Clinical Research	0.8
Health Services Research	0.1
Population Health Sciences	0.3

Figure 11.4: Distribution of commercialisation outputs, per broad research area, 2018–19

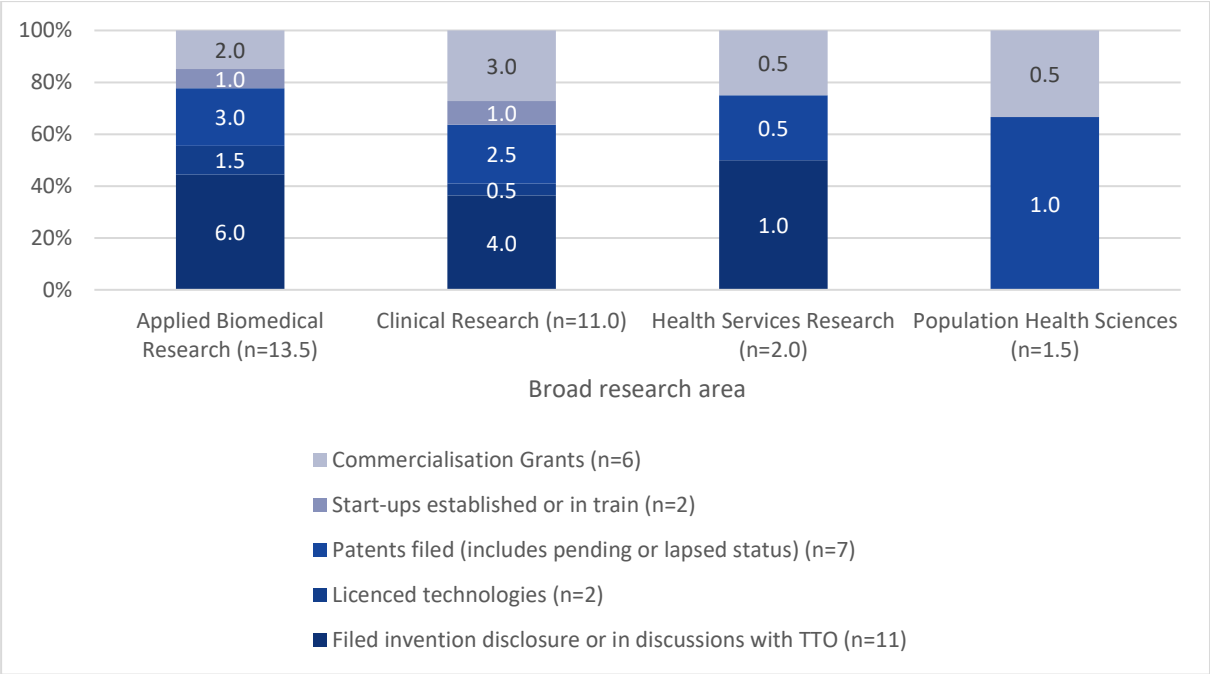


Figure 11.5: Breakdown of commercialisation outputs, per broad research area, 2018–19

11.1.4 Distribution of commercialisation outputs, by scheme

Table 11.2 captures the number of commercialisation outputs reported by individual schemes and examines the total number of outputs as a proportion of the total number of awards per scheme reporting in 2018–19.

The primary focus of HRB-funded research investment is on the generation of opportunities for improved healthcare delivery and better health outcomes, and on the generation of research evidence in order to inform policy and improve clinical practice. Table 11.2 highlights that HRB-funded research can often also have commercial potential. The average number of outputs per award ending in 2018–19 is 0.2.

Unsurprisingly, given their focus, Translational Research Awards resulted in an average of 3.3 commercialisation outputs. The Clinician Scientist Award reported 1 output. The other awards ending in 2018–19 – namely the Collaborative Applied Research Grants, Health Research Awards, Knowledge Exchange and Dissemination Scheme, and MRCG-HRB Joint Funding Scheme reported all reported some commercialisation outputs but these were few in comparison to the total number of awards supported through these schemes.

Schemes with awards that completed in 2018–19 but which did not report any commercialisation outputs (e.g. Applied Research Projects in Dementia, the Cancer Prevention Fellowship Programme, Cochrane Training Fellowships, and PhD Scholars Programmes) were almost exclusively categorised as Population Health Sciences or Health Services Research.

Table 11.2: Distribution of commercialisation outputs, per scheme, 2018–19

Scheme	Commercialisation grants	IDF filed or discussion with TTO	Licenced technology	Patents filed	Start-ups established or in train	Total number of commercialisation outputs 2018–19	Total number of awards funded per scheme	Average number of outputs per award
Clinician Scientist Awards		1				1	1	1.0
Collaborative Applied Research Grants				1		1	4	0.3
Health Research Awards	3	6	1	2	1	13	61	0.2
Knowledge Exchange and Dissemination Scheme		2				2	38	0.1
MRCG-HRB Joint Funding Scheme		1					9	0.1
Translational Research Awards	3	1	1	4	1	10	3	3.3
Total outputs	**6**	**11**	**2**	**7**	**2**	**28**	**116**	**2.1**

11.2 Establishment of collaborations with industry

Interacting with and establishing industry partners can increase the impact of HRB-funded research. Not only can industry be a source of leveraged funding, but access to expertise and research material, networking opportunities, and the completion of joint research are some other positive benefits that can arise from such collaboration. Holders of awards ending in 2018–19 were asked about their interactions with industry. In total, 46 instances of new or strengthened academic–industry collaborations were identified by 33 award holders (19% of all award holders).

11.2.1 Reasons cited for collaborating with industry

Of the 46 collaborations with industry, 29 (63%) were international and 17 (37%) were national. As each award holder could cite more than one reason for interacting with industry, a total of 100 reasons were reported, which is an average of 2 unique reasons per award. Figure 11.6 shows the reasons cited by award holders for establishing a collaboration of some type with an industry partner. Collaboration with both Irish and international industry partners for the purpose of conducting joint research projects accounted for 35% of all cited reasons. Accessing material, cohorts, and datasets was an important reason for connecting internationally (22%), whereas access to infrastructure and equipment was an important reason for national collaboration (19%).

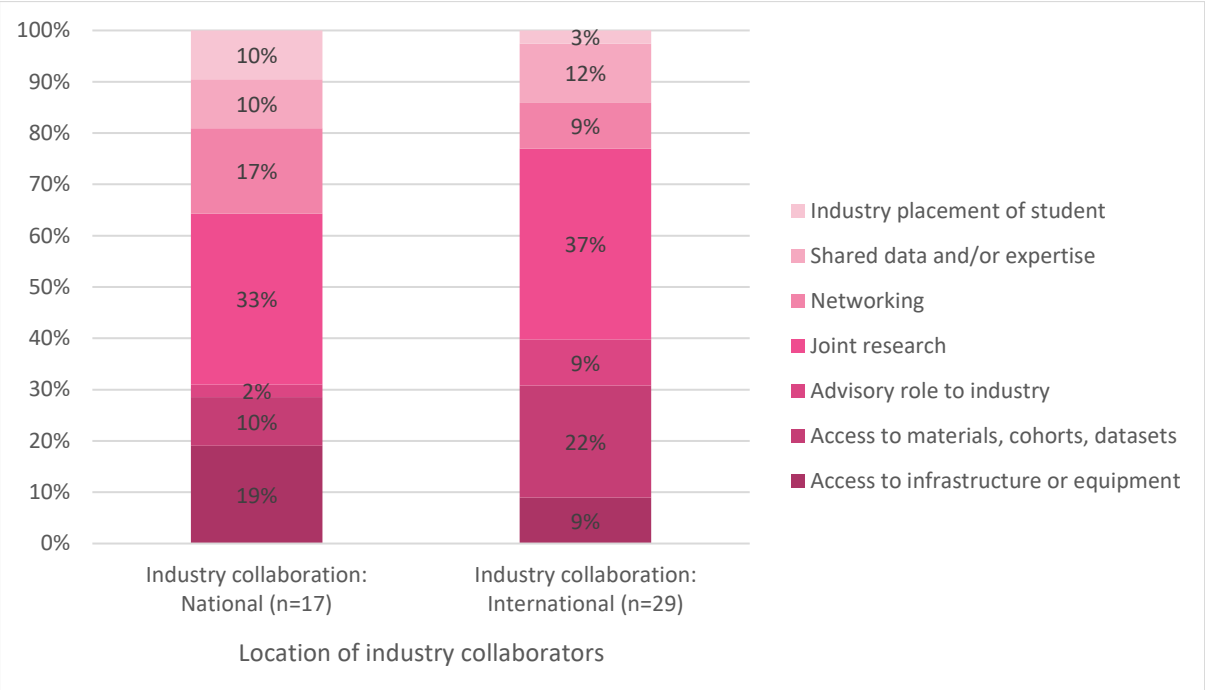


Figure 11.6: Cited reasons for establishing industry collaborations, national and international, 2018–19

11.2.2 Collaboration with industry, by award type

When examining the data further by award type, Projects and Programmes awards accounted for 42 (91%) of the 46 total reported collaborations. Figure 11.7 shows that holders of Projects and Programmes awards collaborated both nationally and internationally, while holders of Capacity Building and Leadership Enhancement awards only collaborated internationally and accounted for 14% of the total international collaborations. There were no reported industry interactions from Infrastructure and Networks awards.

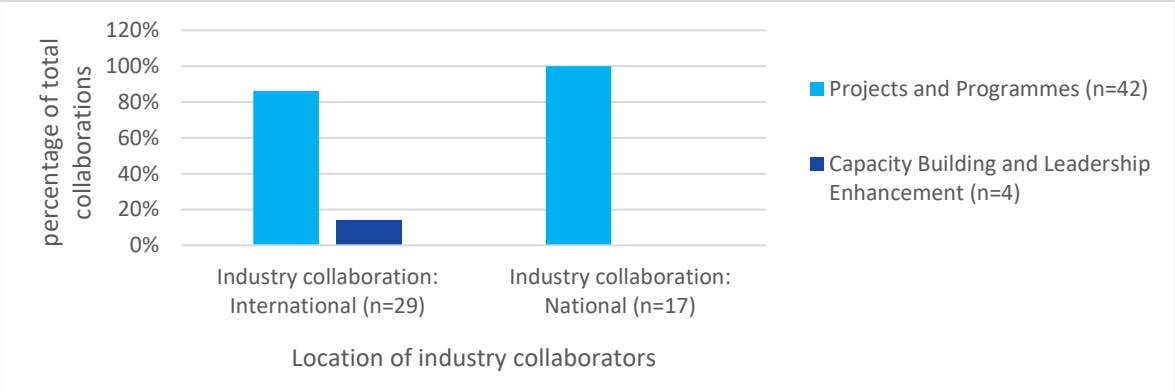


Figure 11.7: Breakdown of industry collaborations, per award type and jurisdiction, 2018–19

11.2.3 Collaboration with industry, by broad research area

Figure 11.8 shows the breakdown of industry collaborations by broad research area. Applied Biomedical Research reported the highest number of collaborations (n=20), followed by Clinical Research (n=15), which is as expected given the nature of these areas of research. Health Services Research reported eight collaborations, while Population Health Sciences reported three collaborations. Applied Biomedical

Research, Clinical Research, and Health Services Research collaborations spanned national and international jurisdictions, while Population Health Sciences awards reported only international collaborations (10% of all such collaborations). Applied Biomedical Research awards collaborated mainly nationally, accounting for 56% of all Irish collaborations.

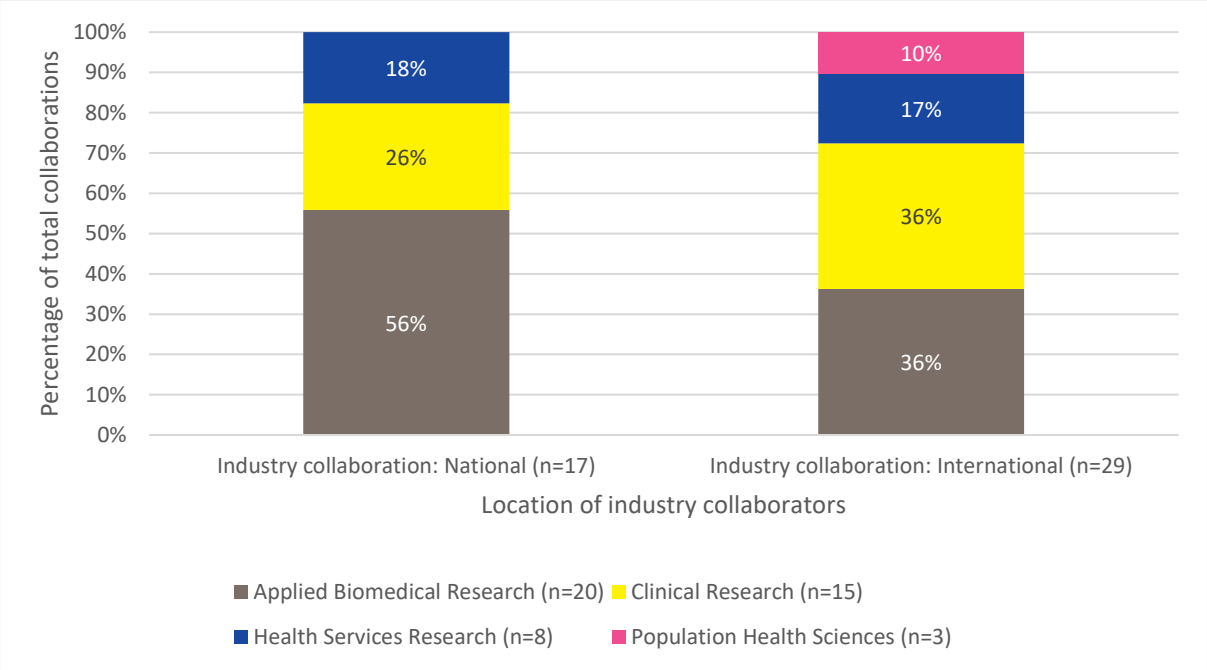


Figure 11.8: Breakdown of industry collaborations, per broad research area and jurisdiction, 2018–19

11.3 Examples of commercialisation and enterprise outputs

Table 11.3 provides examples of the types of commercialisation outputs reported by award holders whose awards completed in 2018–19.

Table 11.3: Examples of commercialisation outputs, 2018–19

Scheme	Output type	Activity orname of collaborator	Details of output
Health Research Awards	Patents filed (includes pending, active, or lapsed status)	Patent, European	Hyperbranched poly-amino ester for hydrogels, Wang, W.; Wei Wang. March 2017. Application number: P120169GB00
Health Research Awards	Start-ups established or in discussion	Start-up	This company's work relates to regulating the blood–brain barrier for therapeutic intervention. The company will license an intellectual property portfolio from Trinity College Dublin related to the use of RNAi to modulate the blood–brain barrier for drug delivery purposes.
Clinician Scientist Awards	Industry collaboration	Critical Diagnostics Ltd	The purpose of this collaboration was to provide access to materials, cohorts, and datasets and to conduct joint research.

Scheme	Output type	Activity orname of collaborator	Details of output
Collaborative Applied Research Grants	Industry collaboration	e-Concepts	We have developed a strong working relationship with an Irish technical solutions company called e-Concepts, which has provided us with expert advice and support in developing some of our research materials, outputs, and innovations (e.g. the knowledge hub, the ENRICH web page, graphic design advice, etc.).
Knowledge Exchange and Dissemination Scheme	Industry collaboration	Roche Diagnostics	Shared data and expertise and gained access to learning materials.
Health Research Awards	Industry collaboration	Omnispirant	Conducted collaborative research on stem cell products for a range of pulmonary diseases, and engaged in networking and the industry placement of a student.
Collaborative Applied Research Grants	Industry collaboration	Hologic Inc.	The award holder gained access to infrastructure or equipment and to materials, cohorts, and datasets; also served in an advisory role to industry and took part in joint research.

12 Data usage

The HRB supports and promotes research that will improve people's health, patient care, and health service delivery. The primary output from the research projects funded by the HRB is often the data gathered and generated to support observations and validate the projects. In order to ensure that these data are used to their maximum potential, data need to be adequately managed from the earliest stage in the research process and should be preserved and made available for reuse beyond the original project. The HRB promotes the FAIR data principles (findable, accessible, interoperable, reusable) of open data – which aim to ensure that data are findable, accessible, interoperable, and reusable – to award holders. Furthermore, the HRB supports the use of secondary analysis by HRB-funded award holders in order to reduce research waste and redundancy in the research system.

Award holders reporting awards that finished in 2018–19 were asked about the level of data deposition, about the secondary analysis of data, and about additional details regarding data linkage. This is the first time that this information is being presented in an HRB research outputs report.

Key findings

- Of the 170 award holders surveyed, only 10 award holders confirmed that the data generated from their HRB-funded research were added to an archive/repository. These awards spanned all broad research areas, with the Applied Biomedical Research and Clinical Research areas recording the highest number of awards (4.5 and 4.0, respectively).
- Three of the repositories used by award holders were Irish, four were European, two were American, and one was British.
- A total of 37 examples of secondary analysis of data were recorded from awards that ended in 2018–19. Much of the data originated in Ireland (78%, n=29); however, there was a reasonable number of international datasets accessed.
- Projects and Programmes awards accounted for 84% (n=31) of the overall total secondary analyses. Capacity Building and Leadership Enhancement awards accounted for 16% (n=6). Most awards reporting secondary analysis were categorised as Health Services Research (62%, n=28.0).
- Health Research Awards were most likely to carry out secondary analysis of data, reporting 26 instances (70%) of secondary analysis across seven unique awards.
- A total of 15 examples of data linkage were reported, with Projects and Programmes awards accounting for the highest level of data linkage activity, with 93% (n=14) of total data linkage instances.
- Almost one-half (47%, n=7) of the award holders reported difficulties with data linkage.

12.1 Data deposition

Award holders were asked if their datasets were added to online depositories. Of the 170 award holders surveyed, only 10 award holders confirmed that the data generated from their HRB-funded research were added to an archive/repository. Nine of these awards were Projects and Programmes awards, namely six Health Research Awards, two Joint Programming Initiative in Neurodegenerative Diseases awards, and one Knowledge Exchange and Dissemination Scheme award. The remaining award was a Capacity Building and Leadership Enhancement award from the National SpR/SR Academic Fellowship Programme. Despite the low number of awards reporting data deposition, the span of awards reporting this activity is positive.

The awards spanned all broad research areas, with the Applied Biomedical Research and Clinical Research areas recording the highest number of awards (4.5 and 4.0, respectively).

Three of the repositories used by award holders were Irish, four were European, two were American, and one was British.

Notably, 70% (n=7) of award holders reported that they did not experience any impediments in the deposition of the data. Of the three award holders who did report difficulty with data deposition, the main reason cited was the size of the file requiring a lot of time for online transfer. Another reason was the coordination required between all collaborating partners and hosts of the database in order to ensure that the deposited data were able to address the different needs of each site.

When asked about their motivations in making the data freely available in a repository, some award holders reported that this is a good way to share data within a consortium and that it ensures standardisation and ongoing monitoring of standards across all countries. Another award holder detailed how they envisaged future collaboration may arise from sharing their data, as well as highlighting that it is often a journal requirement to deposit data. This raises an important point regarding how policy changes drive behavioural change in health research.

However, despite extensive work in this area, few of the awards ending in 2018–19 reported data deposition. This small number of data deposits may be due, in part, to the immaturity of this research activity and the award holders not having access to the appropriate resources or expertise to facilitate data deposition. It is heartening that very few award holders reported encountering difficulties with depositing data, and this may serve as welcome encouragement for award holders in the future.

12.2 Secondary analysis of data

Secondary analysis of data involves using existing research data to answer a new and different research question than that which the data were originally gathered to answer. Award holders were asked about the number of secondary data analyses that took place during their HRB-funded award. A total of 37 examples of secondary analysis of data were recorded from awards that ended in 2018–19.

12.2.1 Secondary analysis of data, by award type

Figure 12.1 shows the distribution of secondary analysis by award type. Projects and Programmes awards accounted for 84% (n=31) of the overall total secondary analyses. Capacity Building and Leadership Enhancement awards accounted for 16% (n=6).

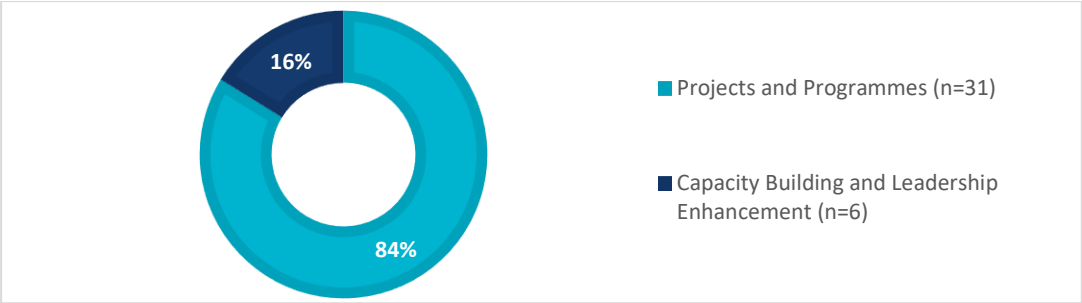


Figure 12.1: Distribution of secondary data analysis, per award type, 2018–19

12.2.2 Secondary analysis of data, by broad research area

The distribution of secondary analysis by broad research area is shown in Figure 12.2. Notably, most awards reporting secondary analysis were categorised as Health Services Research (62%, n=28.0).

Following this, Clinical Research awards accounted for 20% (n=7.5) of the secondary analysis of data activity in awards ending in 2018–19. Population Health Sciences and Applied Biomedical Research were the broad research areas in which awards were least likely to carry out secondary analysis of data (8% and 10%, respectively).

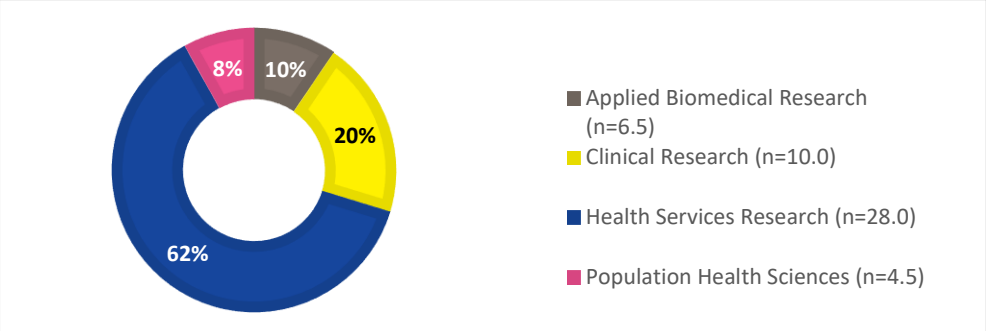


Figure 12.2: Distribution of secondary data analysis, per broad research area, 2018–19

12.2.3 Secondary analysis of data, by jurisdiction

Figure 12.3 outlines the various jurisdictions that the data involved in the secondary analyses originated from. Unsurprisingly, much of the data originated in Ireland (78%, n=29); however, there was a reasonable number of international datasets accessed.

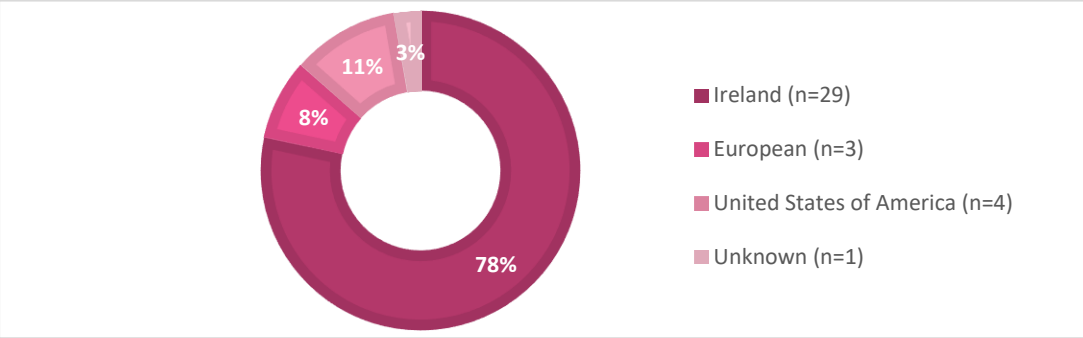


Figure 12.3: Distribution of secondary data analysis sources, per jurisdiction, 2018–19

12.2.4 Secondary analysis of data, by scheme

The number and proportion of secondary data analyses across the HRB-funded schemes is shown in Table 12.1. Health Research Awards were most likely to carry out secondary analysis of data, reporting 26 instances (70%) of secondary analysis across seven unique awards. Of note, one of the Health Research Awards reported 20 instances of secondary analysis. While this was a comparatively high level of activity, given that the award's objective was to complete an inter-sectoral analysis on the level of need and supply of health services by geographical area in Ireland, this result is as expected.

A broad selection of awards in other schemes also completed secondary analysis. This highlights the broadly applicable nature of secondary data analysis and demonstrates how future awards funded across a wide variety of HRB schemes may be able to avail of existing datasets to answer new research questions.

There were 17 unique award holders reporting secondary analysis in 2018–19, which accounts for 10% of the total awards included in the reporting period.

Table 12.1: Distribution of secondary data analysis activities, per scheme, 2018–19

Scheme	Number of analyses	Number of awards reporting analyses	Percentage of total
Health Research Awards	26	7	70%
MRCG-HRB Joint Funding Scheme	3	3	8%
Interdisciplinary Capacity Enhancement Awards	2	1	5%
Research Leader Awards	1	1	3%
Cancer Prevention Fellowship Programme	1	1	3%
Research Collaborative in Quality and Patient Safety	1	1	3%
Research Training Fellowships for Healthcare Professionals	1	1	3%
Applied Research Projects in Dementia	1	1	3%
National SpR Academic Fellowship Programme	1	1	3%
Total	**37**	**17**	**100%**

12.2.5 Challenges associated with secondary analysis of data

Award holders were asked if they encountered any impediments to secondary analysis of data during the lifetime of their award, and most (84%, n=31) reported no issues with secondary analysis. This was heartening and indicated that, in most cases, any perceived potential issues regarding secondary analysis of data did not hinder a project.

Among the six award holders who reported difficulty carrying out secondary analysis of data, the main reasons included needing to know the right person to contact in order to access the data, as well as long, unpredictable waiting times when contacting organisations to access their data. However, a number of award holders reported that establishing such relationships was valuable exercise involving building trust and concluded that the benefit of establishing networks between organisations where there were none previously outweighed the difficulties encountered.

Some award holders noted that additional analysis of existing datasets raised concerns about compliance with the General Data Protection Regulation, and that this took time to consider.

12.2.6 Motivation to use secondary analysis of data

When asked about the motivation to use secondary analysis of data in the award, award holders cited that the activity saved a huge amount of time and reduced research waste. Award holders noted that secondary analysis of data as part of a project grant is very efficient, and highlighted that rich datasets exist in the research system which should be utilised to the greatest possible extent.

12.3 Linkage of datasets

Fully utilising health research data is vital to reducing research waste and to garnering the full benefit of investment in research. Often, the linkage of data from various datasets is necessary in order to fully harness their power. While still a relatively underutilised area in health research, the HRB supports data linkage as a powerful method of answering important and complex research questions.

Award holders were asked to report on data linkages that took place in awards ending in 2018–19. In total, 15 instances of data linkage were recorded. It is envisaged that ongoing HRB investment in data linkage – such as the pilot project in data linkage based at the Irish Centre for High-End Computing

(ICHEC) at National University of Ireland, Galway, funded in 2019 – will increase the level of activity in this area in the coming years.

12.3.1 Data linkage, by award type

Figure 12.4 shows the distribution of data linkage activity by award type. Projects and Programmes awards account for the highest level of data linkage activity, with 93% (n=14) of total data linkage instances. There were no reported data linkage activities in the Infrastructure and Networks awards.

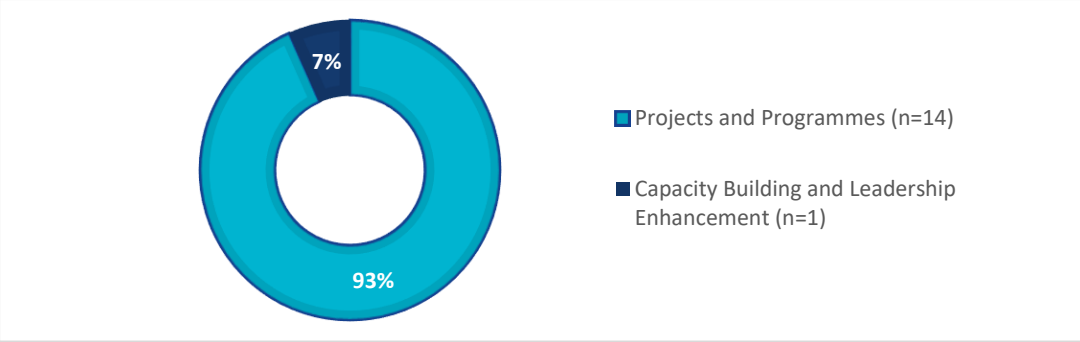


Figure 12.4: Distribution of data linkage activities, per award type, 2018–19

12.3.2 Data linkage, by broad research area

As shown in Figure 12.5, in line with the findings related to the secondary analysis of data, Health Services Research was the most common research area recording data linkage activity (67%, n=10). Awards categorised as Clinical Research accounted for 23% (n=3.5) of all data linkage activity, and Population Health Sciences accounted for 10% (n=1.5) of all activity. There were no instances of data linkage recorded for Applied Biomedical Research awards.

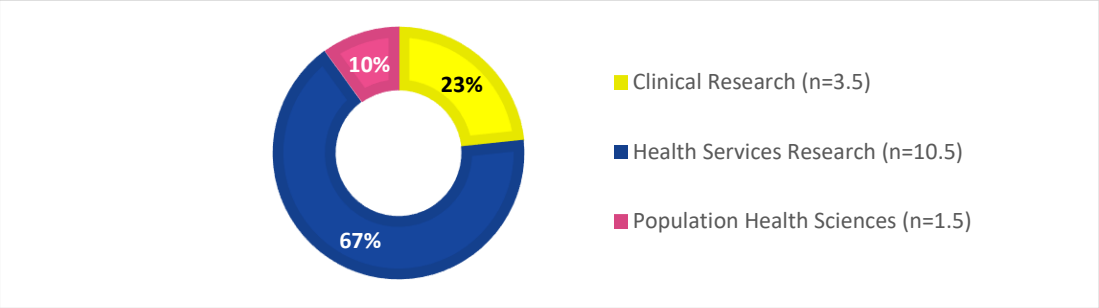


Figure 12.5: Distribution of data linkage activities, per broad research area, 2018–19

12.3.3 Data linkage, by scheme

Table 12.2 shows the level of data linkage activity per scheme across awards ending in 2018–19. The awards reporting the most data linkage activities were Health Research Awards (n=8, 53%). Similar schemes completed data linkage activities as those that reported the secondary analysis of data, with the addition of one Clinician Scientist Award and one Collaborative Applied Research Grants award.

A total of 10 unique holders of awards ending in 2018–19 recorded data linkage activities, which accounts for 6% of the total 170 awards included in this reporting period.

Table 12.2: Distribution of data linkage activities, per scheme, 2018–19

Scheme	Number of of data linkage activities	Number of awards reporting activity	Percentage of total data linkage activities
Health Research Awards	8	4	53%
Collaborative Applied Research Grants	2	1	13%
Knowledge Exchange and Dissemination Scheme	2	2	13%
Clinician Scientist Awards	1	1	7%
Research Collaborative in Quality and Patient Safety	1	1	7%
MRCG-HRB Joint Funding Scheme	1	1	7%
Total	**15**	**10**	**100%**

12.3.4 Challenges associated with data linkage

Award holders were asked if they encountered any impediments to data linkage over the lifetime of their HRB-funded award. Almost one-half (47%, n=7) of the award holders reported difficulties with data linkage. An array of reasons for these difficulties were cited by award holders, such as:

- Limited comparability between datasets necessitating extensive data cleaning
- Extreme difficulty in securing permission for data access and linkage from various statutory regulatory authorities, and a distinct lack of an independent organisation that was responsible for coordination and linkage of national datasets
- Delays with ethical approval, and
- The requirement for patient groups to re-consent.

Despite the difficulties, one award holder noted in their survey response that “the final integration and linkage of datasets was rewarding”.

This highlights that much work is needed in this area in order to facilitate successful data linkage in the health research space.

13 Conclusion

The data described in this report demonstrate a wide variety of outputs produced by HRB-funded research in terms of knowledge production, capacity building, policy and practice outputs, healthcare innovations, and enterprise outputs.

The trends observed since 2010 and reported here demonstrate the impact of strategic and policy decisions that the HRB has taken over this time period. These strategic and policy decisions include the following:

- Shifting investment away from Basic Biomedical Research to focus on enhancing activity in patient-oriented research, Population Health Sciences, and Health Services Research has resulted in significant increases in the productivity of awards in these areas, particularly in the knowledge creation, capacity enhancement, and informing policy and clinical practice Payback categories. For example, the share of publications by awards in the broad research area of Health Services Research tripled since 2016–17, and the combination of Health Services Research and Population Health Sciences posts accounted for more than one-half of all positions supported for the first time in 2018–19.
- The impact of the HRB's strategic objective to generate relevant knowledge and promote its application in policy and practice is evidenced by a significant increase in reported engagement outputs with policy-makers, healthcare providers and decision-makers, patient groups, and the public.
- Investing in infrastructure and research leaders in order to facilitate high-quality clinical research and designing schemes to attract both academic and health and social care professionals has paid dividends. This was the first time that the number of post-holders with a health and care background was higher than the number with a scientific or social sciences background. In addition, the 2018–19 reporting period saw the highest average number of healthcare innovations per award.
- The HRB's continuing emphasis on a multidisciplinary collaborative funding model has resulted in HRB award holders reporting collaborations with partners in 21 countries and significant Irish research collaborations with academics, policy-makers, healthcare providers, and decision-makers.
- Driving the policy changes and infrastructure required in order to support open access publication of HRB-funded publications resulted in open access publications accounting for 85% of all peer-reviewed publications in 2018–19; 37% of these were published on HRB Open Research.
- Taking a lead nationally in promoting the incorporation of public and patient involvement (PPI) in the research that HRB funds led to the 2018–19 reporting period seeing the highest level of PPI to date, with a growing understanding of what PPI requires and increasing numbers of award holders including meaningful engagement with the public, patients, and carers at all stages of their research.
- The importance that the HRB places on international peer review and methodological rigour in order to ensure that only high-quality research is funded is reflected in the observed upward trend since 2010 across the full range of Payback Categories, with increases in many metrics compared to previous reporting periods. It is also reflected in the success of HRB award holders in leveraging their HRB-supported research to win more than €100 million in additional funding from a wide variety of exchequer and non-exchequer sources both nationally and internationally.

The MRC was the only comparator health funding agency internationally who collect and publish similar evaluation data to the HRB. This lack of a suitable comparator reduced the opportunity to benchmark the

level of outputs and outcomes of HRB award holders against those of researchers elsewhere. To partially address this, a bibliometric analysis of publication outputs from HRB awards 2017-2020 is planned for 2022, which will include a number of comparator countries and funding agencies globally.

For the first time, this report examined the level of data usage by HRB award holders, including their level of data deposition and sharing, their use of secondary data analysis in their research, and linkage of datasets, as well as the impediments they have experienced in carrying out these activities. The number of award holders reporting any of these activities was modest but is expected to grow in future reporting periods as the emphasis on data sharing becomes more embedded into HRB schemes and the skills, knowledge, and awareness of researchers in this sphere increases. The HRB has already take positive steps towards increasing data usage metrics, including a requirement for the development of a Data Management Plan (DMP) for awards; the facilitation of online DMP preparation, peer review, and publication through a partnership with the United Kingdom's Digital Curation Centre and F1000; the training of data stewards in Irish universities; and engagement with the GO FAIR Initiative and FAIRsFAIR in Europe, which will ultimately enable Irish health researchers to derive the maximum benefits from existing and new data outputs.

Appendix A Impact Assessment ("Payback Framework")

Table A1: Payback Framework impact categories and indicators

Impact category	Indicators
Knowledge creation	• Peer-reviewed publications and citations • Other publications, such as books, book chapters, editorials, or bulletins • Presentations to national and international conferences • Research reports and grey literature produced, and • Cochrane systematic reviews produced, or findings included in a review • Invited keynote presentations to international conferences; and involvement of HRB-funded researchers in international research programmes)
Capacity building and leadership	• Education and training of personnel such as clinicians, health professionals, and scientists • Higher degrees, such as PhDs, obtained by research personnel • Retention rates of research personnel in national research or the health system • Development and use of novel research techniques • Establishment of new datasets or databases, or research data lodged in national databases • New national/international collaborations or strategic partnerships formed with other research teams, industrial partners, or health agencies, and • Internationalisation of research: involvement of researchers funded by the Health Research Board (HRB) with European Union and global health research initiatives.
Informing policy, practice and the public	• Influencing national and international research policies and strategies • Dissemination and knowledge-transfer events or networks established with research users, such as policy-makers and health professionals • HRB-funded researchers in advisory roles to government or policy-makers • Policy briefing papers, practical handbooks, and other grey literature material produced and disseminated to research users, such as policy-makers and health professionals • Contribution of research to clinical treatment or best practice guidelines, and • Evidence of public outreach and dissemination through media and other fora. • Inclusion of PPI in research design, conduct, analysis and dissemination
Healthcare innovations	• Contribution of HRB-funded research to health promotion initiatives • Randomised controlled trials completed, and new interventions established as a result • Numbers of patients enrolled in clinical trials or engaged with studies undertaken in clinical research facilities supported by the HRB • Contribution of HRB-funded research to actual health benefits within the Irish population • Savings to the health system through gains in health service efficiency, improved primary care, or the introduction of preventative health measures, where research and evidence generated by HRB-funded researchers contributed to this, and • Increased availability of a local pool of evidence and 'evidence generators' to Irish health policy-makers and health practitioners.

Impact category	Indicators
Commercialisation and economic benefits	• Improvement of Ireland's international reputation for health and medical research (e.g., by attracting pharmaceutical industry research and development and collaborative partnerships with HRB-funded researchers • Patents and other intellectual property applications and the distribution of commercialisation support awards to develop marketable products or devices • Licence agreements and revenues generated as a result of these • Spin-out companies created, or formal collaborative partnerships formed between researchers and industry • Success of HRB-funded personnel in attaining additional research funding, for example through the European Union's Framework Programmes • Success of HRB-funded researchers in obtaining Enterprise Ireland funding for further development of potentially viable enterprise outputs of the research.

Appendix B Summary of key indicators from awards ending in 2018–19, per award type

Table A.2: Summary of key payback indicators from awards ending in 2018–19, per award type

Impact category/key indicator (total no.)	Projects and Programmes (n=128 awards)	Capacity Building and Leadership Enhancement (n=41 awards)	Infrastructure and Networks (n=1 award)
Amount invested (€)	**€32,051,601**	**€16,669,831**	**€761,835**
1. Knowledge creation			
Total number of peer-reviewed publications (n=792)	388	350	54
Mean number of peer-reviewed publications per award	3.0	8.5	54.0
Average number of publications per €1 million spend	12.1	21.0	71.1
Number of scientific presentations (n=1560)	954	578	28
Number of keynote presentations internationally (n=20)	19	1	0
2. Capacity building and leadership			
Total number of research-related posts created (n=451)	335	114	2
Number of PhD degrees (n=103)	42	61	0
Number of postdoctoral researchers supported (n=136)	121	15	0
Number of researchers from a health professional background (n=176)	142	34	0
Number of researchers remaining in the national health or research system (n=339)	253	85	1
Number of awards reporting indicators of peer recognition (n=324)	216	108	0
Number of research collaborations established (n=396)	247	138	11
Number of collaborations with health bodies or government agencies (n=35)	21	14	0
Number of new research methods, materials, datasets, or tools developed (n=116)	105	11	0
Number of leveraged additional awards (n=174)	136	33	5
Value of funding leveraged by HRB researchers (total=€100.4 million)	€91,674,796	€8,026,747	€675,399
3. Informing policy, practice, and the public			
Total number of policy/practice outputs (n=190)	137	53	0

Impact category/key indicator (total no.)	Projects and Programmes (n=128 awards)	Capacity Building and Leadership Enhancement (n=41 awards)	Infrastructure and Networks (n=1 award)
Amount invested (€)	**€32,051,601**	**€16,669,831**	**€761,835**
Average number of policy and practice outputs per €1 million spend	4.3	3.2	0.0
Number of advisory roles to government or policy-makers (n=16)	14	2	0
Number of policy briefings, practical handbooks, etc. disseminated to research users (policy-makers, health professionals, etc.) (n=9)	6	3	0
Number of contributions to clinical treatment or best practice guidelines (n=14)	5	9	0
Number of policy/health system/public engagement outputs (n=473)	398	67	8
Average number of policy/health system/public engagement outputs per €1 million spend	12.4	4.0	10.5
Number of public and patient involvement (PPI) outputs (n=575)	469	86	20
4. Healthcare innovations			
Total number of healthcare innovations developed (n=57)	46	11	0
Number of therapeutic interventions (behavioural, drug, cell, vaccine, device) (n=10)	9	1	0
Number of preventative interventions ((behavioural) (n=3)	3	0	0
Number of prognostic or diagnostic tools (n=11)	9	2	0
Number of care models and clinical decision support tools (n=12)	7	5	0
Number of innovations in the design/pilot/feasibility/proof-of-concept/trial stages (n=34)	28	6	0
Number of innovations adopted in the health system (small or large scale) (n=22)	17	5	0
Average number of healthcare innovations per €1 million spend	1.4	0.7	0.0
5. Commercialisation and economic benefits			
Number of patents/copyrights/trademarks filed or pending (n=7)	7	0	0
Number of licensed technologies developed (n=2)	2	0	0
Number of start-up/spin-out companies established (n=2)	2	0	0
Number of industrial collaborations established (n=46)	42	4	0
Number of commercialisation outputs per €1 million spend	0.7	0.1	0.0

Appendix C Summary of key indicators from awards ending 2018–19, per broad research area

Table A.3: Summary of key payback indicators from awards ending in 2018–19, per broad research area

Impact category/key indicator (no.)	Applied Biomedical Research (n=40.0 awards)	Clinical Research (n=56.0 awards)	Health Services Research (n=52.5 awards)	Population Health Sciences (n=21.5 awards)
Amount invested (€)	**€11,529,224**	**€13,020,262**	**€19,940,672**	**€4,993,110**
1. Knowledge creation				
Total number of peer-reviewed publications (n=792)	124.5	182.5	409.0	76.0
Mean number of peer-reviewed publications per award	3.1	3.3	7.8	3.5
Average number of publications per €1 million spend	10.8	14.0	20.6	15.2
Number of scientific presentations (n=1560)	365.5	378.5	608.0	208.0
Number of keynote presentations internationally (n=20)	4.5	8.0	5.5	2.0
2. Capacity building and leadership				
Total number of research-related posts created (n=451)	81	127	202	41
Number of PhD degrees (n=103)	14.5	24.5	59.5	4.5
Number of postdoctoral researchers supported (n=136)	38.5	42.5	42.0	13.0
Number of researchers from a health professional background (n=176)	11	72	74	19
Number of researchers remaining in the national health or research system (n=339)	57.5	99.0	151.0	31.5
Number of awards reporting indicators of peer recognition (n=324)	100.5	93.0	104.0	26.5
Number of research collaborations established (n=396)	87	108	160	41
Number of collaborations with health bodies (n=35)	13.5	5.0	16.0	0.5
Number of new research methods, materials, datasets, or tools developed (n=116)	47	32	31	6
Number of leveraged additional awards (n=174)	55.0	53.5	44.5	21.0
Value of funding leveraged by HRB researchers (total=€100.4 million)	€44,320,003	€42,908,701	€6,342,550	€6,825,689
3. Informing policy, practice, and the public				
Total number of policy/practice outputs (n=190)	16.5	42.0	107.0	24.5
Average number of policy and practice outputs per €1 million spend	1.4	3.2	5.3	5.4
Number of advisory roles to government or policy-makers (n=16)	1.5	7.0	3.0	4.5

Impact category/key indicator (no.)	Applied Biomedical Research (n=40.0 awards)	Clinical Research (n=56.0 awards)	Health Services Research (n=52.5 awards)	Population Health Sciences (n=21.5 awards)
Amount invested (€)	**€11,529,224**	**€13,020,262**	**€19,940,672**	**€4,993,110**
Number of policy briefings, practical handbooks, etc. disseminated to research users (policy-makers, health professionals, etc.) (n=9)	0.0	0.5	7.5	1.0
Number of contributions to clinical treatment or best practice guidelines (n=14)	1.5	7.0	4.5	1.0
Number of policy/health system/public engagement outputs (n=473)	108.5	153.5	145.0	66.0
Average number of policy/health system/public engagement outputs per €1 million spend	9.4	11.8	7.3	13.2
Number of public and patient involvement (PPI) outputs (n=575)	63.5	212.0	222.0	77.5
4. Healthcare innovations				
Total number of healthcare innovations developed (n=57)	9.5	20.5	24.0	3.0
Number of therapeutic interventions (behavioural, drug, cell, vaccine) (n=10)	5.0	2.5	2.5	0.0
Number of preventative interventions ((behavioural) (n=3)	0	0	3	0
Number of prognostic or diagnostic tools (n=11)	3.0	6.0	1.5	0.5
Number of care models and clinical decision support tools (n=12)	0.5	6.5	5	0
Number of innovations in the design/pilot/feasibility/proof-of-concept/trial stages (n=34)	9.0	11.5	11.0	2.5
Number of innovations adopted in the health system (small or large scale) (n=22)	0.5	9.0	12.0	0.5
Average number of healthcare innovations per €1 million spend	0.8	1.6	1.2	0.6
5. Commercialisation and economic benefits				
Number of patents/copyrights/trademarks filed or pending (n=7)	1.5	3.0	2.0	0.5
Number of licensed technologies developed (n=2)	1.0	0.5	0.5	0.0
Number of start-up/spin-out companies established (n=2)	0	1	1	0
Number of industrial collaborations established (n=46)	20	15	8	3
Number of commercialisation outputs per €1 million spend	0.7	0.7	0.2	0.1

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