Bibliometric analysis of ongoing projects

11th Report
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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

This report presents a bibliometric analysis of the Innovative Medicine Initiative Joint Undertaking's (IMI JU) research published between 2010 and 2019, using citations as an index of academic impact and co-authorship as an index of collaboration. This is the eleventh report commissioned by IMI from Clarivate.

The data show that IMI continues to perform well. To date, IMI projects have produced 5,943 publications which have been matched to the Clarivate Web of Science™. This represents a 20% increase from the 4,938 publications matched to the Web of Science in the tenth report, which covered IMI project research published between 2010 and 2018.

Between 2010 and 2018, the number of IMI research publications increased year on year. However, in 2019, the most recent year, publication output had fallen slightly. Growth had previously been sustained by an increasing number of active IMI projects and the fact that by some of IMI 1's longest running and most productive projects (e.g., BTCure) have now come to an end is almost certainly a factor in the observed change in trend. However, this is a single observation and should not necessarily be taken as indicative of a long-term change in trajectory which will depend on the output of new and future IMI 2 projects.

The majority of IMI research (55.7%) continues to be published in high impact journals, i.e. those journals in the highest quartile (Q1) ranked by Journal Impact Factor, and the average Journal Impact Factor of all IMI project publications was 6.38. IMI research was wide-ranging from basic biological research to clinical practice. IMI project research has been published most frequently in the fields of Pharmacology & Pharmacy, Neurosciences and Biochemistry & Molecular Biology.

The impact of IMI project research (as indicated by citation impact) has remained high, with an increase in citation impact since last year. The field-normalised citation impact of IMI project research (2.05) is over twice the world average (1.00), which indicates the research was internationally influential. Between 2010 and 2019, the field-normalised citation impact of IMI papers was considerably higher (80%) than the European Union's (EU) average citation impact (1.14) in similar biomedical fields (journal subject categories). Over a quarter of papers from IMI projects were highly cited - that is, the papers were in the world's top 10% of papers in the same journal category and year of publication, when ranked by number of citations.

The output of individual IMI projects has also increased between 2010 and 2019. BTCure (Call 2) has remained the most prolific IMI project, with 680 publications as of this report. This is a 5.4% increase on the 645 publications attributed to BTCure in the previous report. However, this growth is slower than the growth for all IMI projects in aggregate; most likely because the BTCure project ended in early 2017.

Projects funded by IMI are highly collaborative. Since the last report, an increasing percentage of IMI publications involve collaboration between researchers in different sectors. Nearly two-thirds (64.1%) of all IMI project papers were co-authored by researchers working in different sectors, more than three-quarters (83.8%) involved collaboration between institutions and more than half (61.8%) were internationally collaborative. Internationally collaborative IMI project research had an average citation impact (2.73) well over twice the world average (1.00) and higher than non-internationally collaborative IMI project research (1.89).

Research in both Europe and North America tends to be clustered in major cities with an existing strong academic research base. It is clear that the citation impact of IMI papers within these clusters is higher than national averages and rates of international co-authorship are very high compared to the averages for EU-28 biomedical research. The cluster with the highest proportion of open access publications is Oxford, UK (83.4%).

IMI's field-normalised citation impact (2.05) is on a par with or exceeds well-established funding bodies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Medical

Research Council (MRC) and the Wellcome Trust (WT) (1.71, 2.00 and 2.05 respectively). Its journal-normalised citation impact (1.19) and percentage of highly cited papers (26.9%) are also similar to those of the comparator funders.

A more detailed summary of the key findings of this report (with cross-references to the relevant sections) is provided below.

Summary of key findings

Since its first call for proposals in 2008, IMI has funded more than 153 projects from a total of 30 funding calls, a further four calls are currently open for proposals. Of the calls, 11 were from IMI's first phase (IMI 1), which ran from 2008 to 2013, and the rest from its second phase (IMI 2), which was launched in 2014 and is ongoing.

It may take several months for a project to progress from inception to the point where it has generated sufficient data for a publication. It may take further months or years until it has produced its most valuable results. As some of the IMI projects analysed in this report are relatively young, the bibliometric indicators may not fully reflect their eventual impact.

- IMI projects have published a total of 5,943 unique Web of Science publications (Figure 4.1.1). For the first time in 2019 IMI project research publication count did not exceed the previous year's output with 1,000 publications compared to 1,095 in 2018. (Figure 4.3.1).
- Over a quarter (26.9%) of IMI papers were in the world's top 10% of most highly cited papers in the relevant field and year of publication, suggesting very strong performance (Table 4.6.1).
- The field-normalised citation impact of IMI project papers was twice the world average (2.05) between 2010 and 2019. This indicates that the impact of IMI-associated research (as indicated by citations) has been maintained as IMI 1 projects end and IMI 2 projects start to publish (Table 4.6.1).
- More IMI project publications appeared in *PLOS One* than in any other journal (168 publications), followed by *Annals of the Rheumatic Diseases* (115 publications). Of the 20 journals in which IMI-funded projects published most frequently, three-quarter (15 journals) rank in the top quartile by Journal Impact Factor (Table 4.7.1).
- The highest Impact Factor journal in which IMI research was published is the *New England Journal of Medicine*, which has a Journal Impact Factor of 74.70. IMI project research published 15 times in *Nature* and 11 times in *Science*, which have Journal Impact Factors of 42.78 and 41.85 respectively (Table 4.7.2).
- IMI project research had a citation impact well above the European (EU-28) average in all of the 20 journal subject categories to which most IMI publications are assigned (Table 4.9.1 and Figure 4.9.1).
- IMI project research was most frequently published in Pharmacology & Pharmacy journals (Figure 4.8.1). Of the 595 papers published in this field, 21.5% were highly cited, 47.1% were open access, and the average citation impact of these papers was nearly 1.5 times the world average for the field to which they relate (Table 4.8.2 and Table 4.8.3).
- IMI 2 project research was most frequently published in Endocrinology & Metabolism journals (107 publications),suggesting that current IMI 2 projects have a slightly different focus that IMI 1 projects (Figure 4.8.2).
- The number of publications from IMI 1 Call 1 increased from 2010 to 2013 to a peak of 177, before falling to 54 publications in 2019. Other early IMI 1 calls follow a similar pattern of initial growth followed by a decline as projects come to a close (Figure 5.1.1).
- Research associated with four projects in IMI 1 Call 1 (EUROPAIN, NEWMEDS, PROACTIVE and SAFE-T) received more than twice the world average number of citations for research

published in the same field and year. U-BIOPRED received three times the world average number of citations (Figure 5.1.2).

- IMI project research is collaborative across sectors, institutions and countries. Nearly two-thirds (64.1%) of IMI project papers were co-authored by researchers from different sectors. More than three-quarters (83.8%) of IMI project papers involved collaboration between different institutions. And more than half (61.8%) of all IMI project papers were internationally collaborative (Table 7.1.1).
- BTCURE followed by EU-AIMS had the highest number of papers with co-authors from more than one country, institution and sector (Table 7.1.1-Table 7.2.3). This may be due to these projects having the highest and second highest overall number of papers.
- ULTRA-DD had three-quarters of papers with one or more international co-author. Over 90% of EU-AIMS and EMIF papers have co-authors at different institutions and over 80% of EMIF papers have authors from different sectors (Table 7.1.1-Table 7.2.3).
- IMI's research output grew faster between 2010 and 2018 than any of the seven selected comparators (Table 8.2.1.1).
- IMI's field-normalised citation impact (2.05) was the same as the Wellcome Trust (2.05) and higher than all the other comparators (Table 8.2.2.1).
- The largest geographic clusters of research supported by IMI in Europe are London (1,154 publications), Amsterdam (1,001 publications) and Stockholm (575 publications). The largest clusters in North America are Toronto (256 publications), Boston (243 publications) and Bethesda (140 publications) (Table 6.1.1 and Table 6.1.3).
- Typically, around 40% of EU-28 biomedical research involves international co-authorship whereas the lowest rate of international co-authorship for IMI's European clusters was 66.7% (Uppsala) and the highest was 97.4% (Toulouse). In addition, more than two thirds of the European clusters have rates of international co-authorship of at least 75%. The North American clusters have the highest rates of international collaboration because IMI is a European funding organisation (Table 6.1.1 and Table 6.1.3).

2 INTRODUCTION

2.1 OVERVIEW

The Innovative Medicines Initiative (IMI) Joint Undertaking has commissioned Clarivate to undertake a yearly evaluation of its research portfolio using bibliometric indicators.

The commissioned evaluation comprises a series of reports focusing on research publications produced by IMI funded researchers. This report is the eleventh evaluation in the series.

2.2 INNOVATIVE MEDICINES INITIATIVE (IMI) JOINT UNDERTAKING

IMI's purpose is to improve health by speeding up the development of, and patient access to, innovative medicines, particularly in areas where there is an unmet medical or social need. It does this by facilitating collaboration between the key players in healthcare research, including universities, pharmaceutical companies and other industries, small and medium-sized enterprises (SMEs), patient organisations, and medicines regulators.

IMI is a partnership between the EU and the European pharmaceutical industry, represented by the European Federation of Pharmaceutical Industries and Associations (EFPIA). IMI, as part of its second phase (IMI 2), has a budget of €3.3 billion for the period of 2014 to 2024. Half of this comes from the EU's research and innovation programme, Horizon 2020. The other half comes from large companies, mostly in the pharmaceutical sector; these organisations do not receive any EU funding, but contribute to the projects 'in kind', for example by donating their researchers' time or providing access to research facilities or resources. The first phase of IMI had a budget of €2 billion equally shared between EU and EFPIA.

To date, IMI has announced 11 calls for proposals under its first phase and a further 23 (ongoing and open for application) calls for proposals under its second phase. The first funding call was announced in 2008 and the latest, was launched in spring 2020. This report covers the research output (publications and papers) of a total of 62 projects from IMI phase one and 92 projects from IMI phase two.

2.3 CLARIVATE

Clarivate, provides reporting and consultancy services to enable customers to understand and interpret their research performance and to inform strategic decision-making. We have extensive experience with databases of research inputs, activity and outputs and have developed innovative analytical approaches for benchmarking, interpreting and visualising research impact.

Clarivate's Research Analytics is a suite of products, services and tools that provide comprehensive research analysis, evaluation and management. For over half a century we have pioneered the world of citation indexing and analysis, helping to connect scientific and scholarly thought around the world. Today, academic and research institutions, governments, not-for-profits, funding agencies, and all others with a stake in research, need reliable, objective methods for managing and measuring performance.

Our consultants have up to 20 years of experience in research performance analysis and interpretation. In addition, the Clarivate regional Sales team provide effective on-site support to maximise the value of our work.

Visit Clarivate or our Professional Research Data Services team online for more information.

2.4 SCOPE OF THIS REPORT

The analyses and indicators presented in this report have been selected to provide an analysis of IMI research published output for research management purposes:

- To identify excellence in IMI-supported research overall and at individual call or project level.
- To benchmark IMI project research performance against other funders research, the EU-28 biomedical research and world averages.
- To show that collaboration, at all levels (researcher, institutional and country), is being encouraged through the projects funded by IMI.

Outline of this report:

- Section 3 describes the data sources and methodology used in this report along with definitions of the indicators and guidelines to interpretation.

  Bibliometrics

- Section 4 presents analyses of IMI project publications overall, including trends in publications, frequently used journals, and top research fields. Where possible IMI research is benchmarked to EU-28 biomedical research.[1]
- Section 5 presents citation analyses of IMI publications at the call level, examining the citation impact and outputs of individual project. Where possible the IMI projects are benchmarked to world output and overall IMI output.
- Section 6 presents geographic clusters where IMI research activity occurs, including bibliometric data, the constituent institutions and top five journal subject categories within the clusters.

  Collaboration

- Section 7 presents collaboration analyses for IMI publications overall and at the project level, examining collaboration between different sectors, institutions and countries.

  Benchmarking

- Section 8 presents analysis of IMI publications, benchmarked to similar funding organisations. The organisations are: Commonwealth Scientific and Industrial Research Organisation (CSIRO), Critical Path Institute (C-Path), Foundation for the National Institutes of Health (FNIH), Grand Challenges in Global Health (GCGH), Indian Council of Medical Research (ICMR), Medical Research Council (MRC), and the Wellcome Trust (WT).

[1] At time of publication, September 2020, the United Kingdom has left the European Union, however as the EU and United Kingdom are a transitionary period in their relationship and to date there has not been any large changes to the United Kingdom's participation in Horizon 2020 funded research the United Kingdom is still included in the EU-28.

3 DATA SOURCES, INDICATORS AND INTERPRETATION

3.1 BIBLIOMETRICS AND CITATION ANALYSIS

Research evaluation is increasingly making wider use of bibliometric data and analyses. Bibliometrics is the analysis of data derived from publications and their citations. Publication of research outcomes is an integral part of the research process and is a universal activity. Consequently, bibliometric data have a currency across subjects, time and location that is found in few other sources of research-relevant data. The use of bibliometric analysis, allied to informed review by experts, increases the objectivity of, and confidence in, evaluation.

Research publications accumulate citation counts when they are referred to by more recent publications. Citations to prior work are a normal part of publication and reflect the value placed on a work by later researchers. Some papers get cited frequently and many remain uncited. Highly cited work is recognised as having a greater impact and Clarivate has shown that high citation rates are correlated with other qualitative evaluations of research performance, such as peer review.[2] This relationship holds across most science and technology areas and, to a limited extent, in social sciences and even in some humanities subjects.

Indicators derived from publication and citation data should always be used with caution. Some fields publish at faster rates than others and citation rates also vary. Citation counts must be carefully normalised to account for such variations by field. Because citation counts naturally grow over time, it is essential to account for growth by year. Normalisation is usually done by reference to the relevant global average for the field and for the year of publication.

Bibliometric indicators have been found to be more informative for core natural sciences, especially for basic science, than they are for applied and professional areas and for social sciences. In professional areas the range of publication modes used by leading researchers is likely to be diverse as they target a diverse, non-academic audience. In social sciences there is also a diversity of publication modes and citation rates are typically much lower than in natural sciences.

Bibliometrics work best with large data samples. As the data are disaggregated, so the relationship weakens. Average indicator values (e.g. of citation impact) for small numbers of publications can be skewed by single outlier values. At a finer scale, when analysing the specific outcome for individual departments, the statistical relationship is rarely a sufficient guide by itself. For this reason, bibliometrics are best used in support of, but not as a substitute for, expert decision processes. Well-founded analyses can enable conclusions to be reached more rapidly and with greater certainty, and are therefore an aid to management and to increased confidence among stakeholders, but they cannot substitute for review by well-informed and experienced peers.

3.2 DATA SOURCE

For the bibliometric analysis, data will be sourced from the databases underlying the Clarivate **Web of Science**, which gives access to conference proceedings, patents, websites, and chemical structures, compounds and reactions in addition to journals. It has a unified structure that integrates all data and search terms together and therefore provides a level of comparability not found in other databases. It is widely acknowledged to be the world's leading source of citation and bibliometric data.

The **Web of Science Core Collection** is part of the Web of Science and focuses on research published in journals and conferences in science, medicine, arts, humanities and social sciences. The authoritative, multidisciplinary content covers over 34,000 of the highest impact journals worldwide, including open access and over 205,000 conference proceedings. Coverage is both current and

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[2] *Evidence* Ltd. (2002) Maintaining Research Excellence and Volume: A report by *Evidence* Ltd to the Higher Education Funding Councils for England, Scotland and Wales and to Universities United Kingdom (UK). (*Adams J, et al.)* 48pp.

retrospective in the sciences, social sciences, arts and humanities, in some cases back to 1900. Within the research community, these data are often still referred to by the acronym 'ISI'.[3] Clarivate has extensive experience with databases on research inputs, activity and outputs and has developed innovative analytical approaches for benchmarking and interpreting international, national and institutional research impact.

3.3 METHODOLOGY

Publications: Many different document types are indexed in the Web of Science, including editorials, meeting abstracts, book reviews as well as research journal articles and reviews. In this report all documents regardless of type are referred to as 'publications'.

Article: Reports of research on original works. Includes research papers, features, brief communications, case reports, technical notes, chronology, and full papers that were published in a journal and/or presented at a symposium or conference.

Review: A renewed study of material previously studied. Includes review articles and surveys of previously published literature. Usually will not present any new information on a subject.

Papers: The terms 'paper' and 'publication' are often used interchangeably to refer to printed and electronic outputs of many types. However, in this report the term 'paper' is used exclusively to refer to articles and reviews - a subset of 'publications' that excludes all other document types.

Articles and reviews are the main way researchers communicate their results to the wider community and standards in methodology and interpretation are ensured by pre-publication peer-review by experts in the same field. Therefore, citation data for papers is the most informative for bibliometric evaluations and only citations to papers are used in calculations of the citation impact indicators presented in this report.

Citations: Papers mention earlier papers to acknowledge their intellectual contribution to a field of research. A paper receives a citation when it is mentioned or cited by another, usually more recent paper.

Citation count: The number of citations received by a paper since it was published reflects the impact it has had on later research. Not all citations are necessarily recorded as not all the citing papers are indexed in the Web of Science. The material indexed by Clarivate, however, is estimated to attract about 95% of global citations.

Citation impact: Citations per paper is an index of academic or research impact (as compared with economic or social impact). for a single paper, raw citation impact is the same as its citation count. For a set of papers, it is calculated by dividing the sum of citations by the total number of papers in any given dataset. Impact can be calculated for papers within a specific research field such as Clinical Neurology, or for a specific institution or group of institutions, or a specific country.

Citation count declines in the most recent years of any time-period as papers have had less time to accumulate citations (papers published in 2007 will typically have more citations than papers published in 2010).

[3] The origins of citation analysis as a tool that could be applied to research performance can be traced to the mid-1950s, when Eugene Garfield proposed the concept of citation indexing and introduced the Science Citation Index, the Social Sciences Citation Index and the Arts & Humanities Citation Index, produced by the Institute of Scientific Information – ISI (now Clarivate).

Field-normalised citation impact: Broadly the field-normalised citation impact compares the citation impact of a paper or set of papers to the average citation impact of all similar papers published worldwide in the same field and year.

As citation rates vary between research fields and with time, analyses must take both field and year into account. In addition, the type of publication will influence the citation count. For this reason, only citation counts of papers (as defined above) are used in calculations of citation impact. The standard normalisation factor is the world average citations per paper for the year and journal category in which the paper was published.

As field-normalised citation impact is normalised to global averages the performance of papers in different fields can be directly compared as the world average always equals 1.00. Therefore, a field-normalised citation impact exceeding 1.00 indicates papers have received more citations than the world average, conversely a value below 1.00 suggests papers are underperforming. See page 113 for a worked example of how field-normalised citation impact is calculated.

Web of Science journal categories or Clarivate InCites: Essential Science Indicators^{SM} fields: Standard bibliometric methodology uses journal category or ESI fields as a proxy for research fields. ESI fields aggregate data at a higher level than the journal categories – there are only 22 ESI research fields compared to 254 journal categories. [4] Journals are assigned to one or more categories, and every article within that journal is subsequently assigned to that category. Papers from prestigious, 'multidisciplinary' and general medical journals such as *Nature, Science*, *The Lancet*, *The BMJ*, *The New England Journal of Medicine* and the *Proceedings of the National Academy of Sciences* (PNAS) are assigned to specific categories based on the journal categories of the references cited in the article. The selection procedures for the journals included in the citation databases are documented here http://mjl.clarivate.com/.

Journal-normalised citation impact: Broadly the journal-normalised citation impact compares a paper or set of papers citation impact to all the other papers published in the same journal in the same year.

It is another bibliometric indicator which can be very useful in small datasets .This indicator is calculated from the citation impact relative to the specific journal in which the paper is published. For example, a paper published in the journal *Acta Biomaterialia* in 2005 that has been cited 189 times, would have an expected citation rate of 49.57 (the average number of citations per paper for this journal and publication year) and hence a journal-normalised citation impact of 6.3. This paper, therefore, has been cited more than expected for the journal.

Like the field-normalised citation impact a value exceeding 1.00 indicates that a paper or set of papers is receiving more citations than other papers in the same journal, and a values less than 1.00 indicates that a paper or set of papers is underperforming, receiving fewer citations that papers in the same journal.

Open access publication: Open access publications are publications that are made available online, at no cost to the reader. The Web of Science open access data come from the Directory of Open Access Journals (DOAJ) and collaborations with Impact Story and Our Research's Unpaywall services. The Web of Science therefore provides unrivalled coverage of open access publications that are published through DOAJ Gold, Other Gold, Green Published, Green Accepted or Bronze routes.

It is also possible that some publishers make publications available without following a recognised open access route. In these cases publications will not be indexed as open access in the Web of Science.

[4] Essential Science Indicators are defined by a unique grouping of journals with no journal being assigned to more than one field. These fields are focussed on the science, technology, engineering and medicine subjects and arts & humanities subjects are excluded. Customised analyses, however, can be designed to include these as an additional category.

Additionally, the analysis presented in this report covers all document types and not just papers, and some of these are not indexed as open access in the Web of Science databases.

The Web of Science open access data coverage is summarised at: clarivate.com/webofsciencegroup/solutions/open-access/

3.4 DATA COLLATION

This analysis used a dataset comprising publications arising from IMI-supported projects. These publications were identified using grant acknowledgments, title and abstract text searches, as well as other parameters developed in conjunction with IMI staff. There are currently 153 IMI projects. IMI staff validated the publications identified by this process and the list of projects to be analysed was provided by IMI staff.

4 CITATION ANALYSIS – IMI SUPPORTED PUBLICATIONS OVERALL

This section analyses the volume and citation impact of publications arising from IMI-supported projects, and where possible, benchmarks this against similar European research.

The datasets analysed in this, the eleventh report, include IMI-supported publications identified in Clarivate Web of Science up to 31st December 2019. The census point for inclusion of publications into the tenth report was 31st December 2018. Therefore, this report reflects changes in IMI activity between these points. Citations to these publications were counts up to 31st December 2019. Unless otherwise specified metrics are for all IMI-supported documents from all calls in IMI 1 and IMI 2, in aggregate.

When considering the analyses in this section, earlier caveats regarding paper numbers should be borne in mind (Section 3).

4.1 PUBLICATIONS FROM IMI-SUPPORTED PROJECTS

Publications from IMI-supported projects were identified using bibliographic data supplied by IMI, and through specific keyword searches using funding acknowledgment data in the Web of Science. The process of identifying publications from IMI-supported projects that have Clarivate citation data is outlined in Figure 4.1.1.

The IMI project dataset started with 4,938 publications which were previously identified as IMI publications and used as the IMI publication dataset in the previous report. Separately, 1,460 new publications were identified as IMI-associated through keyword searches of funding acknowledgement text in databases which underlie Clarivate Web of Science. The combination of these two datasets led to a total of 6,398 unique publication records associated with IMI-supported projects. Of these 6,398 publications, 450 were eliminated as they were either published in 2020 or could not be distinguished as IMI from a manual review of the dataset. Therefore, 5,943 Web of Science publications remained.

The citation counts for this report were sourced from the citation databases which underlie Clarivate Web of Science and were extracted in June 2019. Normalised bibliometric indicators were calculated using standard methodology and the Clarivate National Science Indicators (NSI) database for 2019.

FIGURE 4.1.1 PROCESS FOR IDENTIFYING PUBLICATIONS FROM IMI-SUPPORTED PROJECTS, 2010-2019

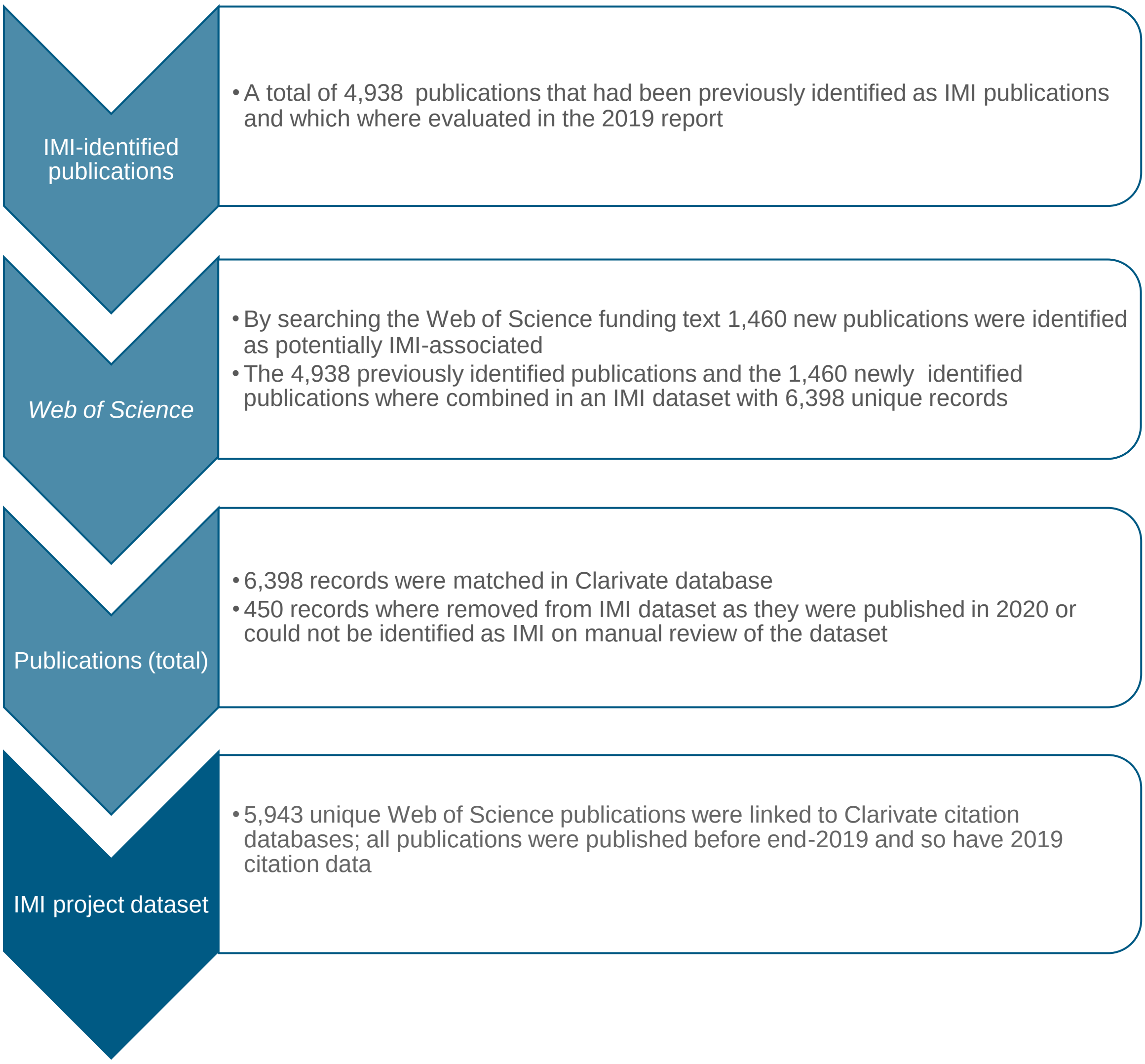


Table 4.1.1 NUMBER OF PUBLICATIONS FROM IMI PROJECTS, 2010-2019

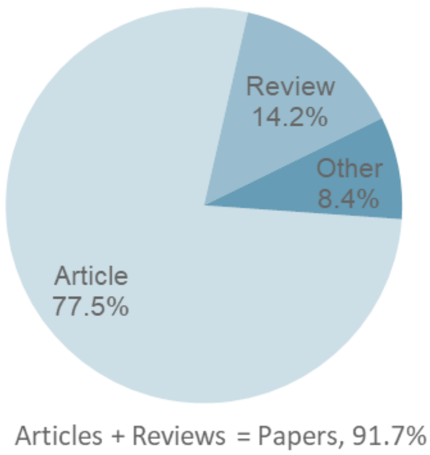
	Number of publications	Number of papers
All IMI	5,943	5,445
IMI 1	5,289	4,921
IMI 2	682	559

Note that some publications belong to IMI 1 and IMI 2, therefore the total number of publications shown for All IMI is smaller than the sum of publications shown for IMI 1 and IMI 2.

4.2 PUBLICATIONS FROM IMI PROJECTS BY DOCUMENT TYPE

Figure 4.2.1**Error! Reference source not found.** shows the percentage of Web of Science publications by document type and the same data is shown in Table 4.2.1.

FIGURE 4.2.1 PERCENTAGE OF IMI PROJECT PUBLICATIONS BY DOCUMENT TYPE, 2010-2019



- IMI project research resulted in 5,943 unique Web of Science publications.
- Of these publications 91.7% were articles (77.5%) and reviews (14.2%) which are collectively referred to as 'papers' in this report.
- A further 498 publications (8.4%) where not papers. These 'other' publications comprised of 109 editorials, 291 meeting abstracts, 44 proceeding papers, 41 letters, seven corrections and three news items and three data papers.

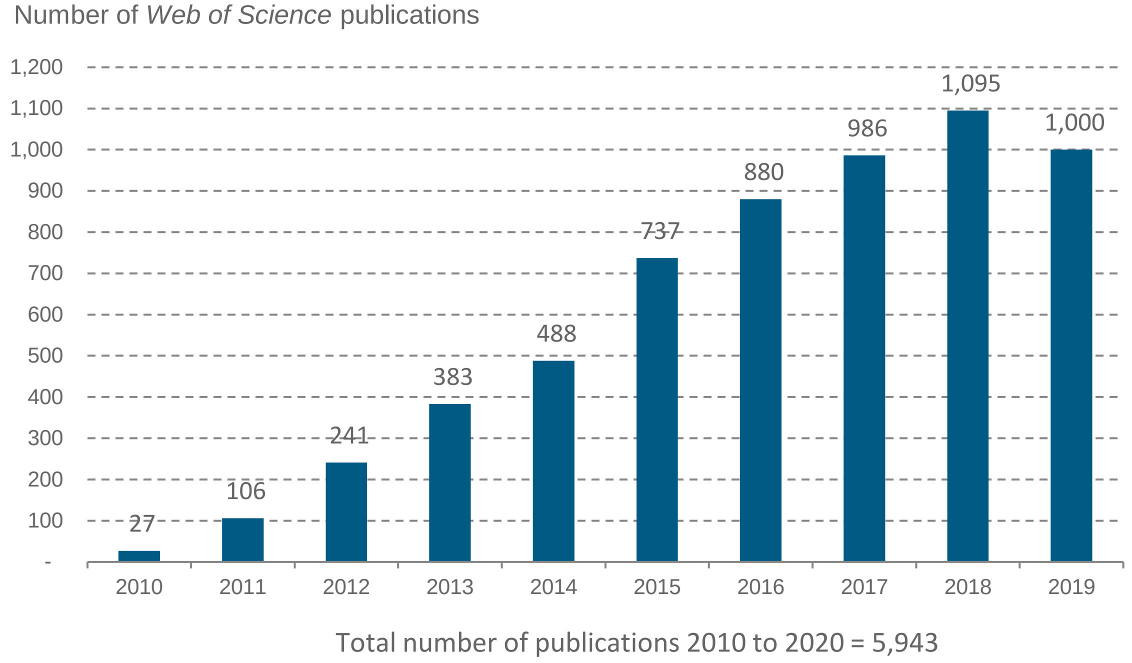
TABLE 4.2.1 NUMBER AND PERCENTAGE OF IMI PROJECT PUBLICATIONS BY DOCUMENT TYPE, 2010-2019

Document type		Number of publications	% of IMI publications
Papers	Article	4,603	77.45%
	Review	842	14.17%
Other document types	Meeting Abstract	291	4.90%
	Editorial Material	109	1.83%
	Proceedings Paper	44	0.74%
	Letter	41	0.69%
	Correction	7	0.12%
	News Item	3	0.05%
	Data Paper	3	0.05%

4.3 TRENDS IN PUBLICATION OUTPUT

Figure 4.3.1 shows the annual number of Web of Science publications arising from IMI projects between 2010 and 2019.

FIGURE 4.3.1 NUMBER OF WEB OF SCIENCE PUBLICATIONS FOR IMI PROJECTS BY YEAR, 2010-2019

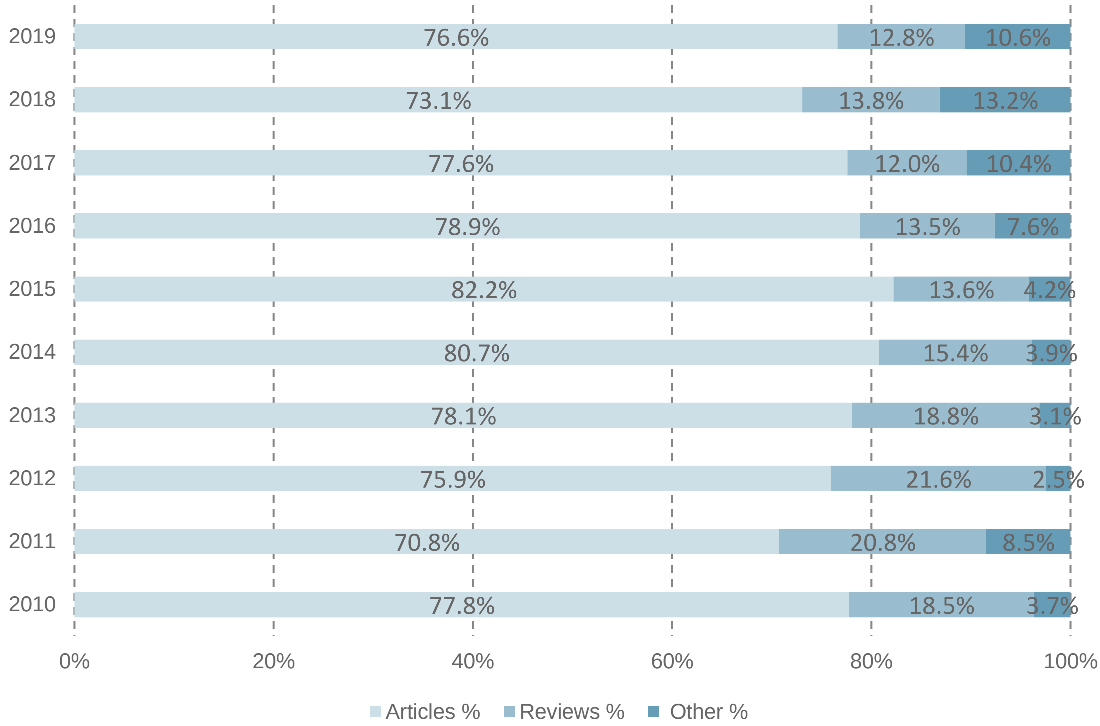


During 2019, IMI project research output slightly decreased compared to 2018, previously IMI project research showed substantial growth, with publication count increasing every year between 2010 and 2018:

- The 2018-2019 period has shown a slight decrease in IMI output to 1,000 publications. Due to some IMI 1 projects having closed and not published since 2018 and decreasing output by some of the previously most productive projects e.g. BTCure.
- The percentage change in the output of IMI project-supported publications between 2018 and 2019 was a decrease of 8.7%, compared with a growth of 11.1% between 2017 and 2018.

FIGURE 4.3.2 shows the proportion of papers (articles and reviews) relative to other document types for IMI project research between 2010 and 2019.

FIGURE 4.3.2 PERCENTAGE OF IMI PROJECT PUBLICATIONS EACH YEAR BY DOCUMENT TYPE, 2010-2019



- IMI project research continued to generate a high proportion of papers relative to other document types. Articles accounted for around 76.6% of all publication in 2019, consistent with recent years.

4.4 PUBLICATION OUTPUT BY COUNTRY

Figure 4.4.1 shows a map highlighting all countries with one or more publication from IMI projects between 2010 and 2019. Figure 4.4.2 shows a map highlighting all countries with at least ten Web of Science publications from IMI projects between 2010 and 2019. Table 4.4.1 and Figure 4.4.3 shows the corresponding data; the total number of publications for the 20 and 10 countries respectively with the highest number publications from IMI projects between 2010 and 2019. A full list of all countries output of publications is included in Annex 3.

FIGURE 4.4.1 MAP OF COUNTRIES WHICH HAVE AT LEAST ONE WEB OF SCIENCE PUBLICATION FOR IMI PROJECTS, 2010-2019

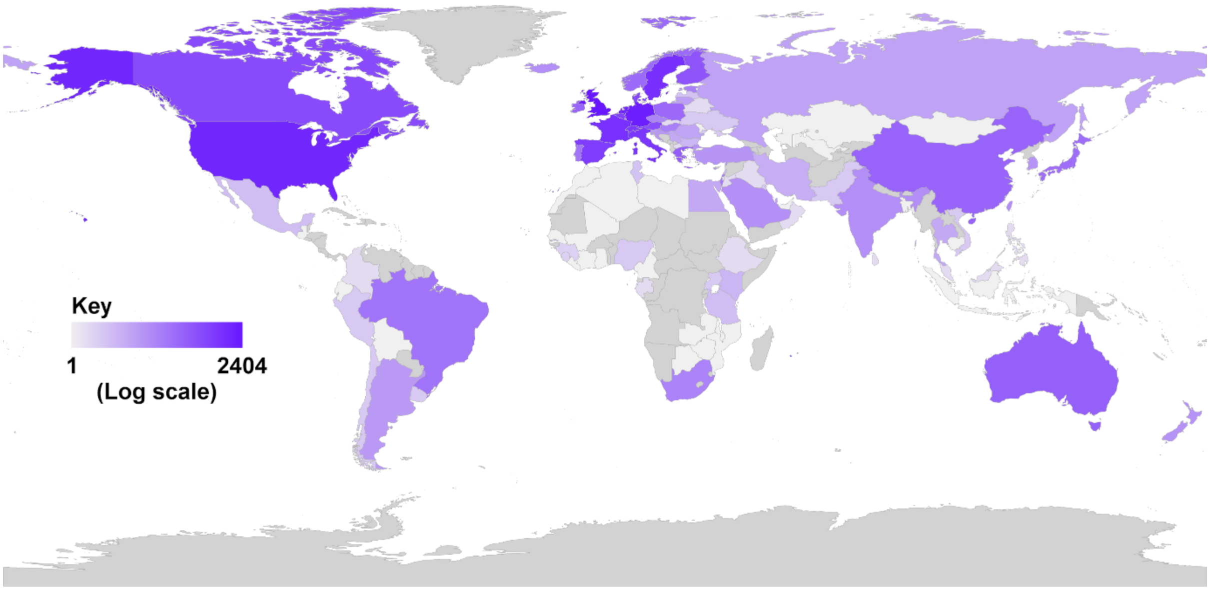
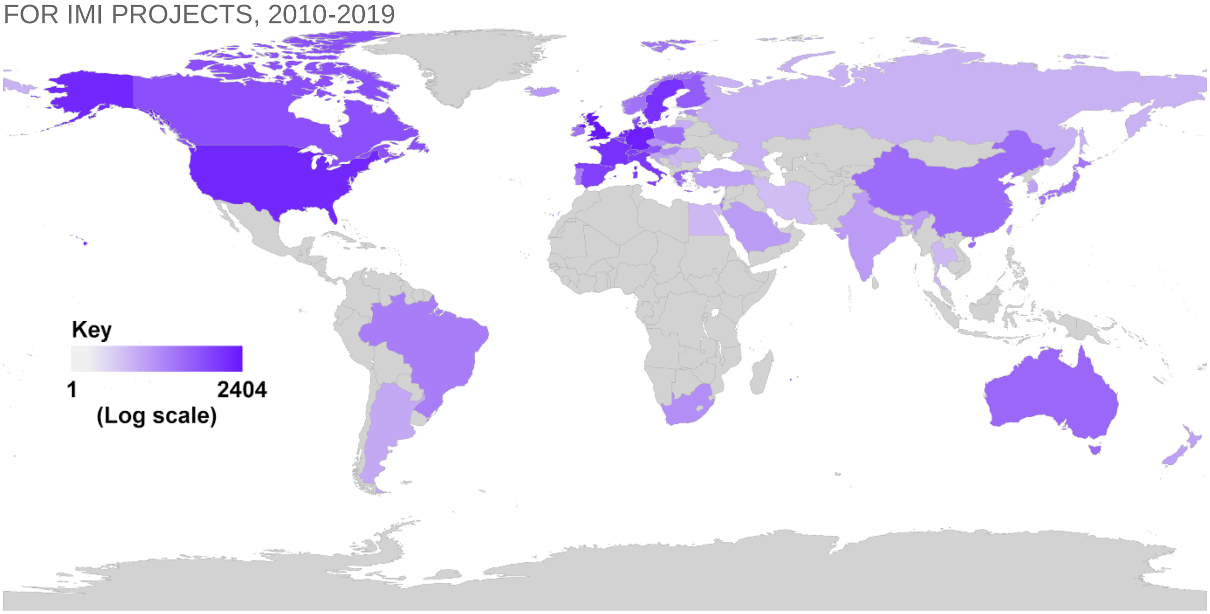


Figure 4.4.2 MAP OF COUNTRIES WHICH HAVE AT LEAST TEN WEB OF SCIENCE PUBLICATION FOR IMI PROJECTS, 2010-2019



- In total 110 countries have at least one IMI publications and 49 countries have at least ten IMI publications.

FIGURE 4.4.3 TEN COUNTRIES WITH THE MOST IMI PROJECT PUBLICATIONS. ANNEX 3 LISTS ALL COUNTRIES WITH AT LEAST ONE IMI PROJECT PUBLICATION, 2010-2019

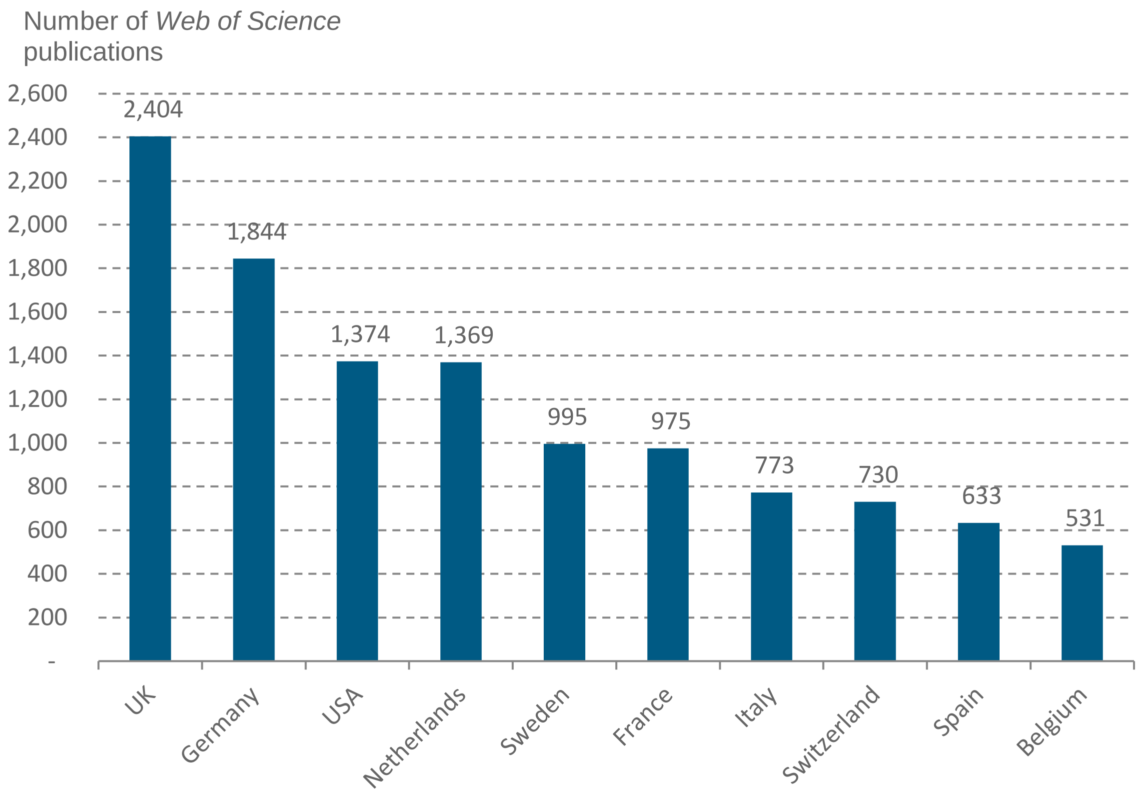


TABLE 4.4.1 TWENTY COUNTRIES WITH THE MOST IMI PROJECT PUBLICATIONS. ANNEX 3 LISTS ALL COUNTRIES WITH AT LEAST ONE IMI PROJECT PUBLICATION, 2010-2019

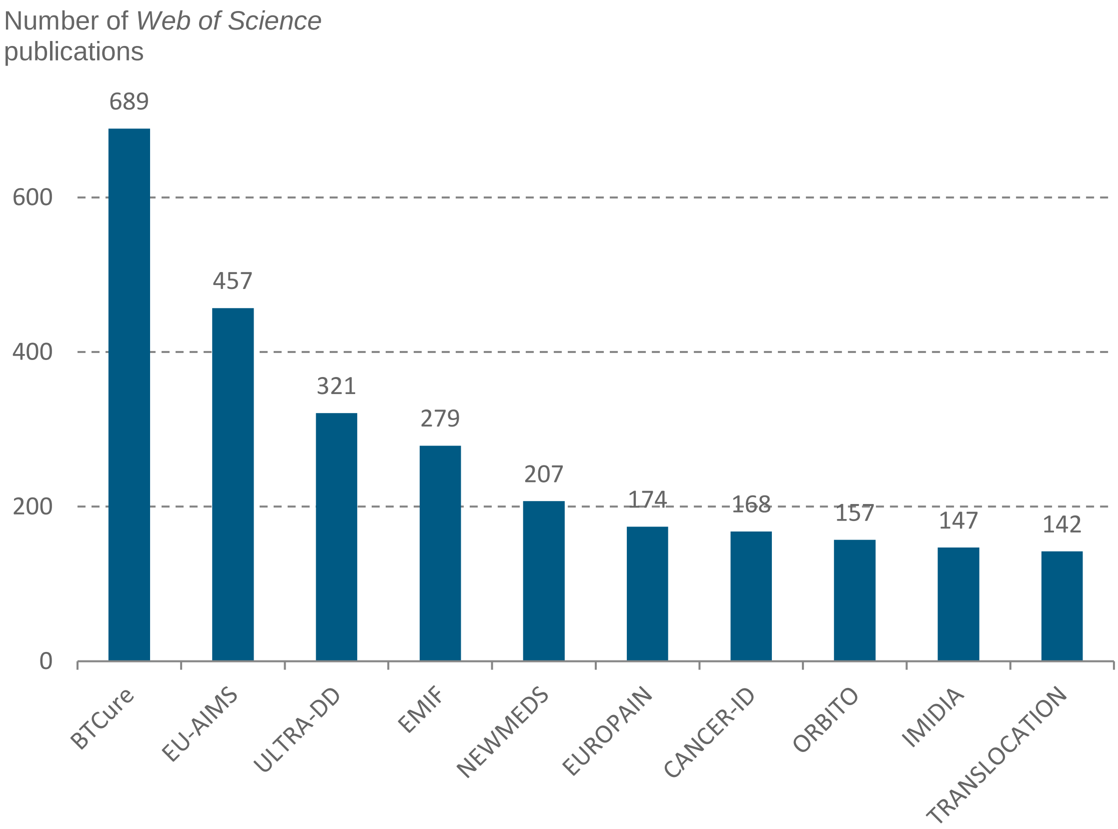
Country	Number of publications
United Kingdom	2,404
Germany	1,844
USA	1,374
Netherlands	1,369
Sweden	995
France	975
Italy	773
Switzerland	730
Spain	633
Belgium	531
Denmark	432
Canada	382
Austria	344
Finland	264
Greece	187
Australia	177
China	155
Ireland	139
Poland	129
Norway	122

- Researchers affiliated to the United Kingdom authored the most IMI project publications (2,404 publications).
- Other EU-28 countries where among the countries with the highest output. The most productive exceptions are the USA (1,374 publications) and Switzerland (703 publications).

4.5 PUBLICATION OUTPUT BY IMI PROJECT

Figure 4.5.1 shows the ten IMI projects with the highest output of publications between 2010 and 2019. Table 4.5.1 expands upon Figure 4.5.1, listing the 20 IMI projects with the most publications, including the number and percentage of open access publications and the number of papers between 2010 and 2019. A full list projects and the number of associated publications is presented in Annex 4.

FIGURE 4.5.1 NUMBER OF WEB OF SCIENCE PUBLICATIONS FOR TEN IMI PROJECTS WITH THE HIGHEST OUTPUT OF PUBLICATIONS, 2010-2019



- BTCure has been the most projective IMI project in terms of number of publications (689 publications) and the second most productive project has been EU-AIMS (457 publications).

TABLE 4.5.1 TWENTY IMI PROJECTS WITH THE MOST PUBLICATIONS, THE NUMBER OF PAPERS, NUMBER AND PERCENTAGE OF OPEN ACCESS PUBLICATIONS, 2010-2019.

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
BTCure	689	634	406	58.9%
EU-AIMS	457	420	308	67.4%
ULTRA-DD	321	276	209	65.1%
EMIF	279	248	201	72.0%
NEWMEDS	207	194	107	51.7%
EUROPAIN	174	171	61	35.1%
CANCER-ID	168	128	106	63.1%
ORBITO	157	148	38	24.2%
IMIDIA	147	135	114	77.6%
TRANSLOCATION	142	138	76	53.5%
STEMBANCC	129	120	91	70.5%
U-BIOPRED	129	78	54	41.9%
SUMMIT	129	120	88	68.2%
CHEM21	127	119	43	33.9%
INNODIA	121	92	68	56.2%
ELF	115	110	70	60.9%
PreDiCT-TB	113	100	87	77.0%
MIP-DILI	112	103	59	52.7%
Quic-Concept	101	99	73	72.3%
PROTECT	101	98	38	37.6%

4.6 IS IMI PROJECT RESEARCH WELL CITED?

The number of citations a paper receives (also known as its raw citation impact) is at least partly determined by the field to which it relates and the year in which it was published. Typically, papers published in disciplines such as biomedical research receive more citations than papers published in subjects such as engineering, and older papers tend to have higher citations counts on average than newer ones because they have had longer to accrue them. Therefore, citation impact are usually normalised to the relevant world average to allow comparison between years and fields; the resulting indicator is called the field-normalised citation impact.

Figure 4.6.1 shows the average field-normalised citation impact for all IMI papers compared to the average for EU-28 papers in relevant biomedical journal categories (see Annex 2) and all global papers published between 2010 and 2019. Table 4.6.1 and Table 4.6.2 present average citation impact indicators for all IMI papers.

FIGURE 4.6.1 FIELD-NORMALISED CITATION IMPACT FOR IMI SUPPORTED RESEARCH PAPERS COMPARED TO THE AVERAGE FOR EU-28 PAPERS AND WORLD PAPERS, 2010-2019

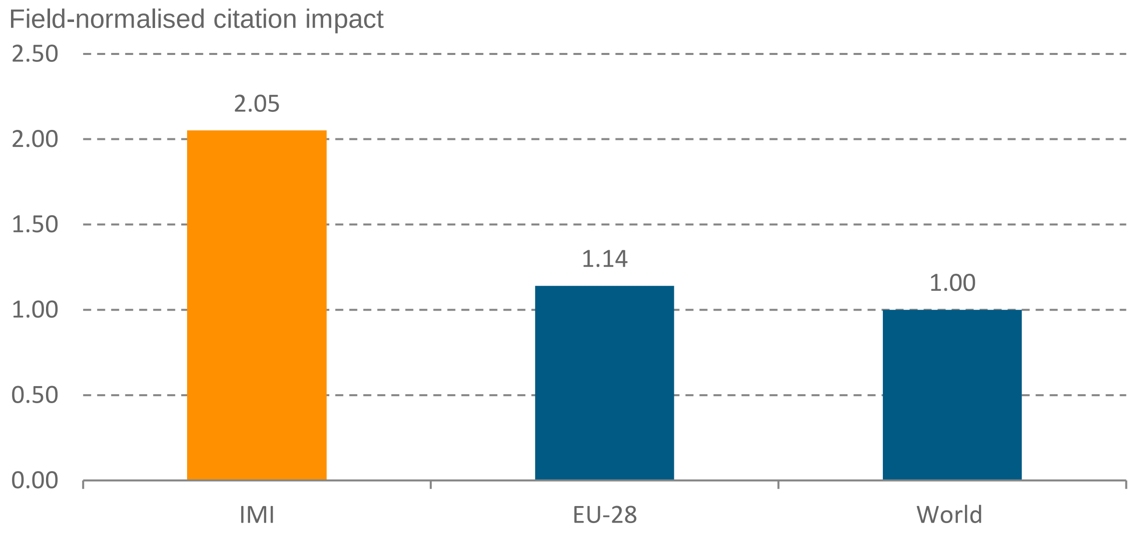


TABLE 4.6.1 SUMMARY CITATION ANALYSIS FOR IMI SUPPORTED RESEARCH PAPERS, 2010-2019

	Number of papers	Citation impact Normalised at field level	Citation impact Normalised at journal level	Average percentile	% of highly cited papers
IMI projects	5,445	2.05	1.23	34.5	26.9%
IMI 1	4,921	2.03	1.24	33.2	27.1%
IMI 2	559	1.97	1.12	47.8	23.4%

TABLE 4.6.2 SUMMARY OF IMI SUPPORTED RESEARCH PUBLICATIONS, 2010-2019

	Number of publications	% of open access publications*	Number of papers	Citations	Raw citation impact
IMI Projects	5,943	62.6%	5,445	128,001	23.51
IMI 1	5,289	61.7%	4,921	123,466	25.09
IMI 2	682	72.6%	559	3,712	6.64

SUMMARY OF KEY FINDINGS

- The field-normalised citation impact of IMI project papers was 2.05 for the ten-year period, 2010-2019 (twice the world average of 1.00). This shows that the impact of IMI-associated research (as indicated by citations) had been maintained throughout IMI's existence.
- The field-normalised citation impact of IMI project papers was 80% higher than the EU's average citation impact (1.14)[5] between 2010 and 2019, in similar biomedical journal categories.
- More than a quarter (26.9%) of IMI papers were highly cited, that is they were in the world's top 10% of most highly cited papers in the relevant journal category and year of publication.
- IMI 2 has a higher percentage of open access publications compared with IMI 1. This is likely due to the stipulation that IMI 2 funded researcher should publish open access articles.[6]

[5] EU-28 grouping of countries: Clarivate National Science Indicators 2018 database; similar research has been defined as biomedical journal categories listed in Annex 2.

[6] Note that IMI 2 funded researchers are contractually obliged to make their scientific articles open access through Green or Gold routes. However, for some of other document types, such as editorials, reviews or conference proceedings open access publication is strongly encouraged but not mandatory.

Nevertheless, it is obvious that fewer than all of IMI's publications are classified as open access in this analysis, and this is likely to be due to ancillary factors (such as challenges relating to definitions and coverage) as well as non-compliance. The Web of Science open access data come from the Directory of Open Access Journals (DOAJ) and collaborations with Impact Story and Our Research's Unpaywall services. The Web of Science therefore provides unrivalled coverage of open access publications that are published through DOAJ Gold, Other Gold, Green Published, Green Accepted or Bronze routes.

It is also possible that some publishers makes publications available without following a recognised open access route. In these cases publications will not be indexed as open access in the Web of Science or in this report. Additionally, the analysis presented in this report covers all document types and not just papers, and some of these are not indexed as open access in the Web of Science databases.

The Web of Science open access data coverage is summarised at: https://clarivate.com/webofsciencegroup/solutions/open-access/

4.7 IN WHICH JOURNALS DO IMI PROJECT PUBLICATIONS APPEAR MOST FREQUENTLY?

The 20 journals in which IMI project publications appeared most frequently (ranked by number of IMI publications) between 2010 and 2019, are listed in Table 4.7.1. Together, the 20 most frequently used journals account for 1,313 publications - almost one-quarter of all IMI project publications.

IMI project publications appeared most frequently in *PLOS One* (168 publications), followed by *Annals of the Rheumatic Diseases* (166 publications). For most journals, papers (articles and reviews) were the most frequent publication type, however large collections of meeting abstracts where published in *Diabetologia* (46 meeting abstracts), *Diabetes* (14 meeting abstracts) and *European Respiratory Journal* (25 meeting abstracts).

IMI continued to have a strong focus on Rheumatology with three of the ten most frequently used journals assigned to this journal subject category. A further two top-ten journals, *Diabetologia* and *Diabetes* are assigned to Endocrinology & Metabolism and the titles suggest a focus on diabetes. Among, the top 20 most frequently used journals, three titles are in the Neurosciences; five in Pharmacology & Pharmacy and four in the Multidisciplinary category, indicating the broad range of research IMI funds.

Of the 20 most frequently used journals, 17 were in the top quartile (Q1) by Journal Impact Factor (JIF) and five were in the second quartile (Q2) ranked against other journals in the same category.

Overall IMI project publications were published in a total of 1,232 journals, of which 610 were ranked in the top quartile (by Journal Impact Factor) of journals in their relevant journal category. A total of 2,938 publications (55.7% of IMI project publications) were published in these well-regarded journals. The average Journal Impact Factor for all IMI project publications is 6.38, a slight decrease of 0.40 compared to the previous year.

The 20 highest Journal Impact Factor journals in which IMI project research was published are listed in Table 4.7.2. The journal with the highest Impact Factor is *The New England Journal of Medicine*, with a Journal Impact Factor of 74.70. IMI projects have published a total of 15 publications (four since the tenth report) in *Nature*, (JIF=42.78) and 11 (two since the tenth report) in *Science* (JIF=41.84).

The 20 open access journals in which IMI projects publish most frequently (ranked by number of publications), are listed in Table 4.7.3. Of the top 20 open access journals *Annals of the Rheumatic Diseases* had the highest Journal Impact Factor (16.10) and *PLUS One* published the most IMI publications (168 publications).

TABLE 4.7.1 JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY NUMBER OF IMI PUBLICATIONS, 2010-2019

Journal	**Number of IMI publications**	**Number of IMI papers**	**Journal Impact Factor (2018)**	***Web of Science* journal categories**	**Quartile**
Plos One	168	168	2.74	Multidisciplinary Sciences	Q2
Annals of the Rheumatic Diseases	166	115	16.10	Rheumatology	Q1
Scientific Reports	133	133	4.00	Multidisciplinary Sciences	Q1
Diabetologia	111	62	7.52	Endocrinology & Metabolism	Q1
Nature Communications	70	70	12.12	Multidisciplinary Sciences	Q1
Arthritis Research & therapy	57	57	4.10	Rheumatology	Q1
Arthritis & Rheumatology	57	48	9.59	Rheumatology	Q1
Diabetes	51	37	7.72	Endocrinology & Metabolism	Q1
Journal of Alzheimers Disease	51	50	3.91	Neurosciences	Q2
Pain	49	49	5.48	Anesthesiology; Clinical Neurology; Neurosciences	Q1
European Respiratory Journal	46	14	12.34	Respiratory System	Q1
European Journal of Pharmaceutical Sciences	45	43	3.62	Pharmacology & Pharmacy	Q2
Journal of Medicinal Chemistry	44	44	6.21	Medicinal Chemistry	Q1
Psychopharmacology	42	42	3.13	Neurosciences; Pharmacology & Pharmacy; Psychiatry	Q2
Frontiers in Immunology	42	41	5.09	Immunology	Q1
European Journal of Pharmaceutics and Biopharmaceutics	37	37	4.60	Pharmacology & Pharmacy	Q1
Molecular Pharmaceutics	37	37	4.32	Research & Experimental Medicine; Pharmacology & Pharmacy	Q1
Proceedings of the National Academy of Sciences of the United States of America	36	36	9.41	Multidisciplinary Sciences	Q1
Drug Safety	36	35	3.44	Pharmacology & Pharmacy; Public, Environmental & Occupational Health; Toxicology	Q2
Journal of Antimicrobial Chemotherapy	35	34	5.44	Infectious Diseases; Microbiology; Pharmacology & Pharmacy	Q1

TABLE 4.7.2 JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY JOURNAL IMPACT FACTOR, 2010-2019

Journal	Number of IMI publications	Number of IMI papers	Journal Impact Factor (2018)	*Web of Science* journal categories	Quartile
New England Journal of Medicine	1	1	74.70	General & Internal Medicine	Q1
Nature Reviews Drug Discovery	9	4	64.80	Biotechnology & Applied Microbiology; Pharmacology & Pharmacy	Q1
Lancet	4	2	60.39	General & Internal Medicine	Q1
Nature Reviews Molecular Cell Biology	1	1	55.47	Cell Biology	Q1
Nature Reviews Clinical Oncology	8	7	53.28	Oncology	Q1
Nature Reviews Cancer	2	2	53.03	Oncology	Q1
Chemical Reviews	2	2	52.76	Multidisciplinary Chemistry	Q1
Jama-Journal of the American Medical Association	8	6	45.54	General & Internal Medicine	Q1
Chemical Society Reviews	1	1	42.85	Multidisciplinary Chemistry	Q1
Nature	15	15	42.78	Multidisciplinary Sciences	Q1
Science	11	10	41.85	Multidisciplinary Sciences	Q1
Nature Reviews Disease Primers	2	2	40.69	General & Internal Medicine	Q1
Nature Reviews Immunology	2	2	40.36	Immunology	Q1
Cell	4	4	38.64	Biochemistry & Molecular Biology; Cell Biology	Q1
Nature Biotechnology	2	0	36.56	Biotechnology & Applied Microbiology	Q1
Nature Medicine	9	9	36.13	Biochemistry & Molecular Biology; Cell Biology; Research & Experimental Medicine	Q1
Nature Reviews Microbiology	1	1	34.21	Microbiology	Q1
Lancet Oncology	1	1	33.75	Oncology	Q1
Nature Reviews Neuroscience	2	2	33.65	Neurosciences	Q1
Nature Reviews Genetics	3	3	33.13	Genetics & Heredity	Q1

TABLE 4.7.3 OPEN ACCESS JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY NUMBER OF WEB OF SCIENCE PUBLICATIONS, 2010-2019

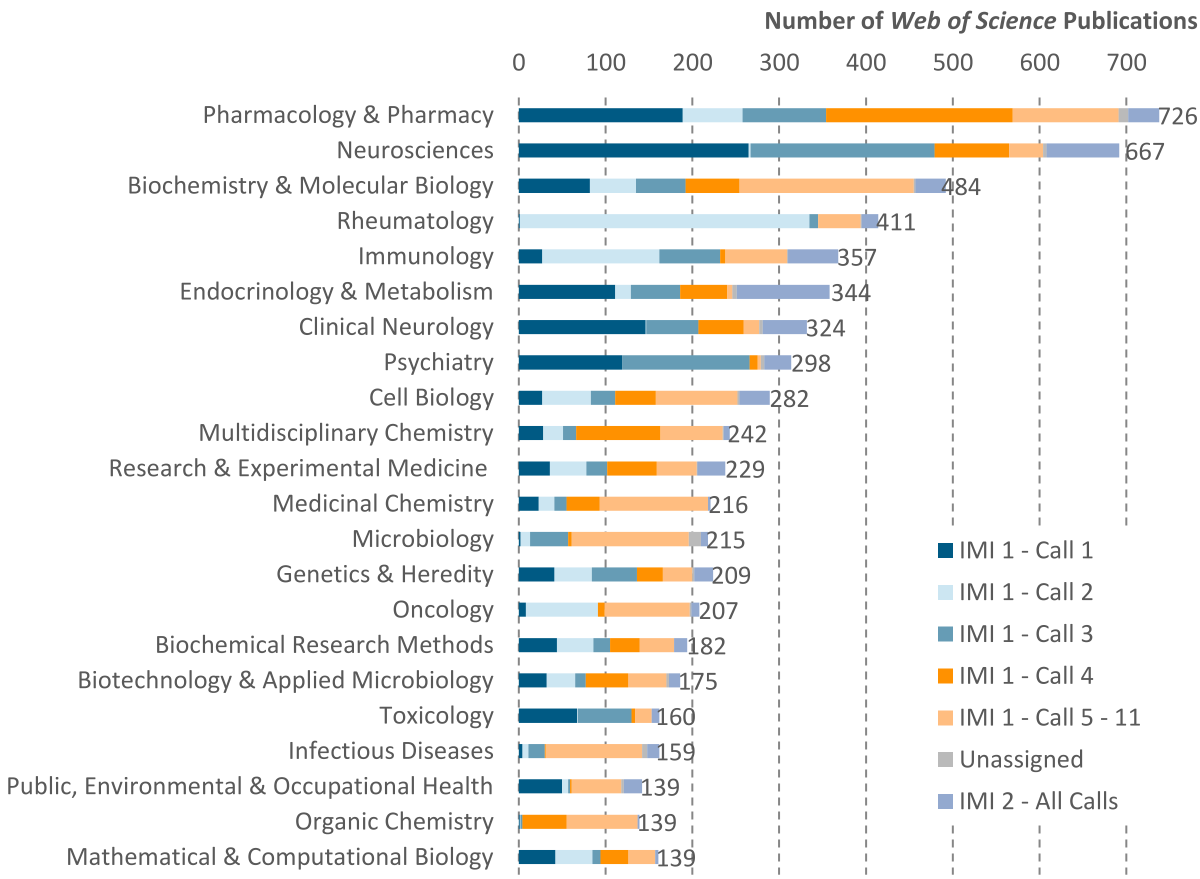
Journal	Number of IMI publications	Number of IMI papers	Journal Impact Factor (2018)	*Web of Science* journal categories	Quartile
Plos One	168	168	2.74	Multidisciplinary Sciences	Q2
Scientific Reports	133	133	4.00	Multidisciplinary Sciences	Q1
Nature Communications	70	70	12.12	Multidisciplinary Sciences	Q1
Annals of the Rheumatic Diseases	65	40	16.10	Rheumatology	Q1
Arthritis Research & therapy	57	57	4.10	Rheumatology	Q1
Diabetologia	55	52	7.52	Endocrinology & Metabolism	Q1
Frontiers in Immunology	42	41	5.09	Immunology	Q1
Proceedings of the National Academy of Sciences of the United States of America	36	36	9.41	Multidisciplinary Sciences	Q1
Arthritis & Rheumatology	35	34	9.59	Rheumatology	Q1
Diabetes	35	35	7.72	Endocrinology & Metabolism	Q1
Nucleic Acids Research	32	32	11.50	Biochemistry & Molecular Biology	Q1
Journal of Antimicrobial Chemotherapy	32	31	5.44	Infectious Diseases; Microbiology; Pharmacology & Pharmacy	Q1
Antimicrobial Agents and Chemotherapy	30	29	4.90	Microbiology; Pharmacology & Pharmacy	Q1
Translational Psychiatry	30	30	5.28	Psychiatry	Q1
Bioinformatics	30	30	5.61	Biochemical Research Methods; Biotechnology & Applied Microbiology; Computer Science Interdisciplinary Applications; Mathematical & Computational Biology; Statistics & Probability	Q1
Journal of Alzheimers Disease	29	28	3.91	Neurosciences	Q2
Journal of Immunology	28	28	4.89	Immunology	Q2
Journal of Biological Chemistry	26	26	4.24	Biochemistry & Molecular Biology	Q2
Cell Reports	26	26	8.11	Cell Biology	Q1
Toxicological Sciences	25	25	3.70	Toxicology	Q1

4.8 WHICH RESEARCH FIELDS ACCOUNT FOR THE HIGHEST VOLUME OF IMI PROJECT PUBLICATIONS?

Figure 4.8.1 shows the twenty Web of Science journal categories[7] most frequently associated with IMI funded research between 2010 and 2019. IMI 1 calls 5-11 have a lower number of publications relative to calls 1-4 and for clarity of presentation these publications are shown as one group in Figure 4.8.1. Likewise, IMI 2 has far fewer publication compared to IMI 1 and so all IMI 2 publications are shown as one group in Figure 4.8.1. Publications that acknowledge IMI funding but do not specify a project, phase or call are classed as Unassigned. Note that some bars are longer than the total number of IMI publications in a journal category (indicated by the data labels) due to some papers being associated with multiple calls. Figure 4.8.2 shows the ten Web of Science journal categories most frequently associated with IMI 2 funded research.

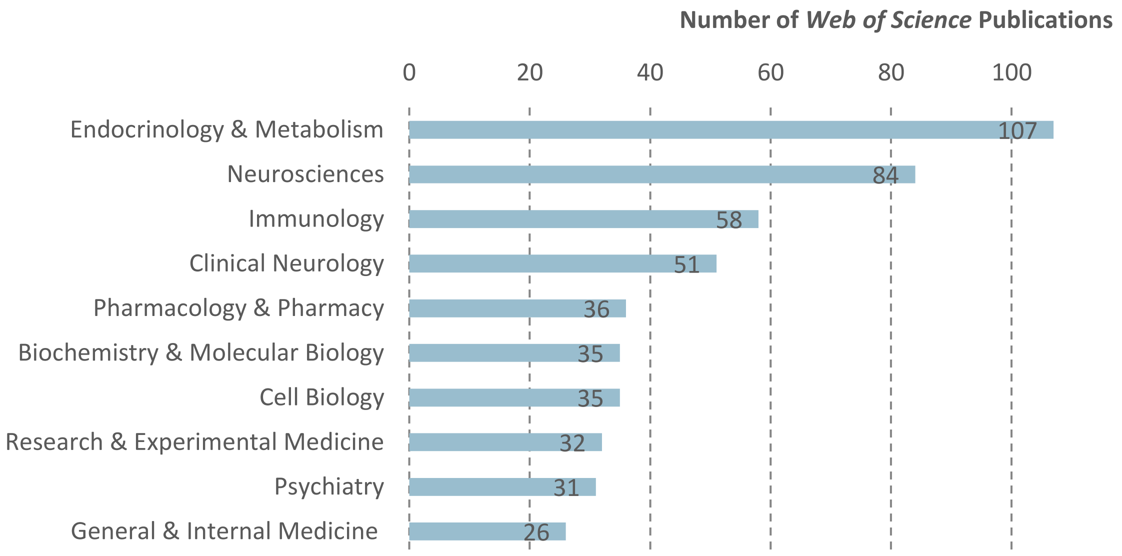
Table 4.8.1 shows the same data as Figure 4.8.1 and Figure 4.8.2 for the top twenty journal categories. It provides the number of publications assigned to each of the top twenty Web of Science journal categories in which IMI project research is published by IMI 1 calls and IMI 2 in total.

FIGURE 4.8.1 TOP TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS PUBLISHED MOST FREQUENTLY, 2010-2019. DATA LABELS SHOWS THE TOTAL NUMBER OF PUBLICATIONS PER JOURNAL CATEGORY



[7] Journals can be associated with more than one Web of Science category.

FIGURE 4.8.2 TOP TEN WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI 2 PROJECT RESEARCH (ALL CALLS) WAS PUBLISHED MOST FREQUENTLY, 2010-2019. DATA LABELS SHOWS THE TOTAL NUMBER OF PUBLICATIONS PER JOURNAL CATEGORY



- IMI projects produced more publications in Pharmacology & Pharmacy (726 publications) than in other journal categories, followed by Neurosciences (667 publications) and Biochemistry & Molecular Biology (484 publications).
- The majority of Rheumatology publications (81.1%) come from the call 2 project BTCURE. This is a drop of 5% from the 10th report as IMI 2 and IMI 1 call 11 projects have increasingly published in Rheumatology journals.
- The publications assigned to Neurosciences, Clinical Neurology and Psychiatry were predominantly from calls 1 and 3.
- The majority of publication in IMI 1 calls 5 to 11 belong to call 11.
- IMI 2 publications most frequently appeared in Endocrinology & Metabolism journals (107 publications), followed by Neurosciences (84 publications) and Immunology (58 publications). For IMI in total, Endocrinology & Metabolism is the sixth most frequent journal category, suggesting that current IMI 2 projects have a different focus that IMI 1 projects.

TABLE 4.8.1 NUMBER OF PUBLICATIONS BY IMI 1 CALL AND IMI 2 FOR TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS PUBLISHED MOST FREQUENTLY, 2010-2019. ORDERED BY TOTAL NUMBER OF PUBLICATIONS.

	Number of publications by IMI 1 Call												
Journal Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**IMI 2**	**Not assigned**
Pharmacology & Pharmacy	189	69	96	215	9	29	7	12	39	0	41	36	11
Neurosciences	265	2	212	86	0	0	0	26	3	0	11	84	4
Biochemistry & Molecular Biology	82	53	57	62	24	37	0	26	9	0	107	35	2
Rheumatology	1	334	10	0	0	0	1	26	0	0	22	19	1
Immunology	27	135	70	6	0	8	7	14	7	22	19	58	1
Endocrinology & Metabolism	111	18	57	54	0	0	0	1	2	0	3	107	5
Clinical Neurology	146	1	60	52	0	0	0	6	0	0	13	51	4
Psychiatry	119	0	147	9	0	0	1	1	0	0	2	31	4
Cell Biology	27	56	28	47	2	6	0	15	3	0	68	35	2
Multidisciplinary Chemistry	28	23	15	97	30	10	0	5	4	0	23	7	1
Research & Experimental Medicine	36	42	24	57	0	3	9	2	1	10	21	32	1
Medicinal Chemistry	23	18	14	38	41	8	0	8	0	0	70	3	0
Microbiology	2	11	44	4	0	69	1	9	46	4	42	8	14
Genetics & Heredity	41	43	52	30	0	2	0	9	1	0	25	22	2
Oncology	8	83	0	8	1	0	2	1	0	0	94	9	2
Biochemical Research Methods	44	42	19	34	1	6	0	10	1	1	23	15	0
Biotechnology & Applied Microbiology	32	33	12	49	1	3	0	15	2	6	17	13	3
Toxicology	67	1	62	4	0	0	1	0	11	0	7	9	0
Infectious Diseases	4	7	19	1	0	41	2	4	51	6	46	14	6
Public, Environmental & Occupational Health	50	7	2	2	0	9	18	0	20	1	18	21	3
Organic Chemistry	1	1	2	51	60	3	0	4	0	0	16	2	0
Mathematical & Computational Biology	42	43	9	32	0	2	5	11	1	0	14	4	0

Table 4.8.2 and Table 4.8.3 show the citation impact, percentage of highly cited papers and percentage of open access publications for IMI project research in the top twenty journal categories.

TABLE 4.8.2 FIELD-NORMALISED, JOURNAL-NORMALISED AND RAW CITATION IMPACT OF PAPERS FOR THE TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS PUBLISHED MOST FREQUENTLY, 2010-2019. ORDERED BY TOTAL NUMBER OF PAPERS.

		Citation impact		
Journal category	**Number of papers**	**Normalised at field level**	**Normalised at journal level**	**Raw citation impact**
Pharmacology & Pharmacy	685	1.43	1.10	15.48
Neurosciences	622	2.28	1.45	25.35
Biochemistry & Molecular Biology	475	2.44	1.57	26.65
Rheumatology	339	1.96	0.96	21.67
Immunology	343	1.56	1.20	18.79
Endocrinology & Metabolism	275	1.96	1.16	14.73
Clinical Neurology	287	2.94	1.57	31.52
Psychiatry	276	1.90	0.99	23.73
Cell Biology	273	2.12	1.26	24.15
Multidisciplinary Chemistry	237	1.54	1.21	27.07
Research & Experimental Medicine	223	2.00	1.03	22.17
Medicinal Chemistry	214	1.52	1.22	11.56
Microbiology	208	1.65	1.06	14.45
Genetics & Heredity	193	2.53	1.33	30.08
Oncology	182	2.74	1.42	32.56
Biochemical Research Methods	180	1.48	1.16	18.79
Biotechnology & Applied Microbiology	159	1.52	1.20	18.91
Toxicology	149	1.49	1.27	14.87
Infectious Diseases	147	1.93	1.35	13.36
Public, Environmental & Occupational Health	123	1.51	1.15	10.30
Mathematical & Computational Biology	138	1.44	1.25	16.53
Organic Chemistry	139	1.10	1.15	9.79

TABLE 4.8.3 NUMBER OF PUBLICATIONS, NUMBER OF PAPERS, PERCENTAGE OPEN ACCESS AND PERCENTAGE HIGHLY CITED PAPERS FOR THE TOP TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS PUBLISHED MOST FREQUENTLY 2010-2019. ORDERED BY TOTAL NUMBER OF PUBLICATIONS.

Journal category	Number of publications	% of open access publications	Number of papers	% of highly cited papers
Pharmacology & Pharmacy	726	47.1%	685	21.5%
Neurosciences	667	56.1%	622	29.9%
Biochemistry & Molecular Biology	484	66.5%	475	27.6%
Rheumatology	411	52.1%	339	27.1%
Immunology	357	67.5%	343	25.4%
Endocrinology & Metabolism	344	60.5%	275	24.0%
Clinical Neurology	324	43.2%	287	39.4%
Psychiatry	298	60.4%	276	28.6%
Cell Biology	282	74.8%	273	34.4%
Multidisciplinary Chemistry	242	56.6%	237	21.9%
Research & Experimental Medicine	229	63.3%	223	27.4%
Medicinal Chemistry	216	50.9%	214	19.6%
Microbiology	215	81.4%	208	28.8%
Genetics & Heredity	209	75.1%	193	31.1%
Oncology	207	66.7%	182	39.0%
Biochemical Research Methods	182	59.9%	180	25.0%
Biotechnology & Applied Microbiology	175	76.0%	159	26.4%
Toxicology	160	41.2%	149	22.8%
Infectious Diseases	159	79.2%	147	32.0%
Mathematical & Computational Biology	139	82.7%	138	21.7%
Organic Chemistry	139	46.8%	139	11.5%
Public, Environmental & Occupational Health	139	54.7%	123	17.9%

- IMI project research was most frequently published in Pharmacology & Pharmacy journals. Of the 685 papers published in this category, more than one fifth were highly cited.
- There were 287 papers in Clinical Neurology; this category has the highest percentage of highly cited papers (39.4%), just ahead of Oncology with 182 papers of which 39.0% are highly cited.
- The percentage of open access publications is highest in Mathematical & Computational Biology (82.7%), followed by Microbiology (81.4%).

4.9 IMI RESEARCH FIELDS WITH THE HIGHEST VOLUME OF PUBLICATIONS BENCHMARKED AGAINST EU-28 PUBLICATIONS OF THE SAME FIELD

Figure 4.9.1 shows the field-normalised citation impact of IMI funded research in the twenty Web of Science journal categories in which IMI project research was published most frequently between 2010 and 2019. These data are benchmarked against the average citation impact of all EU-28 research papers in the same journal categories. Table 4.9.1, expands on the data presented in Figure 4.9.1, showing the percentage of IMI and EU-28 papers in each journal category.

FIGURE 4.9.1 THE FIELD-NORMALISED CITATION IMPACT OF IMI PROJECT RESEARCH IN THE TOP 20 WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS MOST FREQUENTLY PUBLISHED, BENCHMARKED AGAINST EU-28 PAPERS IN THE SAME JOURNAL CATEGORIES, 2010-2019. ORDERED BY THE FIELD-NORMALISED CITATION IMPACT OF IMI RESEARCH.

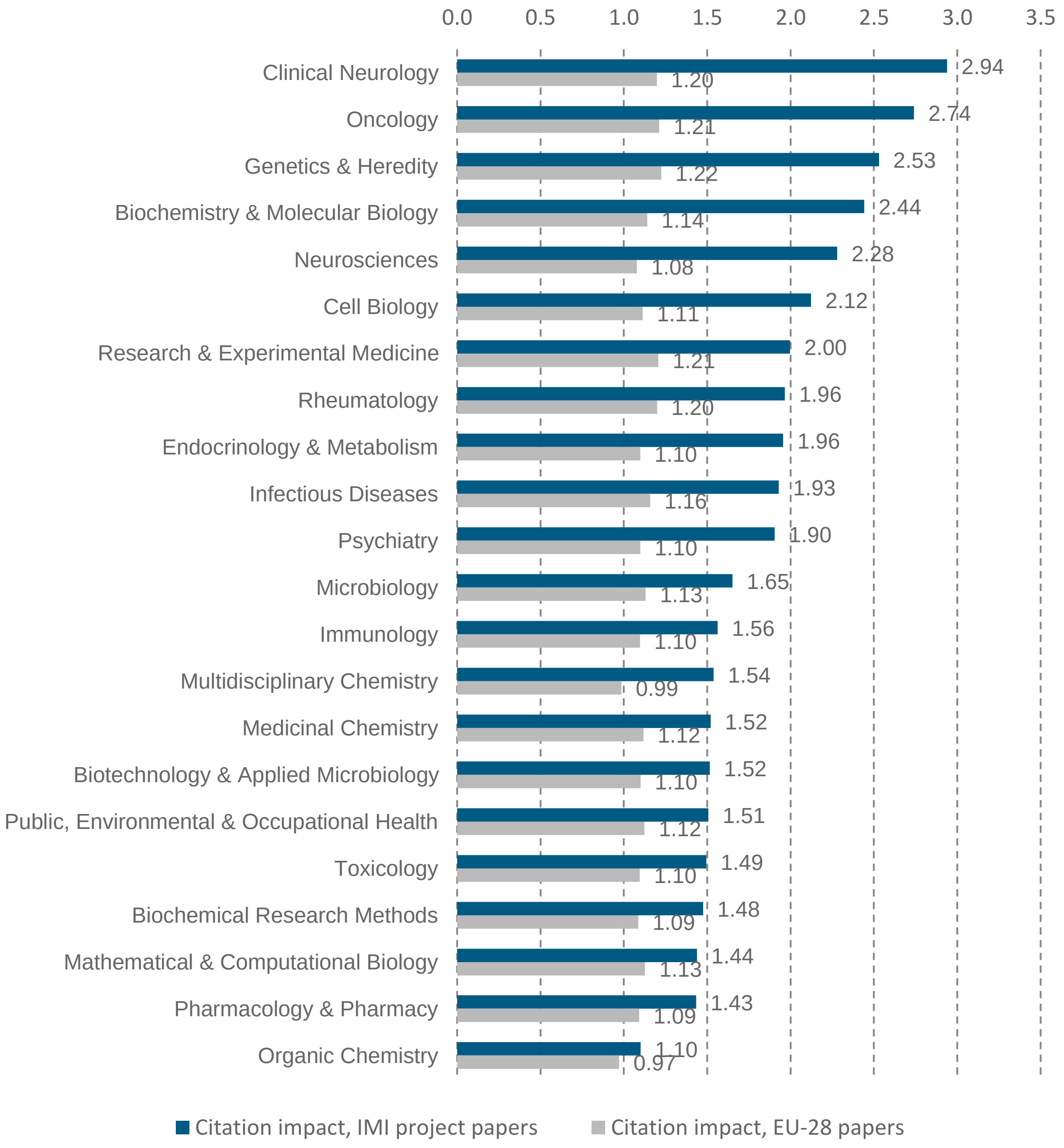


TABLE 4.9.1 CITATION IMPACT AND PERCENTAGE OF PAPERS IN TOP TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS MOST FREQUENTLY PUBLISHED, BENCHMARKED AGAINST EU-28 PAPERS IN THE SAME JOURNAL CATEGORIES, 2010-2019

			Citation impact normalised at field level	
Journal category	**% of IMI papers**	**% of EU-28 papers**	**IMI papers**	**EU-28**
Clinical Neurology	5.95%	2.05%	2.94	1.20
Oncology	3.80%	2.48%	2.74	1.21
Genetics & Heredity	3.84%	1.49%	2.53	1.22
Biochemistry & Molecular Biology	8.89%	3.88%	2.44	1.14
Neurosciences	12.25%	3.03%	2.28	1.08
Cell Biology	5.18%	1.95%	2.12	1.11
Research & Experimental Medicine	4.21%	1.20%	2.00	1.21
Rheumatology	7.55%	0.46%	1.96	1.20
Endocrinology & Metabolism	6.32%	1.44%	1.96	1.10
Infectious Diseases	2.92%	1.09%	1.93	1.16
Psychiatry	5.47%	1.51%	1.90	1.10
Microbiology	3.95%	1.64%	1.65	1.13
Immunology	6.56%	1.69%	1.56	1.10
Multidisciplinary Chemistry	4.44%	3.16%	1.54	0.99
Medicinal Chemistry	3.97%	0.73%	1.52	1.12
Biotechnology & Applied Microbiology	3.21%	1.54%	1.52	1.10
Public, Environmental & Occupational Health	2.55%	1.84%	1.51	1.12
Toxicology	2.94%	0.65%	1.49	1.10
Biochemical Research Methods	3.34%	1.20%	1.48	1.09
Mathematical & Computational Biology	2.55%	0.48%	1.44	1.13
Pharmacology & Pharmacy	13.33%	2.31%	1.43	1.09
Organic Chemistry	2.55%	0.98%	1.10	0.97

- In all twenty journal categories listed, IMI project research had a higher field-normalised citation impact than EU-28 papers in the same field.
- The journal category in which IMI-supported research had the highest field-normalised citation impact was Clinical Neurology (2.94) followed by Oncology (2.74).
- The average field-normalised citation impact of EU-28 papers was highest in Genetics & Heredity (1.22).

5 CITATION ANALYSIS – AT IMI PROJECT LEVEL

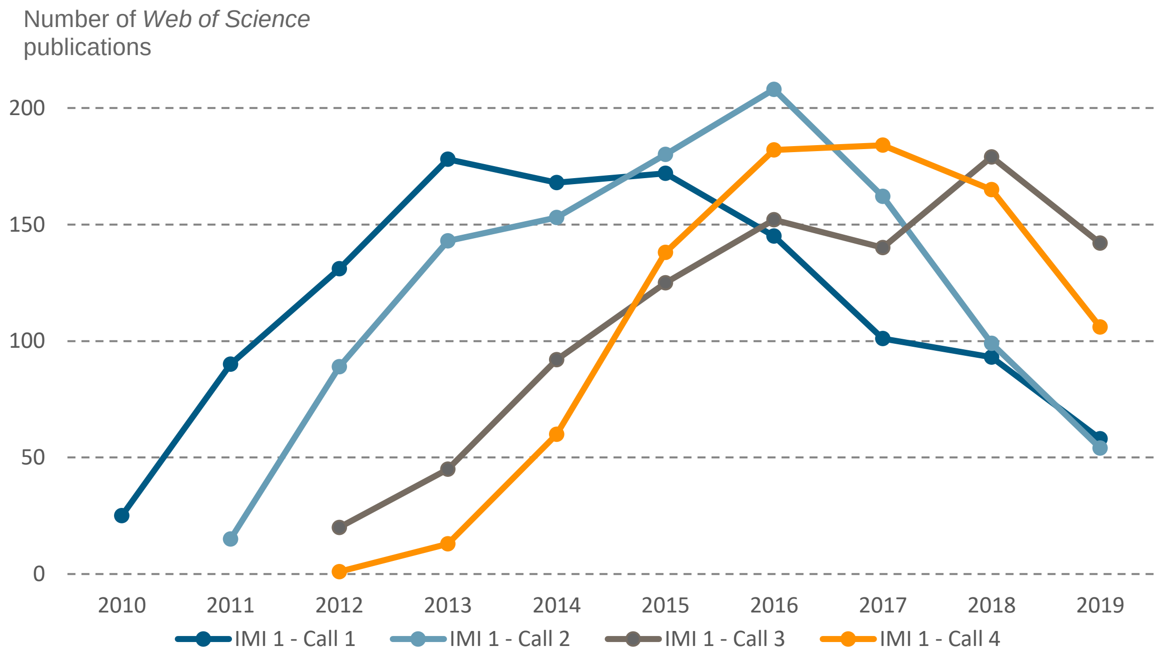
This section analyses the volume and citation impact of publications arising from different IMI-phases and calls.

5.1 TRENDS IN PUBLICATION OUTPUT BY IMI FUNDING CALL

Figure 5.1.1 and Figure 5.1.2 show the number of Web of Science publications between 2010 and 2019 for IMI project research disaggregated by call. IMI 1 calls 1-4 (Figure 5.1.1) are shown separately from the more recent IMI 1 calls 5-11 (Figure 5.1.2) which tend to have fewer publications. Likewise, IMI 2 calls are shown separately in Figure 5.1.3 as individual IMI 2 calls has far fewer publication compared to most IMI 1 calls as the longest running IMI 2 projects only started publishing in 2015.

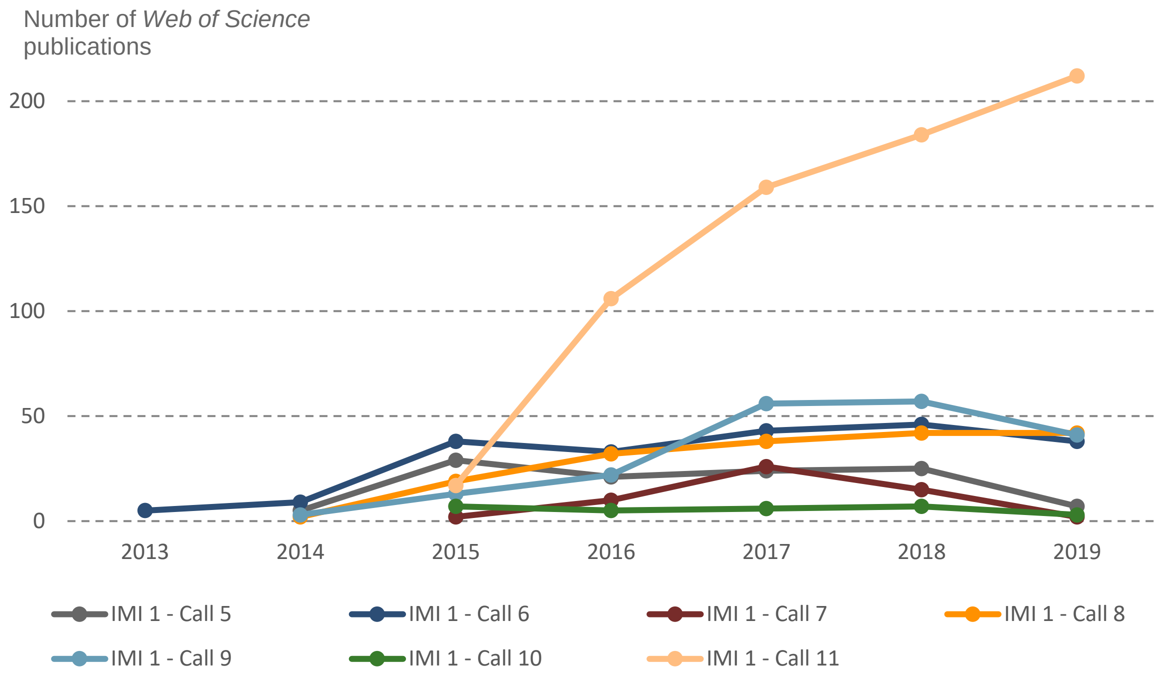
Table 5.1.1 presents summary bibliometric data for all IMI 1 and IMI 2 calls that have at least one publication, including the number of publications, numbers of papers, and citation impact indicators.

FIGURE 5.1.1 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2019



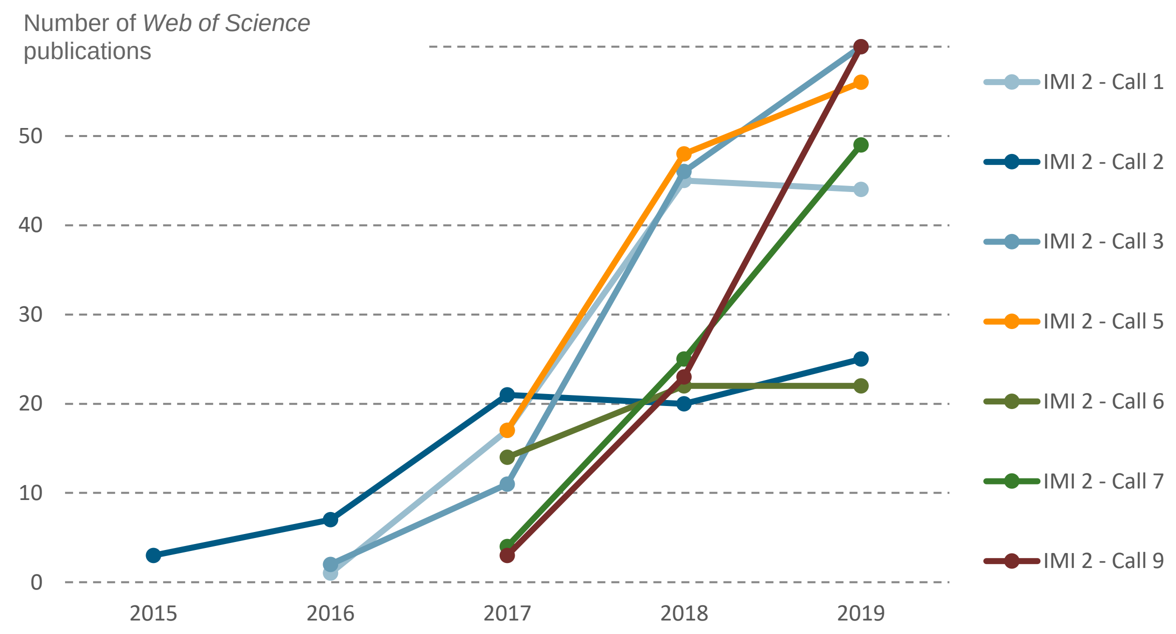
- Over the five years 2010 to 2014, IMI 1 call 1 had the highest output of publications, reaching a peak output of 178 publications in 2013.
- In 2015 and 2016, IMI 1 call 2 had the highest number of publications (180 and 208, respectively). In 2017 call 2's output fell (162 publications) and call 4 had the highest output of publications (182 publications).
- There appears to be a general trend in the output of publications over a call's lifetime; they grow approximately linearly for after their first publications, followed by a short plateau and then a fall. By 2019 IMI 1 calls 1,2 and 4 are showing a decline in output which is most pronounced for the earlier calls.
- In 2019 call 3 had the highest output (142 publications) a slight decline on the previous year, though it is too soon to determine if this is a sustained downward trend.

FIGURE 5.1.2 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2019



- Overall IMI 1 calls 5-10 have not grown as rapidly as IMI 1 calls 1-4, most calls produce fewer than 50 publications a year. Call 11 is the exception, with growth in output akin to IMI 1 calls 1-4. This growth was sustained during 2019.

FIGURE 5.1.3 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2019. ONLY SHOWING IMI 2 CALLS WITH AT LEAST 50 PUBLICATIONS IN TOTAL.



- The output of publications from IMI 2 calls is growing. IMI 2 call 2 was the first to start publishing in 2015 and since 2017 its output has plateaued at a modest 20 to 25 publications a year.
- Since beginning to publish in 2016 or 2017 IMI 2 calls 1, 3, 5, 7 and 9 have all rapidly increased output. In 2019 each call of these calls had an output of 49 or more publications, a similar or higher output than IMI 1 calls 5-10 shown in Figure 5.1.2.

TABLE 5.1.1 SUMMARY BIBLIOMETRIC ANALYSES OF IMI PROJECTS AGGREGATED BY FUNDING CALL, 2010-2019

					Citation impact		
Phase	Call	Number of publications[8]	% of open access publications	Number of papers	Raw citation impact	Normalised at field level	Normalised at journal level
1	1	1,161	65.6%	1,072	34.00	1.17	1.93
1	2	1,103	85.9%	1,037	32.16	1.23	2.13
1	3	895	72.0%	821	22.04	1.13	1.91
1	4	849	75.6%	812	22.32	1.36	2.19
1	5	111	57.0%	110	12.20	1.01	1.10
1	6	212	71.4%	206	12.74	0.98	1.32
1	7	55	60.5%	48	10.96	1.16	1.68
1	8	175	63.3%	153	16.74	1.54	2.74
1	9	192	53.7%	179	15.51	1.77	2.12
1	10	28	74.5%	28	11.43	1.12	1.19
1	11	678	66.3%	610	15.07	1.28	2.24
2	1	108	84.2%	92	5.67	0.92	1.72
2	2	76	71.4%	71	8.27	1.12	1.68
2	3	119	63.1%	84	6.55	1.24	2.04
2	4	4	74.1%	4	5.00	0.51	0.91
2	5	121	62.7%	104	6.01	0.97	2.06
2	6	58	81.0%	40	3.90	0.99	1.38
2	7	78	63.0%	69	12.88	1.67	3.85
2	8	11	75.6%	10	3.00	0.44	0.44
2	9	86	75.0%	73	3.95	1.49	2.11
2	10	45	25.0%	37	1.92	0.75	1.14

[8] Publications can be associated with more than one call.

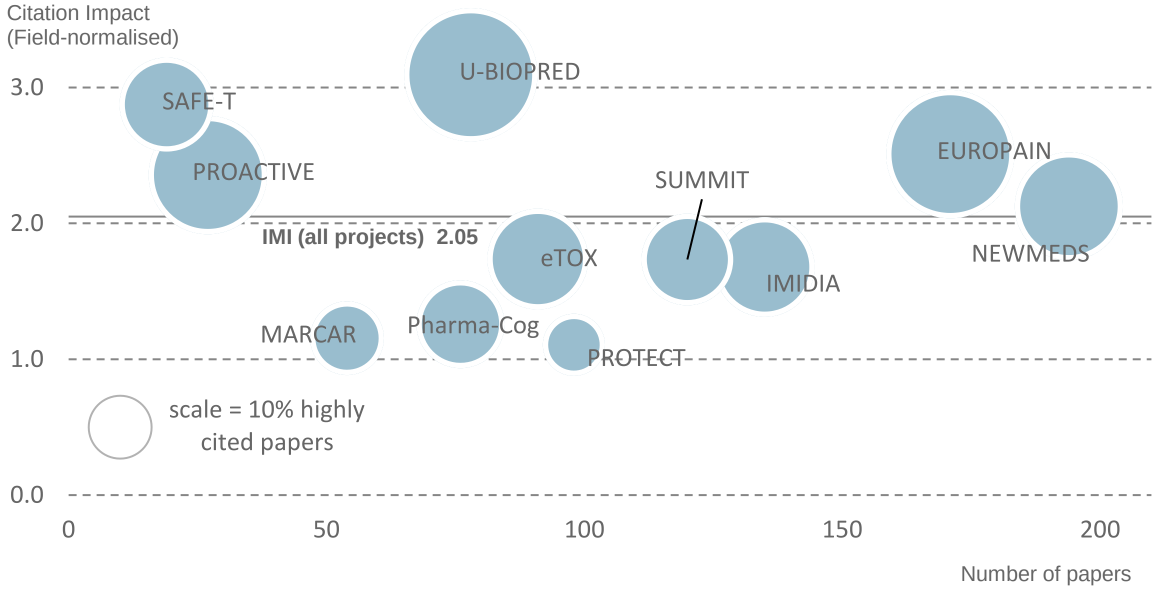
Phase	Call	Number of publications[8]	% of open access publications	Number of papers	Citation impact Raw citation impact	Normalised at field level	Normalised at journal level
2	12	6	72.7%	3	0.00	0.00	0.00
2	13	8	16.7%	6	0.67	0.52	0.41

- IMI 1 call 1 produced the highest number of Web of Science publications (1,161), and papers (1,072). The papers from IMI 1 call 1 also had the highest raw citation impact (34.00), this is probably because they are older and have had longer to accrue citations.
- Papers assigned to IMI 1 call 9 had the highest average field-normalised citation impact (1.77).
- The highest percentage of open access publications belongs to IMI 2 call 7 (85.9%). Generally IMI 2 calls have a higher proportion of open access publications compared to IMI 1 calls.
- IMI 2 call 5 with 121 publications is IMI 2's highest output call and IMI 2 call 7 has the highest field-normalised citation impact (1.67).

5.2 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALL 1

Figure 5.2.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 call 1 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.2.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 1, 2010-2019



The data in Figure 5.2.1 shows that:

- The average field-normalised citation impact of all IMI 1 call 1 projects with at least 10 papers was above the world average (1.00). Furthermore, the percentage of highly cited research was also above the world average (10%) from all projects apart for PROTECT with only 9.2% of highly cited papers. This indicates excellent research performance.
- Research associated with NEWMEDS, EUROPAIN, PROACTIVE and SAFE-T was cited more than twice the world average and research associated with U-BIOPRED was cited more than three times the world average. These five projects have an average citation impact greater than the average citation impact of all IMI project papers (2.05).

Table 5.2.1 shows raw citation impact and the percentage of open access publication by project for IMI 1 call 1 publications. Table 5.2.2 shows the normalised citation impact (normalised against world average values) of IMI 1 call 1 projects and is an expansion of the data shown in Figure 5.2.1.

TABLE 5.2.1 BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALL 1, 2010-2019

Project	Number of publications	Number of papers	% of open-access publications	Citations	Raw citation impact
NEWMEDS	199	194	53.8%	9,046	46.63
EUROPAIN	171	171	35.7%	7,802	45.63
IMIDIA	145	135	78.6%	4,593	34.02
SUMMIT	124	120	71.0%	2,662	22.18
PROTECT	100	98	38.0%	1,749	17.85
eTOX	96	91	64.6%	3,041	33.42
U-BIOPRED	125	78	43.2%	2,751	35.27
Pharma-Cog	82	76	29.3%	2,148	28.26
MARCAR	55	54	74.5%	1,122	20.78
PROACTIVE	32	27	75.0%	1,062	39.33
SAFE-T	21	19	28.6%	407	21.42

TABLE 5.2.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 1, 2010-2019

		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% of highly cited papers
NEWMEDS	194	2.13	1.10	31.88	27.8%
EUROPAIN	171	2.51	1.39	23.96	39.2%
IMIDIA	135	1.68	1.06	30.85	23.7%
SUMMIT	120	1.73	1.08	35.86	20.0%
PROTECT	98	1.11	0.94	38.86	9.2%
eTOX	91	1.74	1.31	29.54	24.2%
U-BIOPRED	78	3.09	1.43	20.24	42.3%
Pharma-Cog	76	1.26	0.99	42.36	18.4%
MARCAR	54	1.16	0.80	40.50	13.0%
PROACTIVE	27	2.36	1.84	26.76	33.3%
SAFE-T	19	2.87	1.48	29.04	21.1%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- Of the projects in call 1, NEWMEDS had the highest number of publications (199) and IMIDIA had the highest percentage of open access publications (78.6%).

5.3 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALL 2

Figure 5.3.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 call 2 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers. The same data is shown in Figure 5.3.1 and Figure 5.3.2, however Figure 5.3.1 has a smaller x-axis range that excludes BTCure so that the other projects are less clustered.

FIGURE 5.3.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 2, 2010-2019

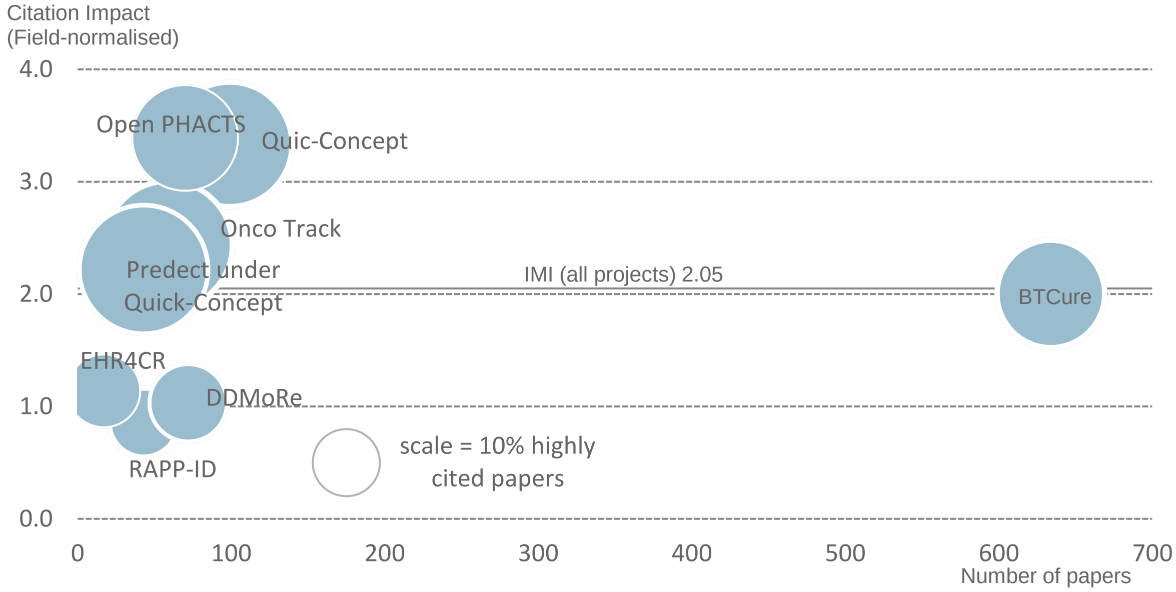
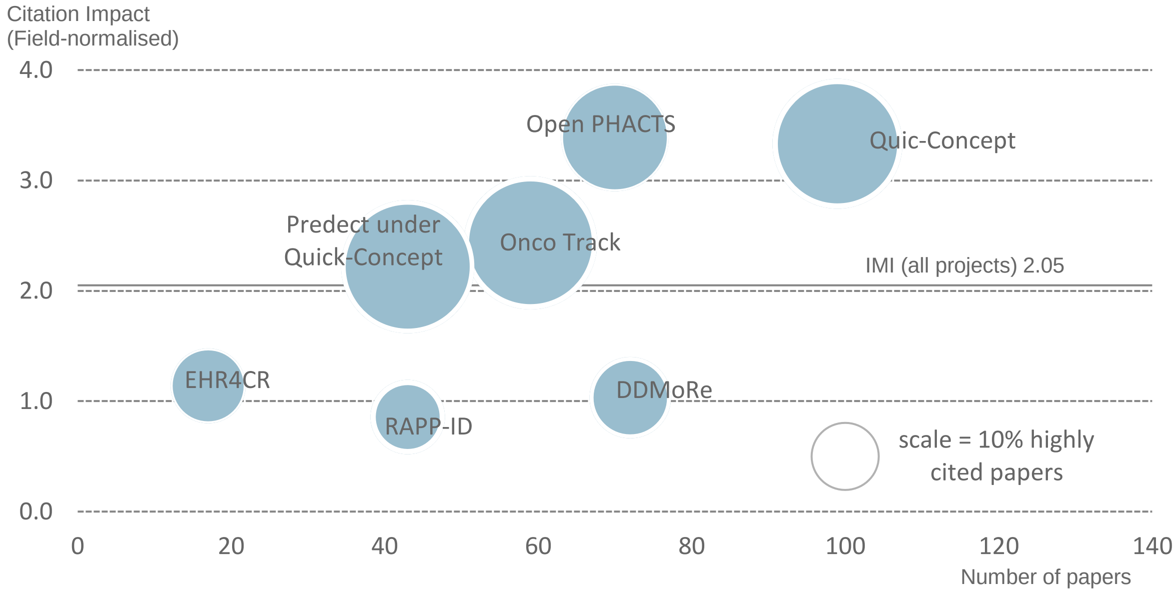


FIGURE 5.3.2 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 2, 2010-2019 SAME GRAPH AS FIGURE 5.3.2 APART FROM A SMALLER X-AXIS RANGE



The data in Figure 5.3.1 and Figure 5.3.2 shows that:

- The average field-normalised citation impact of most IMI 1 call 2 projects was above world average apart from RAPP-ID which had the lowest citation impact (0.86).
- BTCURE was by far the most prolific IMI 1 call 2 project with 634 papers and a citation impact twice the world average (2.00).
- QUIC-CONCEPT and Open PHACTS were very well-cited with citation impacts more than three times the world average; 3.33 and 3.39 respectively.
- Four of the nine projects in this call had an average citation impact greater than the average citation impact of all IMI project papers (2.05).

Table 5.3.1 shows raw citation impact and the percentage of open access publication by project for IMI 1 call 2 publications. Table 5.3.2 shows the normalised citation impact (normalised against world average values) of IMI 1 call 2 projects and is an expansion of the data shown in Figure 5.3.1 and Figure 5.3.2.

TABLE 5.3.1 BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALL 2, 2010-2019

Project	Number of publications	Number of papers	% of open-access publications	Citations	Raw citation impact
BTCure	680	634	59.7%	18,615	29.36
Quic-Concept	100	99	73.0%	5,318	53.72
DDMoRe	77	72	63.6%	906	12.58
Open PHACTS	73	70	82.2%	3,466	49.51
Onco Track	63	59	65.1%	3,026	51.29
Predect	47	43	76.6%	1,389	32.30
RAPP-ID	44	43	50.0%	702	16.33
EHR4CR	19	17	57.9%	291	17.12

TABLE 5.3.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 2, 2010-2019

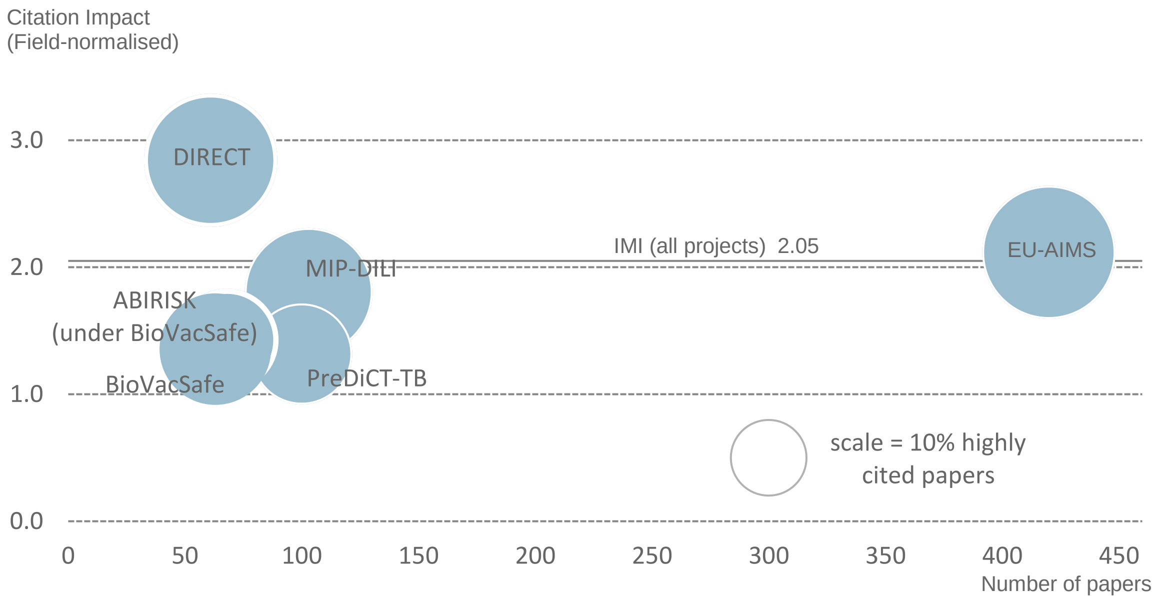
		Citation impact			
Project	**Number of papers**	**Normalised at field level**	**Normalised at journal level**	**Average percentile**	**% of highly cited papers**
BTCure	634	2.00	1.09	30.13	26.7%
Quic-Concept	99	3.33	2.08	30.47	35.4%
DDMoRe	72	1.03	0.88	49.58	13.9%
Open PHACTS	70	3.39	1.86	36.18	24.3%
Onco Track	59	2.44	1.28	23.57	37.3%
Predect	43	2.22	1.33	34.98	37.2%
RAPP-ID	43	0.86	0.80	42.05	11.6%
EHR4CR	17	1.14	1.06	41.43	11.8%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- Among IMI 1 call 2 projects Open PHACTS has the highest percentage of open-access publications (82.2%).
- Onco Track and Predect the highest percentages of highly cited papers (37.3% and 37.2% respectively)

5.4 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALL 3

Figure 5.4.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 call 3 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.4.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 3, 2010-2019



The data in Figure 5.4.1 shows that:

- The average citation impact and percentage of highly cited papers for all projects in this call was above world averages.
- EU-AIMS was by far the most prolific IMI 1, call 3 project with 420 papers. The field-normalised citation impact of this research was twice the world average (2.12) and above average for all IMI research (2.05).
- Research associated with DIRECT was very well-cited with a field-normalised citation impact over two-and-a-half times (2.84) the world average. DIRECT and EU-AIMS had the highest percentage of highly cited papers (29.5% each)

Table 5.4.1 shows raw citation impact and the percentage of open access publications by project for IMI 1 call 3 publications. Table 5.4.2 shows the normalised citation impact (normalised against world average values) of IMI 1 call 3 projects and is an expansion of the data shown in Figure 5.4.1.

TABLE 5.4.1 SUMMARY BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALL 3, 2010-2019

Project	Number of publications	Number of papers	% of open-access publications	Citations	Raw citation impact
EU-AIMS	435	420	70.8%	10,557	25.14
MIP-DILI	110	103	53.6%	1,830	17.77
PreDiCT-TB	105	100	82.9%	1,476	14.76
ABIRISK	86	68	41.9%	1,268	18.65
BioVacSafe	66	63	74.2%	1,415	22.46
DIRECT	86	61	54.7%	1,616	26.49

TABLE 5.4.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 3, 2010-2019

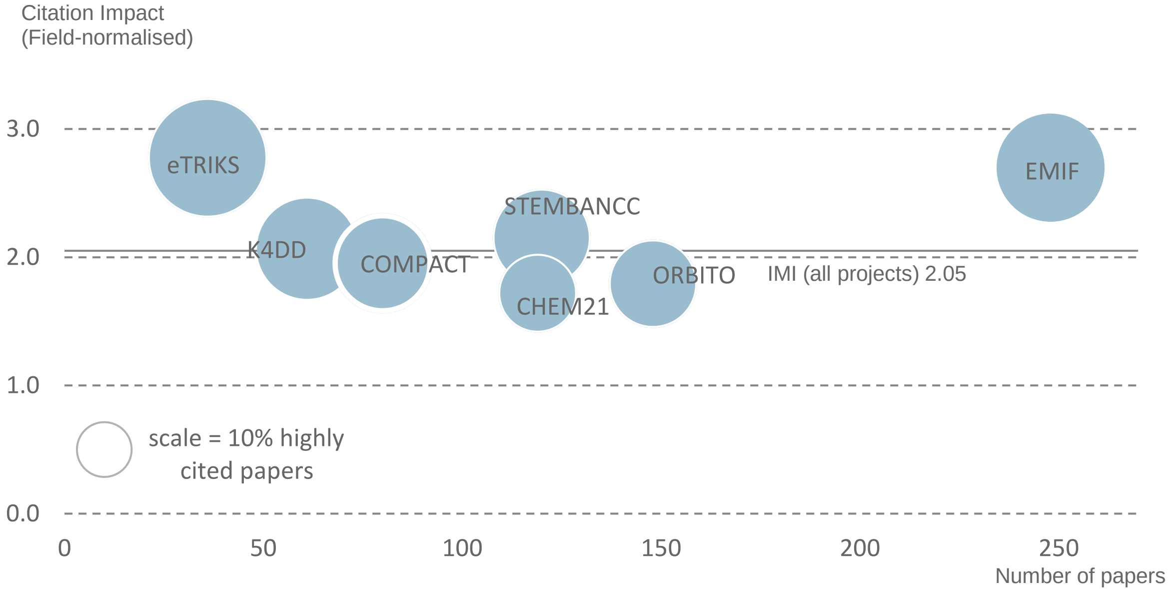
		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% of highly cited papers
EU-AIMS	420	2.12	1.14	32.56	29.5%
MIP-DILI	103	1.81	1.35	33.90	27.2%
PreDiCT-TB	100	1.32	0.86	42.08	17.0%
ABIRISK	68	1.43	0.97	45.44	17.6%
BioVacSafe	63	1.36	1.09	33.75	20.6%
DIRECT	61	2.84	1.32	37.78	29.5%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- PreDiCT-TB had the highest percentage of open access publications (76.8%).

5.5 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALL 4

Figure 5.5.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 call 4 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.5.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 4, 2010-2019



The data in Figure 5.5.1 shows that:

- The average field-normalised citation impact of all projects in this call is above world average.
- EMIF produced the highest number of papers in call 4, with 248 papers published by the end of 2019.
- Research associated with EMIF and eTRICKS was very well-cited, with field-normalised citation impacts of 2.70 and 2.78, respectively and percentage of highly cited papers of 36.6% and 44.4%, respectively.
- Four-of-the- seven projects in this call had an average field-normalised citation impact greater than the average citation impact for all IMI project research (2.05).

Table 5.5.1 shows raw citation impact and the percentage of open-access publications by project for IMI 1 call 4 publications. Table 5.5.2 shows the normalised citation impact (normalised against world average values) of IMI 1 call 4 projects and is an expansion of the data shown in Figure 5.5.1.

TABLE 5.5.1 BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALL 4, 2010-2019

Project	Number of publications	Number of papers	% of open access publications	Citations	Raw citation impact
EMIF	267	248	75.3%	6,328	25.52
ORBITO	150	148	25.3%	2,332	15.76
STEMBANCC	124	120	73.4%	2,284	19.03
CHEM21	122	119	35.2%	3,235	27.18
COMPACT	80	80	45.0%	2,166	27.07
K4DD	62	61	62.9%	959	15.72
eTRIKS	44	36	81.8%	901	25.03

TABLE 5.5.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 4, 2010-2019

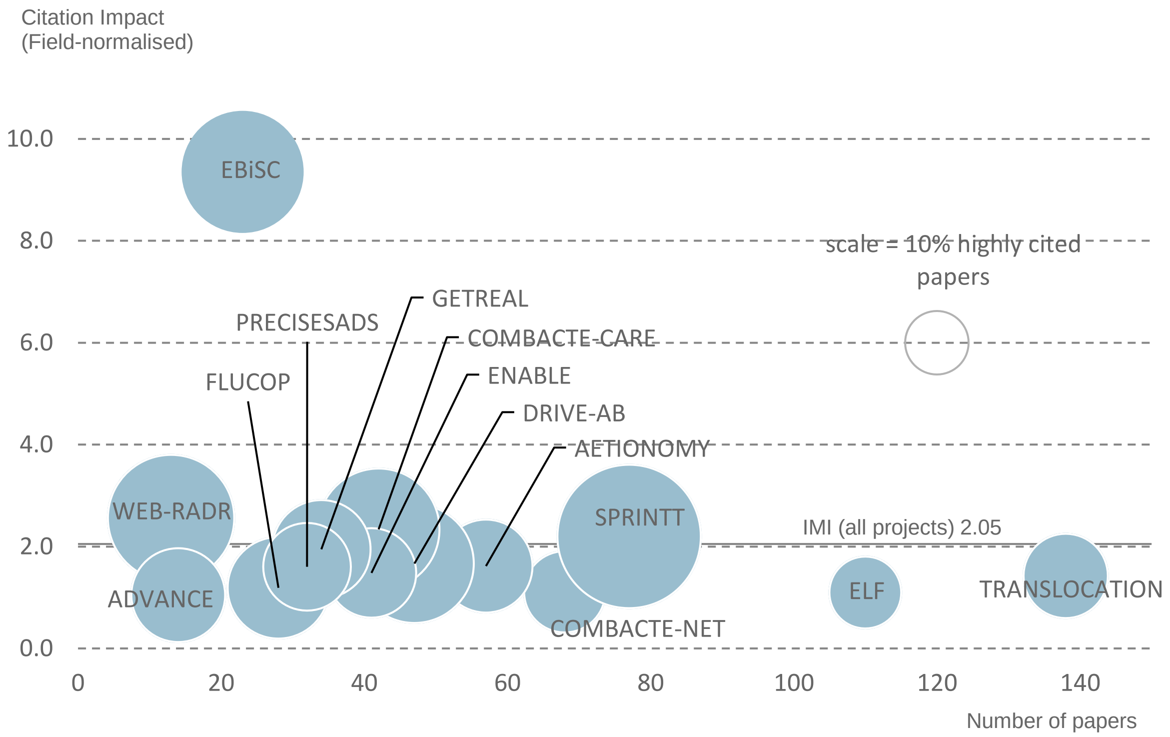
		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% of highly cited papers
EMIF	248	2.70	1.32	28.96	36.3%
ORBITO	148	1.79	1.26	33.78	24.3%
STEMBANCC	120	2.15	1.34	30.75	30.0%
CHEM21	119	1.72	1.27	35.86	19.3%
COMPACT	80	1.95	1.49	29.06	31.3%
K4DD	61	2.07	1.63	30.65	31.1%
eTRIKS	36	2.78	1.73	19.42	44.4%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- EMIF has the highest number of citations (6,328).
- CHEM21 has the highest raw citation impact (27.18) just ahead of COMPACT (27.07).
- eTRIKS has the highest percentage of open access publications (81.8%).

5.6 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALLS 5-10

Figure 5.6.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 calls 5-10 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.6.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALLS 5-10, 2010-2019



The data in Figure 5.6.1 shows that:

- Research associated with EBiSC was very well cited with a field-normalised citation impact more than nine times the world average (9.35). However, the total number of EBiSC papers is relativity low (23 papers) so citation indicators are easily inflated by one or a few very highly cited papers.
- Nearly half of SPRINTT papers are highly cited (49.4%).
- TRANSLOCATION produced the most papers (138) likely due to it being one of the longest running projects from IMI 1 calls 5-10.
- The majority of projects in calls 5-10 have a field-normalised citation impact greater than the world average but below average for all IMI project research (2.05).
- COMBACT-NET and ADVANCE are the only calls 5-10 projects which did not attained world average citation impact with field-normalised citation impacts of 0.85 and 0.83 respectively.

Table 5.6.1 shows raw citation impact and the percentage of open-access publications by project for IMI 1 call 5-10 publications. Table 5.6.2 shows the normalised citation impact (normalised against world average values) of IMI 1 calls 5-10 projects and is an expansion of the data shown in Figure 5.6.1.

TABLE 5.6.1 BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALLS 5-10, 2010-2019

Project	Number of publications	Number of papers	% of open-access publications	Citations	Raw citation impact
TRANSLOCATION	138	138	55.1%	2,062	14.94
ELF	111	110	63.1%	1,343	12.21
SPRINTT	79	77	46.8%	1,494	19.40
COMBACTE-NET	74	68	77.0%	575	8.46
AETIONOMY	58	57	75.9%	708	12.42
DRIVE-AB	53	47	77.4%	572	12.17
COMBACTE-CARE	46	42	84.8%	620	14.76
ENABLE	41	41	85.4%	426	10.39
GETREAL	40	34	75.0%	418	12.29
PRECISESADS	48	32	50.0%	506	15.81
FLUCOP	28	28	71.4%	320	11.43
EBiSC	28	23	82.1%	939	40.83
ADVANCE	15	14	73.3%	140	10.00
WEB-RADR	14	13	64.3%	151	11.62

TABLE 5.6.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALLS 5-10, 2010-2019

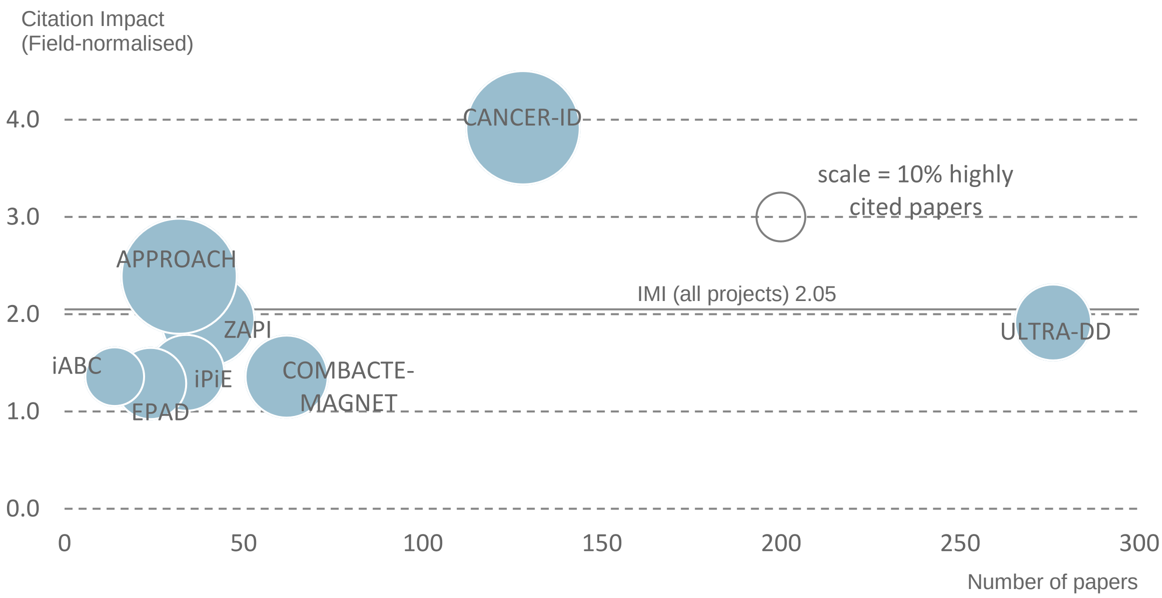
Project	Number of papers	Citation impact		Average percentile	% of highly cited papers
		Normalised at field level	Normalised at journal level		
TRANSLOCATION	138	1.42	1.05	38.39	17.4%
ELF	110	1.10	1.01	39.81	12.7%
SPRINTT	77	2.20	2.31	22.80	49.4%
COMBACTE-NET	68	1.11	0.85	43.72	16.2%
AETIONOMY	57	1.62	1.22	41.10	21.1%
DRIVE-AB	47	1.67	1.17	29.84	34.0%
COMBACTE-CARE	42	2.34	1.33	37.41	35.7%
ENABLE	41	1.48	1.09	36.31	19.5%
GETREAL	34	1.95	1.30	31.08	23.5%
PRECISESADS	32	1.60	1.02	33.80	18.8%
FLUCOP	28	1.19	1.12	45.71	25.0%
EBiSC	23	9.35	3.89	29.49	34.8%
ADVANCE	14	1.05	0.83	51.25	21.4%
WEB-RADR	13	2.56	2.11	22.85	38.5%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- ENABLE has the highest percentage (85.4%) of open access publications.
- TRANSLOCATION has the highest number of publications (138).
- EBiSC has the highest raw citation impact (40.83) for only 23 papers.

5.7 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 1 PROJECTS – CALL 11

Figure 5.7.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers for IMI 1 call 11 projects. Only projects with at least 10 papers and one highly cited paper over the time period (2010-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.7.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 11, 2010-2019



The data in Figure 5.7.1 shows that:

- ULTRA-DD produced by far the most papers (276), accounting for IMI 2 call 11 high output compared to other, later IMI 1 calls
- Research associated with CANCER-ID was very well-cited with a field-normalised citation impact nearly four times the world average (3.92).
- Over half of CANCER-ID and APPROACH papers are highly cited (51.6% and 53.1% respectively).
- All projects in call 11 have a field-normalised citation impact greater than the world average and APPROACH and CANCER-ID's citation impacts are greater than the average for all IMI research (2.05).

Table 5.7.1 shows raw citation impact and the percentage of open-access publications by project for IMI 1 call 11 publications. Table 5.7.2 shows the normalised citation impact (normalised against world average values) of IMI 1 call 11 projects and is an expansion of the data shown in Figure 5.7.1.

TABLE 5.7.1 BIBLIOMETRIC INDICATORS FOR IMI 1 PROJECTS IN CALL 11, 2010-2019

Project	Number of publications	Number of papers	% of open-access publications	Citations	Raw citation impact
ULTRA-DD	283	276	73.9%	3,256	11.80
CANCER-ID	152	128	69.7%	3,747	29.27
COMBACTE-MAGNET	71	62	74.6%	536	8.65
ZAPI	42	40	97.6%	534	13.35
iPiE	35	34	60.0%	271	7.97
APPROACH	40	32	67.5%	697	21.78
EPAD	28	24	53.6%	279	11.63
iABC	27	14	44.4%	150	10.71

TABLE 5.7.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 11, 2010-2019

Project	Number of papers	Citation impact			
		Normalised at field level	Normalised at journal level	Average percentile	% of highly cited papers
ULTRA-DD	276	1.92	1.14	36.68	23.6%
CANCER-ID	128	3.92	1.69	21.59	51.6%
COMBACTE-MAGNET	62	1.36	0.99	45.11	27.4%
ZAPI	40	1.94	1.11	37.12	35.0%
iPiE	34	1.40	1.13	39.25	23.5%
APPROACH	32	2.39	1.83	19.66	53.1%
EPAD	24	1.29	0.88	40.70	20.8%
iABC	14	1.36	1.80	53.58	14.3%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

- ZAPI has the highest percentage (97.6%) of open access publications.
- CANCER-ID has more citations (3,747) that ULTRA-DD (3,256) despite having fewer papers. Accordingly, CANCER-ID has the highest raw citation impact (29.27).

5.8 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 2 PROJECTS

Figure 5.8.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers from IMI 2 projects from all calls. Only projects with at least 10 papers and one highly cited paper over the time period (2015-2019) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The solid horizontal line indicates the average field-normalised citation impact for all IMI project papers. The same data is shown on Figure 5.8.2 with a smaller axis ranges that excludes INNODIA and IMPRiND so that the relativity lower impact and output projects are less crowded.

FIGURE 5.8.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – ALL CALLS, 2015-2019

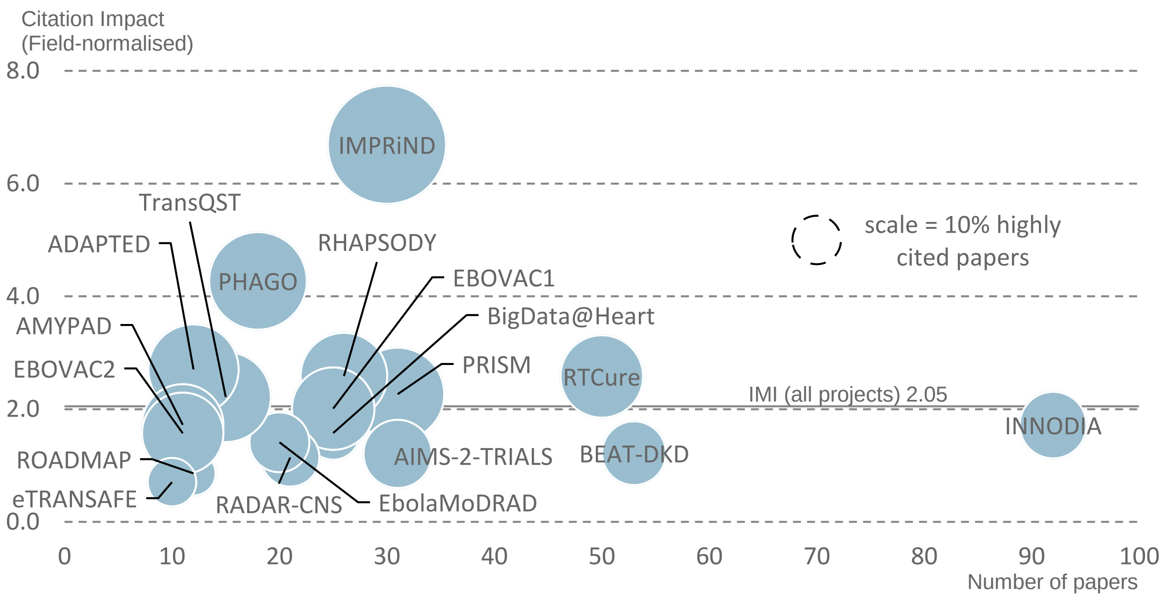
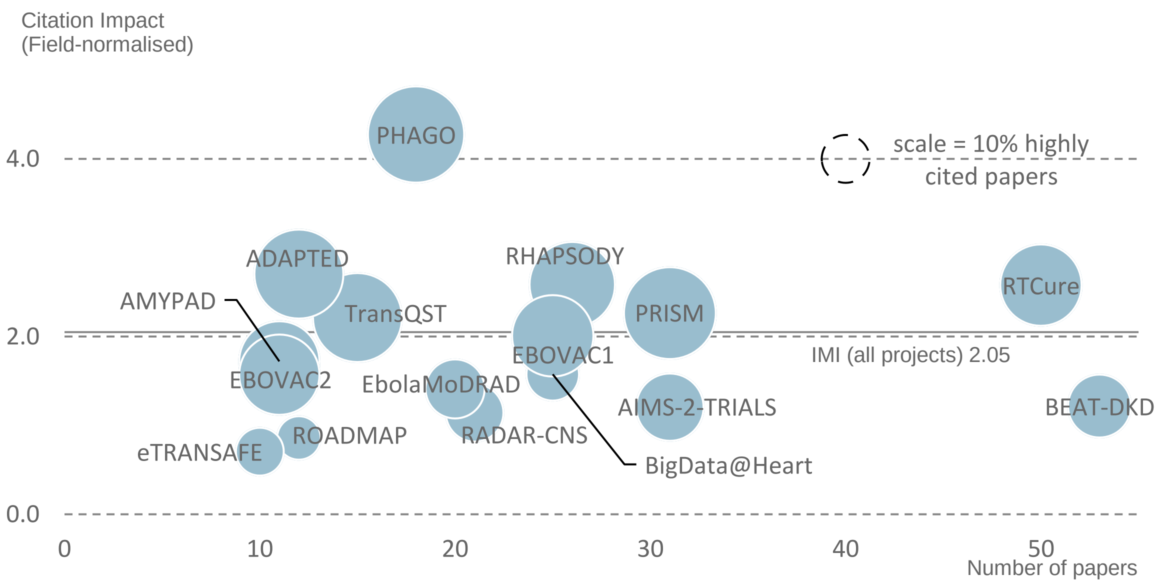


FIGURE 5.8.2 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – ALL CALLS, 2015-2019. SAME GRAPH AS FIGURE 5.8.2 APART FROM A SMALLER AXIS RANGE



The data in Figure 5.8.1 and Figure 5.8.2 shows that:

- All projects in call 11 have a field-normalised citation impact greater than the world average apart from ROADMAP (0.86) and eTRANSAFE (0.70).
- IMPRiND has the highest field-normalised citation impact (6.69) over six times the world average and over half of papers are highly cited (56.7%).
- INNODIA has by far the highest output of papers (92 papers).

Table 5.8.1 shows raw citation impact and percentage of open-access publications by project for IMI 2 publications. and Table 5.8.2 shows indicators for IMI 2 project research where citation impact has been normalised against world average values.

TABLE 5.8.1 BIBLIOMETRIC INDICATORS FOR IMI 2 PROJECTS, 2015-2019

Project	Number of publications	Number of papers	% of open-access publications[9]	Citations	Raw citation impact
INNODIA	108	92	63.0%	544	5.91
BEAT-DKD	55	53	83.6%	260	4.91
RTCure	52	50	78.8%	257	5.14
AIMS-2-TRIALS	33	31	87.9%	72	2.32
PRISM	36	31	66.7%	135	4.35
IMPRiND	32	30	87.5%	720	24.00
RHAPSODY	36	26	72.2%	331	12.73
BigData@Heart	29	25	79.3%	116	4.64
EBOVAC1	27	25	100.0%	329	13.16
RADAR-CNS	41	21	39.0%	125	5.95
EbolaMoDRAD	21	20	66.7%	104	5.20
PHAGO	18	18	100.0%	161	8.94
TransQST	17	15	76.5%	69	4.60
ADAPTED	13	12	92.3%	105	8.75
ROADMAP	17	12	76.5%	38	3.17
AMYPAD	16	11	56.3%	82	7.45
EBOVAC2	11	11	90.9%	77	7.00
eTRANSAFE	14	10	64.3%	8	0.80
VSV-EBOVAC	10	9	60.0%	89	9.89

[9] Note that IMI 2 funded researchers are contractually obliged to make their scientific articles open access through Green or Gold routes. However, for some of other document types, such as editorials, reviews or conference proceedings open access publication is strongly encouraged but not mandatory.

Nevertheless, it is obvious that fewer than all of IMI's publications are classified as open access in this analysis, and this is likely to be due to ancillary factors (such as challenges relating to definitions and coverage) as well as non-compliance. The Web of Science open access data come from the Directory of Open Access Journals (DOAJ) and collaborations with Impact Story and Our Research's Unpaywall services. The Web of Science therefore provides unrivalled coverage of open access publications that are published through DOAJ Gold, Other Gold, Green Published, Green Accepted or Bronze routes.

It is also possible that some publishers makes publications available without following a recognised open access route. In these cases publications will not be indexed as open access in the Web of Science or in this report. Additionally, the analysis presented in this report covers all document types and not just papers, and some of these are not indexed as open access in the Web of Science databases.

The Web of Science open access data coverage is summarised at: https://clarivate.com/webofsciencegroup/solutions/open-access/

- INNODIA has the highest number of papers (92) but IMPRiND has the highest number of citations (720), with a raw citation impact of 24.00, far higher than any other IMI 2 project.
- The majority of publications produced by IMI 2 projects are open-access and all 18 of publications that belong to PHAGO are open-access.
- Very low paper counts make it difficult to draw firm conclusions from average citation impact indicators. However, the IMPRiND project has a very high field-normalised citation impact (6.69).

TABLE 5.8.2 SUMMARY CITATION INDICATORS FOR IMI 2 PROJECTS, 2015-2019

Project	Number of papers	Citation impact Normalised at field level	Normalised at journal level	Average percentile	% of highly cited papers
INNODIA	92	1.72	0.92	49.32	18.5%
BEAT-DKD	53	1.22	0.65	50.12	17.0%
RTCure	50	2.58	1.66	43.27	28.0%
PRISM	31	2.26	1.43	39.50	35.5%
AIMS-2-TRIALS	31	1.21	0.76	66.02	19.4%
IMPRiND	30	6.69	2.26	22.45	56.7%
RHAPSODY	26	2.58	0.93	40.26	30.8%
BigData@Heart	25	1.58	1.13	58.69	12.0%
EBOVAC1	25	2.01	1.24	36.06	28.0%
RADAR-CNS	21	1.14	1.29	48.75	14.3%
EbolaMoDRAD	20	1.41	1.06	50.56	15.0%
PHAGO	18	4.27	1.57	40.29	38.9%
TransQST	15	2.21	1.75	53.25	33.3%
ADAPTED	12	2.70	0.95	22.80	33.3%
ROADMAP	12	0.86	0.58	54.77	8.3%
AMYPAD	11	1.72	0.67	51.71	27.3%
EBOVAC2	11	1.57	1.25	29.33	27.3%
eTRANSAFE	10	0.70	0.57	71.33	10.0%
Overall (IMI projects)	**5,445**	**2.05**	**1.23**	**34.5**	**26.9%**

6 GEOGRAPHIC CLUSTERING ANALYSIS

6.1 LOCATIONS WHERE IMI-FUNDED RESEARCH TAKES PLACE

This section of the report analyses geographic clusters where IMI research occurs, the citation impact of research published by these clusters and the clusters' constituent institutions.

Substantial clusters of research activity were identified in Europe and North America. While IMI project research also involves institutions in other parts of the world, publication rates for other geographies were low. This analysis, therefore, focuses on Europe and North America and we have identified the 39 and 16 geographic clusters respectively with the highest output.

Clusters have a 20km radius and the clusters in Europe and North America tend to focus on major cities with an existing strong academic research base. The largest European clusters are London (1,154 publications), Amsterdam (1,001 publications), Stockholm (575 publications), Paris (516 publications) and Copenhagen (452 publications). The largest clusters in North America are Toronto (256 publications), Boston (243 publications), Bethesda (140 publications), Montreal (104 publications) and New York (100 publications). It is also clear that the citation impact of the research IMI supports within these clusters is higher than the average national benchmark. A relatively high percentage of IMI research is open access, with the Oxford cluster publishing over 80% of its IMI project research as open access publications.

Rates of international collaboration are very high for most clusters. Around 40% of all EU-28 biomedical research involves international co-authorship, whereas for IMI project research the lowest rate of international co-authorship for a European cluster was 66.7% (Uppsala) and two-thirds of the European clusters have rates of international co-authorship exceeding 80%. Rates of international co-authorship are even higher for North American clusters, approaching 100%, this is expected as IMI is a European funding organisation that primarily funds researchers working in EU-28 countries.

The clusters are visualised on maps in Figure 6.1.1 and Figure 6.1.2. Both maps are scaled separately so that the most intensive areas of output are shaded red and the lowest areas of output are blue. This means that the same colour shading is not comparable between maps. Table 6.1.1 to Table 6.1.4 show the research publication outputs of the individual clusters along with bibliometric indicators of their research performance. The citation metrics in Table 6.1.2 and Table 6.1.4 are shaded green when the performance of a cluster of IMI-supported research outperforms the national average performance for biomedical research.[10]

The institutions that constitute the top five clusters within the European and North American regions are shown in Table 6.1.5 and Table 6.1.6 respectively. The five journal subject categories in which the top five clusters published most frequently within the European and North American regions are shown in Table 6.1.7 and Table 6.1.8 respectively.

[10] Web of Science journal categories which capture biomedically related publications used to calculate the national baselines are listed in Annex 2.

FIGURE 6.1.1 MAP SHOWING EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

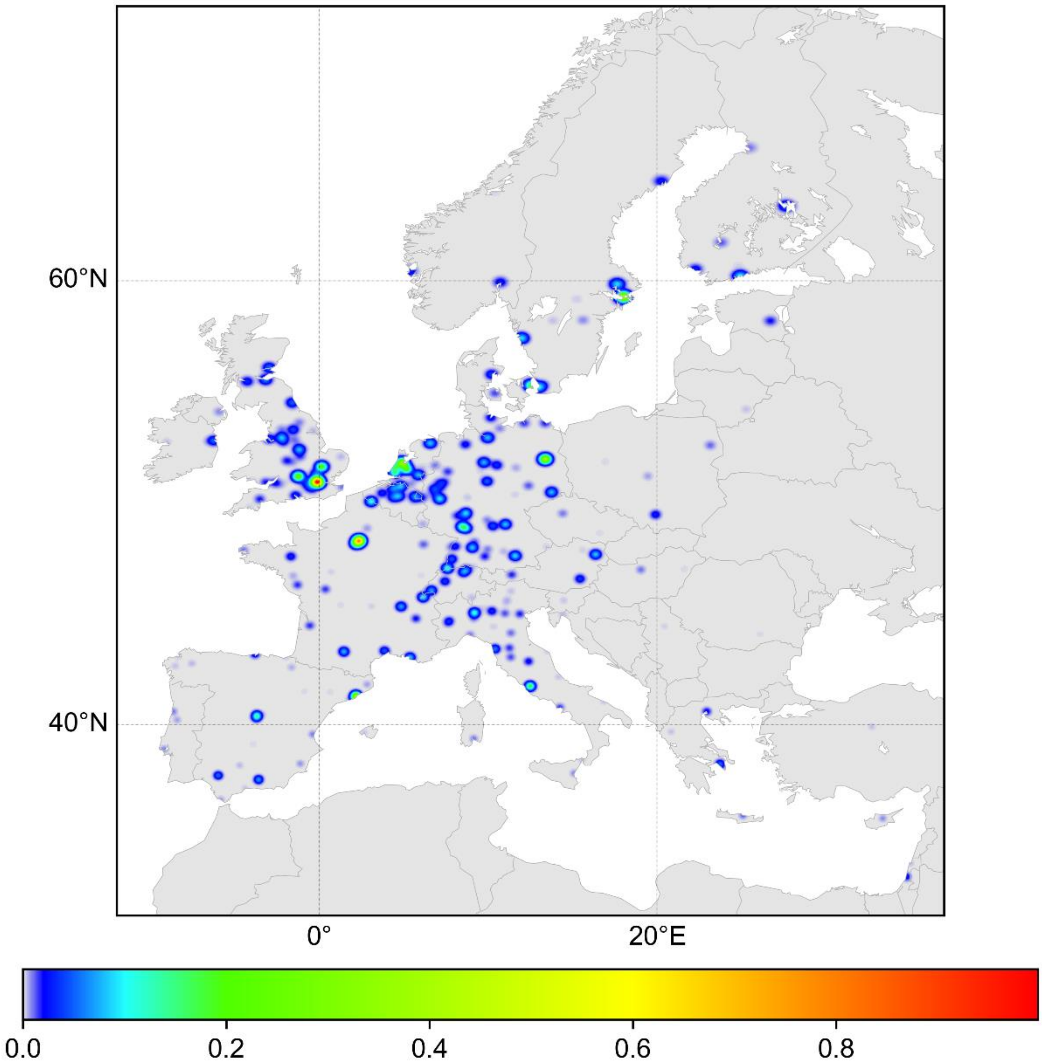


FIGURE 6.1.2 MAP SHOWING NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

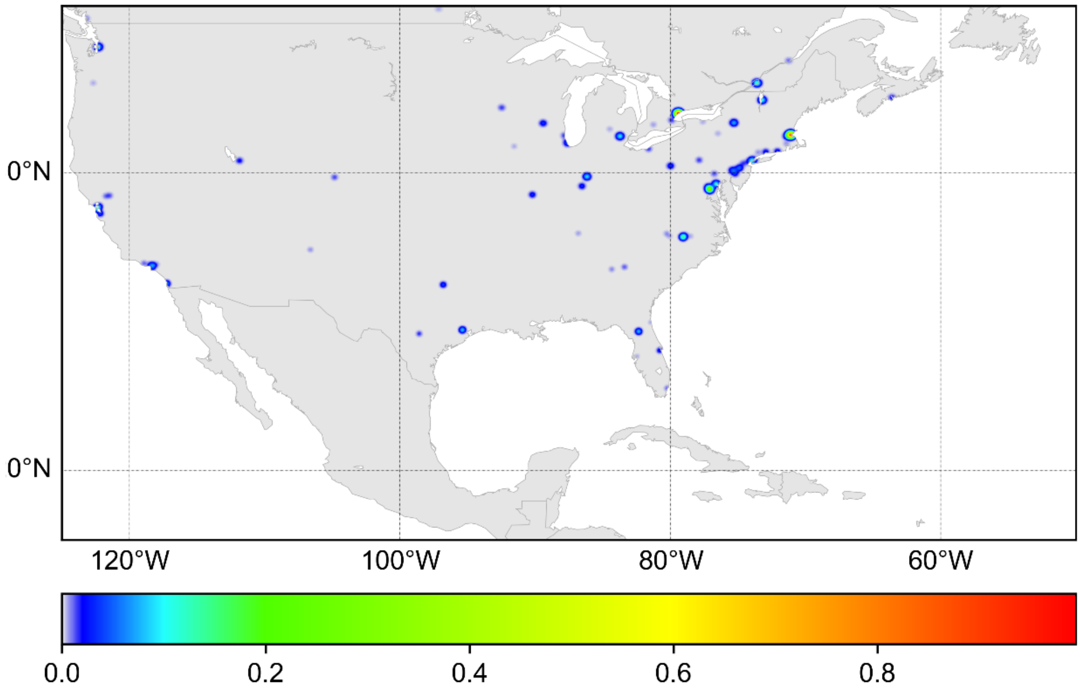


TABLE 6.1.1 OUTPUT AND RESEARCH PERFORMANCE OF EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

Cluster	Number of publications	Number of papers	% of publications open access	Raw citation impact	% of internationally collaborative publications
London (UK)	1,154	1,043	71.4%	27.79	82.6%
Amsterdam (Netherlands)	1,001	894	62.8%	29.14	78.0%
Stockholm (Sweden)	575	533	64.2%	29.63	75.2%
Paris (France)	516	485	66.7%	27.27	84.7%
Copenhagen (Denmark)	452	416	59.3%	22.39	79.1%
Oxford (UK)	439	414	83.4%	24.20	80.9%
Cambridge (UK)	401	370	78.6%	35.59	82.7%
Barcelona (Spain)	327	296	63.0%	22.92	74.3%
Berlin (Germany)	293	272	68.6%	25.35	78.7%
Mannheim (Germany)	268	258	66.8%	36.51	85.3%
Basel (Switzerland)	263	239	59.7%	22.75	92.9%
Uppsala (Sweden)	230	216	67.8%	18.57	66.7%
Molndal (Sweden)	212	197	64.2%	25.37	87.3%
Geneva (Switzerland)	209	187	73.7%	33.40	83.4%
Rome (Italy)	200	177	48.0%	29.30	75.1%
Groningen (Netherlands)	199	186	75.9%	27.33	80.1%
Milan (Italy)	199	172	57.3%	27.80	84.9%
Hamburg (Germany)	189	177	70.9%	22.02	83.1%
Nijmegen (Netherlands)	189	182	69.8%	30.66	81.9%
Madrid (Spain)	188	174	70.7%	20.84	71.8%
Vienna (Austria)	188	176	61.7%	17.88	81.3%
Manchester (UK)	188	163	68.6%	36.10	86.5%
Frankfurt (Germany)	181	168	54.1%	17.50	88.1%
Erlangen (Germany)	176	170	58.5%	35.79	74.1%
Munich (Germany)	170	152	55.9%	28.40	81.6%
Nottingham (UK)	170	154	70.6%	20.08	89.0%
Maastricht (Netherlands)	153	149	76.5%	55.13	89.9%
Leuven (Belgium)	137	119	59.9%	32.36	84.0%
Hannover (Germany)	134	107	59.7%	21.96	69.2%
Helsinki (Finland)	132	130	84.1%	28.82	87.7%
Dresden (Germany)	122	111	69.7%	19.89	95.5%
Bonn (Germany)	110	104	80.9%	26.80	76.9%
Tubingen (Germany)	102	95	68.6%	16.07	72.6%
Marseille (France)	100	88	51.0%	23.64	85.2%
Beerse (Belgium)	99	92	56.6%	20.65	87.0%
Lausanne (Switzerland)	97	88	73.2%	36.41	79.5%
Toulouse (France)	93	77	46.2%	26.04	97.4%
Zurich (Switzerland)	81	71	71.6%	34.49	83.1%
Lille (France)	62	57	53.2%	23.84	89.5%

TABLE 6.1.2 RESEARCH PERFORMANCE OF EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH COMPARED TO NATIONAL BENCHMARKS, 2010-2019

	Field-normalised citation impact		Journal-normalised citation impact		% of highly cited papers	
Cluster	Cluster	National	Cluster	National	Cluster	National
London (UK)	2.43	1.99	1.30	1.29	33.1%	23.7%
Amsterdam (Netherlands)	2.50	1.71	1.34	1.15	30.9%	19.7%
Stockholm (Sweden)	2.67	1.81	1.41	1.25	33.8%	21.5%
Paris (France)	2.37	1.44	1.24	1.08	30.1%	15.4%
Copenhagen (Denmark)	2.29	1.72	1.21	1.17	28.1%	18.9%
Oxford (UK)	2.73	1.99	1.43	1.29	36.2%	23.7%
Cambridge (UK)	3.70	1.99	1.62	1.29	36.5%	23.7%
Barcelona (Spain)	2.21	1.32	1.29	1.08	29.7%	13.9%
Berlin (Germany)	2.45	1.34	1.36	1.09	27.2%	15.0%
Mannheim (Germany)	2.76	1.34	1.29	1.09	33.3%	15.0%
Basel (Switzerland)	2.17	1.73	1.46	1.18	33.9%	19.5%
Uppsala (Sweden)	2.27	1.81	1.27	1.25	27.8%	21.5%
Molndal (Sweden)	3.37	1.81	1.75	1.25	43.1%	21.5%
Geneva (Switzerland)	2.30	1.73	1.09	1.18	32.1%	19.5%
Groningen (Netherlands)	2.55	1.71	1.29	1.15	27.4%	19.7%
Nijmegen (Netherlands)	2.76	1.71	1.43	1.15	33.0%	19.7%
Rome (Italy)	2.50	1.35	1.80	1.15	44.6%	14.7%
Hamburg (Germany)	2.71	1.34	1.13	1.09	28.2%	15.0%
Vienna (Austria)	1.83	1.46	1.11	1.11	23.3%	15.7%
Madrid (Spain)	2.35	1.32	1.31	1.08	30.5%	13.9%
Milan (Italy)	2.76	1.35	1.42	1.15	37.2%	14.7%
Erlangen (Germany)	2.73	1.34	1.39	1.09	32.4%	15.0%
Frankfurt (Germany)	2.28	1.34	1.36	1.09	34.5%	15.0%
Manchester (UK)	3.09	1.99	1.50	1.29	39.9%	23.7%
Nottingham (UK)	2.64	1.99	1.33	1.29	36.4%	23.7%
Munich (Germany)	2.55	1.34	1.38	1.09	34.2%	15.0%
Maastricht (Netherlands)	4.25	1.71	2.17	1.15	44.3%	19.7%
Helsinki (Finland)	3.30	1.63	1.40	1.11	39.2%	16.9%
Leuven (Belgium)	3.08	1.77	1.71	1.22	37.8%	19.9%
Dresden (Germany)	2.15	1.34	0.94	1.09	22.5%	15.0%
Hannover (Germany)	2.33	1.34	1.20	1.09	34.6%	15.0%
Bonn (Germany)	2.39	1.34	1.37	1.09	26.0%	15.0%
Tubingen (Germany)	2.45	1.34	1.24	1.09	36.8%	15.0%
Beerse (Belgium)	2.03	1.77	1.49	1.22	25.0%	19.9%
Marseille (France)	2.63	1.44	1.41	1.08	36.4%	15.4%
Lausanne (Switzerland)	2.40	1.73	1.02	1.18	30.7%	19.5%
Toulouse (France)	2.44	1.44	1.82	1.08	41.6%	15.4%
Zurich (Switzerland)	3.01	1.73	1.39	1.18	29.6%	19.5%
Lille (France)	2.21	1.44	1.18	1.08	36.8%	15.4%

TABLE 6.1.3 OUTPUT AND RESEARCH PERFORMANCE OF NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

Cluster	Number of publications	Number of papers	% of publications open access	Raw citation impact	% of internationally collaborative publications
Toronto (Canada)	256	250	77.0%	29.86	91.2%
Boston (USA)	243	236	84.8%	52.20	98.3%
Bethesda (USA)	140	133	75.0%	42.61	98.5%
Montreal (Canada)	104	103	76.9%	33.92	100.0%
New York (USA)	100	98	67.0%	43.53	99.0%
Chapel Hill (USA)	76	73	88.2%	32.10	89.0%
Burlington (USA)	75	73	69.3%	18.79	100.0%
Indianapolis (USA)	73	71	61.6%	35.59	98.6%
San Francisco (USA)	71	69	78.9%	70.54	100.0%
New York (USA)	64	63	82.8%	36.03	100.0%
Baltimore (USA)	59	58	84.7%	51.97	100.0%
Seattle (USA)	44	43	84.1%	57.00	97.7%
Ann Arbor (USA)	44	42	79.5%	44.10	100.0%
Houston (USA)	40	38	80.0%	30.82	100.0%
Gainesville (USA)	35	34	60.0%	23.35	97.1%
Los Angeles (USA)	16	16	75.0%	66.88	100.0%

TABLE 6.1.4 RESEARCH PERFORMANCE OF NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH COMPARED TO NATIONAL BENCHMARKS, 2010-2019

	Field-normalised citation impact		Journal-normalised citation impact		% of highly cited papers	
Cluster	Cluster	National	Cluster	National	Cluster	National
Toronto (Canada)	2.80	1.50	1.33	1.08	32.8%	16.3%
Boston (USA)	3.85	1.34	1.71	1.03	39.4%	15.7%
New York (USA)	3.63	1.34	1.53	1.03	36.0%	15.7%
Bethesda (USA)	3.27	1.34	1.55	1.03	49.6%	15.7%
Montreal (Canada)	2.76	1.50	1.17	1.08	30.1%	16.3%
Chapel Hill (USA)	3.88	1.34	1.85	1.03	41.1%	15.7%
Burlington (USA)	1.88	1.34	0.80	1.03	17.8%	15.7%
Indianapolis (USA)	3.90	1.34	1.43	1.03	39.4%	15.7%
San Francisco (USA)	5.76	1.34	1.94	1.03	53.6%	15.7%
Baltimore (USA)	4.51	1.34	1.66	1.03	55.2%	15.7%
Seattle (USA)	4.65	1.34	1.74	1.03	55.8%	15.7%
Ann Arbor (USA)	4.29	1.34	1.81	1.03	61.9%	15.7%
Houston (USA)	4.31	1.34	1.88	1.03	52.6%	15.7%
Gainesville (USA)	3.12	1.34	2.11	1.03	64.7%	15.7%
Los Angeles (USA)	5.95	1.34	2.35	1.03	68.8%	15.7%
Toronto (Canada)	2.80	1.50	1.33	1.08	32.8%	16.3%
Boston (USA)	3.85	1.34	1.71	1.03	39.4%	15.7%
New York (USA)	3.63	1.34	1.53	1.03	36.0%	15.7%

TABLE 6.1.5 INSTITUTIONS CONSTITUTING TOP-FIVE, BY NUMBER OF PUBLICATIONS, EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

Cluster	Country	Institutions	Number of publications
London	**United Kingdom**	Kings College London	453
		Imperial College London	317
		University College London	276
		GlaxoSmithKline	99
		London School of Hygiene & Tropical Medicine	56
		Guy's & St Thomas' NHS Foundation Trust	45
		Birkbeck University London	42
		Queen Mary University London	40
		South London & Maudsley NHS Trust	36
		Public Health England	33
		Royal Brompton Harefield NHS Foundation Trust	32
		Medicines and Healthcare products Regulatory Agency	25
		St Georges University London	25
		Royal Brompton Hospital	24
		University of London	24
		Francis Crick Institute	19
		Medical Research Council	17
		European Medicines Agency	17
		UCB Pharma SA	16
		University College London Hospitals NHS Foundation Trust	16
		Cancer Res UK	14
		South London & Maudsley NHS Foundation	11
		London School Economics & Political Science	11
		Royal Marsden NHS Foundation Trust	10
		EMA	10
		Public Health England	8
		University of Westminster	7
		Amgen	7
		National Institute for Health and Care Excellence	7
		Royal Brompton NIHR Biomed Research Unit	7
		National Institute for Biological Standards and Control	5
		Genet Alliance UK	5
		Heptares Therapeut	5
		South London & Maudsley Foundation NHS Trust	5
		UK Dementia Research Institute	5
		King's College Hospital NHS Foundation Trust	4
Amsterdam	**Netherlands**	Leiden University	289
		Vrije Universiteit Amsterdam	284
		Utrecht University	272
		University of Amsterdam	256
		Academic Medical Center University Amsterdam	205
		Erasmus University Rotterdam	179
		Erasmus MC	162
		VU University Medical Center	72

Cluster	Country	Institutions	Number of publications
		University Medical Center Utrecht	39
		Netherlands National Institute for Public Health & the Environment	25
		Netherlands Cancer Institute	10
		Med Evaluation Board	8
		Delft University of Technology	7
		ICIN Netherlands Heart Institute	6
		Jan van Breemen Research Institute Reade	6
Stockholm	**Sweden**	Karolinska Institutet	523
		Karolinska University Hospital	210
		Stockholm City Council	50
		Royal Institute of Technology	44
		Stockholm University	39
		Danderyds Hospital	10
		AstraZeneca	8
Paris	**France**	Institut National de la Sante et de la Recherche Medicale (Inserm)	289
		University Paris	236
		Universite Paris Saclay (ComUE)	166
		University Paris Saclay	152
		Sorbonne University	135
		Centre National de la Recherche Scientifique (CNRS)	134
		CEA	98
		CNRS INSB	68
		Hopital Universitaire Pitie-Salpetriere - APHP	66
		Hopital Universitaire Cochin - APHP	53
		Le Reseau International des Instituts Pasteur (RIIP)	46
		Institute Pasteur Paris	42
		Sanofi-Aventis	41
		Sanofi France	40
		Assistance Publique Hopitaux Paris (APHP)	33
		Institut de Recherches Internationales Servier	28
		University of Versailles Saint-Quentin-En-Yvelines	19
		Orsay Hospital	18
		Hopital Universitaire Bichat-Claude Bernard - APHP	15
		Hopital Universitaire Necker-Enfants Malades - APHP	15
		Hopital Universitaire Europeen Georges-Pompidou - APHP	15
		UNICANCER	14
		Institute Curie	13
		Hopital Universitaire Saint-Louis - APHP	12
		Gustave Roussy	11
		PSL Research University Paris ComUE	10
		Hopital Universitaire Paul-Brousse - APHP	10
		CNRS Institute Chemistry	10
		Institute Ecology Environment	9
		Hopital Universitaire Robert-Debre - APHP	8
		Communaute University Grenoble Alpes	7
		Universite Grenoble Alpes (UGA)	7

Cluster	Country	Institutions	Number of publications
		Hopital Universitaire Bicetre - APHP	7
		Hopital Universitaire Beaujon - APHP	7
		Hopital Universitaire Ambroise-Pare APHP	6
		Servier	5
		SOLEIL Synchrotron	5
		National Museum of Natural History	3
		University Paris XIII	1
Copenhagen	**Denmark**	University of Copenhagen	202
		Lund University	129
		Rigshospitalet	74
		Skane University Hospital	59
		Technical University of Denmark	49
		Lundbeck Corporation	47
		Novo Nordisk	32
		Steno Diabetes Center	29
		Novo Nordisk Foundation	25
		Statens Serum Institut	17
		Nord Bioscience	9
		Danish Cancer Society	5

TABLE 6.1.6 INSTITUTIONS CONSTITUTING TOP-FIVE, BY NUMBER OF PUBLICATIONS, NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2019

Cluster	Country	Institutions	Number of publications
Toronto	**Canada**	University of Toronto	255
		Structural Genomics Consortium	104
		Baycrest	60
		Hospital for Sick Children (SickKids)	51
		Princess Margaret Cancer Centre	48
		University Toronto Affiliates	31
		University Health Network Toronto	22
		Centre for Addiction & Mental Health - Canada	15
		Ontario Institute for Cancer Research	15
		Lunenfeld-Tanenbaum Research Institute	10
		Holland Bloorview Kids Rehabilitation Hospital	7
		Mount Sinai Hospital Toronto	1
Boston	**USA**	Harvard University	183
		Harvard Medical School Affiliates	59
		Brigham & Womens Hospital	49
		Harvard Medical School	46
		Harvard T.H. Chan School of Public Health	43
		Broad Institute	41
		Pfizer	33
		Boston Child Hospital	20
		Boston University	19
		Dana-Farber Cancer Institute	16
		Beth Israel Deaconess Medical Center	13
		Massachusetts General Hospital	12
		Framingham Heart Study	10
		Biogen	10
		NIH National Heart Lung & Blood Institute (NHLBI)	7
		Massachusetts Institute of Technology (MIT)	6
		CARB X	5
		Tufts University	5
		National Institutes of Health (NIH) USA	2
Bethesda	**USA**	National Institutes of Health (NIH) USA	87
		United States Department of Health and Human Services	19
		NIH National Heart Lung & Blood Institute (NHLBI)	18
		AstraZeneca	17
		NIH National Institute of Mental Health (NIMH)	13
		NIH National Institute on Aging (NIA)	10
		US Food & Drug Administration (FDA)	9
		Medimmune	8
		National Institute of Allergy and Infectious Diseases (NIAID)	7
		NIH National Cancer Institute	6
		NIH National Human Genome Research Institute (NHGRI)	5
		Naval Research Laboratory	5
		National Institute of Neurological Disorders and Stroke	3

Cluster	Country	Institutions	Number of publications
Montreal	**Canada**	University of Montreal	74
		McGill University	60
New York	**USA**	Pfizer	32
		Columbia University	26
		New York University	26
		Memorial Sloan Kettering Cancer Center	11
		Albert Einstein College of Medicine	11

TABLE 6.1.7 FIVE JOURNAL SUBJECT CATEGORIES IN WHICH TOP-FIVE, BY NUMBER OF PUBLICATIONS, EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH PUBLISHED MOST FREQUENTLY, 2010-2019

Cluster	Country	Journal subject category	Number of publications
London	**United Kingdom**	Neurosciences	245
		Psychiatry	149
		Pharmacology & Pharmacy	122
		Clinical Neurology	120
		Immunology	84
Amsterdam	**Netherlands**	Rheumatology	146
		Pharmacology & Pharmacy	142
		Neurosciences	116
		Immunology	83
		Clinical Neurology	73
Stockholm	**Sweden**	Rheumatology	113
		Immunology	74
		Neurosciences	58
		Clinical Neurology	51
		Biochemistry & Molecular Biology	42
Paris	**France**	Neurosciences	107
		Psychiatry	56
		Pharmacology & Pharmacy	49
		Endocrinology & Metabolism	41
		Biochemistry & Molecular Biology	38
Copenhagen	**Denmark**	Endocrinology & Metabolism	77
		Pharmacology & Pharmacy	65
		Clinical Neurology	48
		Neurosciences	45
		Anesthesiology	32

TABLE 6.1.8 FIVE JOURNAL SUBJECT CATEGORIES IN WHICH TOP-FIVE, BY NUMBER OF PUBLICATIONS, NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH PUBLISHED MOST FREQUENTLY, 2010-2019

Cluster	Country	Journal subject category	Number of publications
Toronto	**Canada**	Biochemistry & Molecular Biology	67
		Neurosciences	56
		Psychiatry	49
		Cell Biology	27
		Chemistry, Medicinal	27
Boston	**USA**	Neurosciences	37
		Genetics & Heredity	30
		Endocrinology & Metabolism	27
		Clinical Neurology	23
		Pharmacology & Pharmacy	22
Bethesda	**USA**	Pharmacology & Pharmacy	29
		Neurosciences	20
		Public, Environmental & Occupational Health	20
		Psychiatry	17
		Immunology	15
Montreal	**Canada**	Neurosciences	40
		Psychiatry	38
		Psychology, Developmental	11
		Genetics & Heredity	11
		Biochemistry & Molecular Biology	11
New York	**USA**	Pharmacology & Pharmacy	33
		Neurosciences	21
		Psychiatry	18
		Public, Environmental & Occupational Health	16
		Clinical Neurology	11

7 COLLABORATION ANALYSIS FOR IMI RESEARCH

7.1 COLLABORATION ANALYSIS FOR IMI RESEARCH

International research collaboration is increasing[11] and although the reasons for this have not been fully clarified they are likely to include increasing access to facilities, resources, knowledge, people and expertise. In addition, international collaboration has been shown to be associated with an increase in the number of citations received by research papers, although this does depend upon the partner countries involved.[12] Co-authorship is likely to be a good indicator of collaboration, although there will be research collaborations that do not result in co-authored papers, and co-authored papers which may have required limited collaboration. Alternative data-based approaches, for example using information about co-funding or international exchanges, have limitations in terms of both comprehensiveness and validity.

In this report, co-authorship of papers[13] is used as an indicator of collaboration between different sectors, institutions and countries.

In this analysis, different institutions/organisation are assigned to sectors with the following definitions:

- **Medical:** Organisations with the primary function of providing patient care. Typical these are public, private and university hospitals, though we have included in this sector Chinese medicine hospitals and umbrella organisations such as hospital systems (e.g. Mt Sinai) or UK National Health Services Healthcare Trusts.
- **Corporate:** Private or public companies or enterprises that operate for-profit. For IMI projects most corporate organisations are pharmaceuticals, others manufacture medical devices or provide information technology services. Included in this sector are any organisation with a suffix indicating limited liability (e.g. AB, LTD, GmBH, SA, LLC, INC and AG). Other organisations were identified as corporate from their website. It can be challenging to assign smaller organisations, potential small and medium sized enterprises (SMEs) to this category as they may have a limited online presence and if a SME has spun out from a university it can be difficult to ascertain the current relationship between the spin out and academic institution.
- **Academic:** Public and private universities and university departments. This includes research institutes, that may not have a teaching remit but have a clear affiliation to one or more universities and programs of research spanning multiple academic institutions.
- **Government:** Includes state, regional or federally funded research institutions, laboratories and facilities such as NIH or the World Health Organization (WHO); country or regional funders that disperse public money to research (e.g. BBSRC in the UK); government departments and agencies.
- **Other:** Organisation that do not fit in any other sector but have a role in the healthcare or research infrastructure. For example, research institutions not attached to a government, university or hospital; non-governmental organisations like patient groups, advocacy groups, not-for profits and charities; professional associations for healthcare professionals; non-governmental funders; regulators and tissue sample banks.
- **Unknown:** If an organisation cannot be identified as belonging to any of the other sectors then it is assigned as unknown.

A paper is defined as cross-sector if the co-authors are affiliated to organisations that are assigned to different sectors. For example, if a paper has author addresses corresponding to the University of Copenhagen (academic) and the company Novartis (corporate), it would be classified as cross-sector. If a paper only has author addresses corresponding to the University of Cambridge (academic) and Utrecht University (academic), it would be classified as single-sector since both addresses are academic institutions, but it would be defined as cross-institution as more than one institution is listed

[11] Adams J (2013) Collaborations: the fourth age of research. *Nature*, **497**, 557-560.

[12] Adams, J., Gurney, K., & Marshall, S. (2007). Patterns of international collaboration for the UK and leading partners. A report by *Evidence* Ltd to the UK Office of Science and Innovation. 27pp.

[13] In the collaboration analysis papers rather than publications are analysed as some publications, such as editorials do not communicate novel research finding so cannot be considered a product of research collaboration.

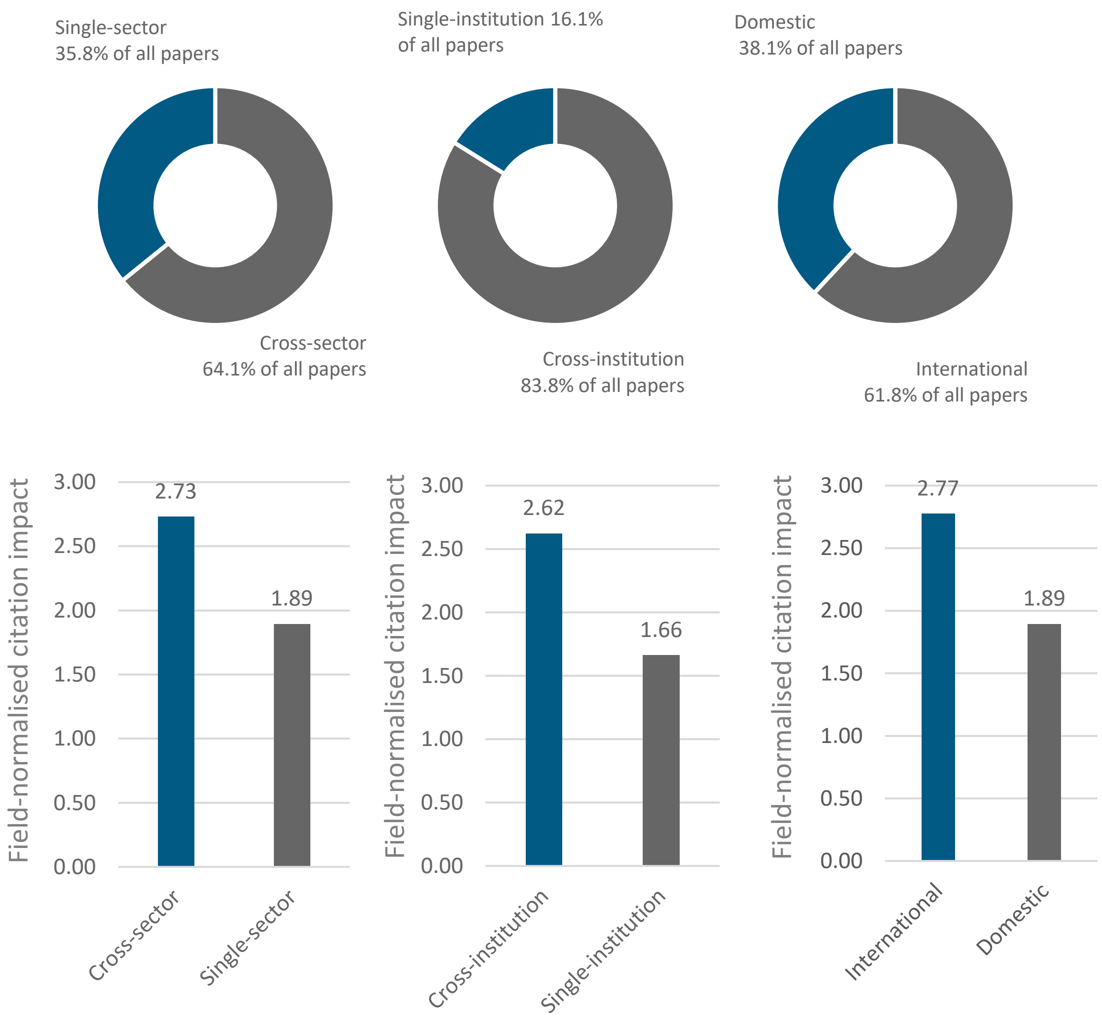
in the addresses. A paper is defined as international if more than one country is listed in the addresses, or domestic if only a single country is listed.

The data in Table 7.1.1 compares the output and field-normalised citation impact of collaborative IMI project research with its non-collaborative research. Figure 7.1.1 presents the same data visually.

TABLE 7.1.1 CROSS-SECTOR, CROSS-INSTITUTION AND INTERNATIONAL OUTPUT AND FIELD-NORMALISED CITATION IMPACT OF IMI PROJECT RESEARCH, 2010-2019

	Number of papers	% of papers	Citation impact (normalised at field level)
Cross-sector	3,491	64.1%	2.73
Single-sector	1,948	35.8%	1.89
Cross-institution	4,562	83.8%	2.62
Single-institution	877	16.1%	1.66
International	3,367	61.8%	2.77
Domestic	2,072	38.1%	1.89

FIGURE 7.1.1 FIELD-NORMALISED CITATION IMPACT OF AND PERCENTAGE OF CROSS-SECTOR, CROSS-INSTITUTION AND INTERNATIONALLY COLLABORATIVE PAPERS FROM IMI PROJECT RESEARCH, 2010-2019



- Nearly two-thirds of (64.1%) of all IMI project papers were published by co-authors working in different sectors.
- More than three-quarters (83.8%) of IMI project papers involved collaboration between different institutions.
- More than half (61.8%) of all IMI project papers involved international collaboration.
- Collaborative IMI project research was internationally influential with field-normalised citation impacts over 2.5-times the world average (1.00), regardless of the type of collaborations.
- IMI's collaborative research has a higher average field-normalised citation impact than IMI's non-collaborative research and the non-collaborative research field-normalised citation impact was below average for IMI project research (2.05).

7.2 COLLABORATION ANALYSIS BY IMI PROJECT

This section analyses the collaboration of IMI research at the individual project level.

Table 7.2.1 shows the number, percentage and field-normalised citation impact of IMI research papers with co-authors from more than one country. Table 7.2.2 shows number, percentage, and field-normalised citation impact of IMI research papers with co-authors from more than one institution. Table 7.2.3 shows number, percentage and field-normalised citation impact of IMI research papers with co-authors from more than one sector.

Figure 7.2.1 to Figure 7.2.5 are maps showing international collaboration for the five IMI projects with the highest number of papers: BTCURE, EU-AIMS, EMIF, NEWMEDS and ULTRA-DD. The countries with the most frequent collaboration are shaded purple, those with little collaboration in green, and those with no collaboration in grey.

It should be noted that the last column in Table 7.2.1 to Table 7.2.3 shows the field-normalised citation impact of those papers involving collaboration of the type being analysed, rather than for all papers belonging to a project. Therefore, in Table 7.2.1, the last column contains the field-normalised citation impact of only the internationally collaborative papers for each project. Similarly, the last column in Table 7.2.2 contains only the field-normalised citation impact of the papers with co-authors from more than one institution, and in Table 7.2.3, the last column contains only the field-normalised citation impact of cross-sector papers.

The key findings of Section 7.2 are:

- BTCURE had the highest number of papers with co-authors from more than one country, institution and sector (Table 7.1.1-Table 7.2.3). This may be due to BTCURE having the highest overall number of papers.
- EU-AIMS had the second highest number of papers with authors from more than one country, institution and sector (Table 7.1.1-Table 7.2.3).
- The majority of collaborative papers from the top five projects were co-authored with researchers from the United States (USA) and Europe (Figure 7.2.1Figure 7.2.1 to Figure 7.2.5). The most frequently collaborating European countries were the UK, Sweden, Netherlands, and Germany.
- EU-AIMS, NEWMEDS and ULTRA-DD had substantial input from Canadian researchers and ULTRA-DD had input from Chinese researchers (Figure 7.2.2-Figure 7.2.5).

TABLE 7.2.1 NUMBER, PERCENTAGE AND CITATION IMPACT[14] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE COUNTRY, 2010-2019

Project	Number of papers	Number of internationally collaborative papers	% of internationally collaborative papers	Citation impact (normalised at field level)
BTCure	634	371	58.5%	2.41
EU-AIMS	420	300	71.4%	2.68
ULTRA-DD	276	209	75.7%	2.37
EMIF	248	181	73.0%	3.41
NEWMEDS	194	122	62.9%	2.58
EUROPAIN	171	69	40.4%	3.16
ORBITO	148	79	53.4%	2.05
TRANSLOCATION	138	81	58.7%	1.90
IMIDIA	135	77	57.0%	2.05
CANCER-ID	128	64	50.0%	5.66
STEMBANCC	120	66	55.0%	2.54
SUMMIT	120	81	67.5%	2.16
CHEM21	119	42	35.3%	2.28
ELF	110	61	55.5%	1.25
MIP-DILI	103	54	52.4%	2.34
PreDiCT-TB	100	57	57.0%	1.70
Quic-Concept	99	66	66.7%	4.52
PROTECT	98	70	71.4%	1.27
INNODIA	92	68	73.9%	2.86
eTOX	91	37	40.7%	1.68
COMPACT	80	41	51.2%	2.61
U-BIOPRED	78	56	71.8%	3.94
SPRINTT	77	50	64.9%	2.16
Pharma-Cog	76	60	78.9%	1.51
DDMoRe	72	46	63.9%	1.18
Open PHACTS	70	43	61.4%	3.43
ABIRISK	68	35	51.5%	1.62
COMBACTE-NET	68	37	54.4%	1.29
BioVacSafe	63	33	52.4%	1.56
COMBACTE-MAGNET	62	40	64.5%	1.77
K4DD	61	37	60.7%	2.86
DIRECT	61	44	72.1%	3.24
Onco Track	59	29	49.2%	3.25
AETIONOMY	57	26	45.6%	2.34
MARCAR	54	26	48.1%	1.44
BEAT-DKD	53	43	81.1%	1.59
RTCure	50	27	54.0%	4.47
DRIVE-AB	47	32	68.1%	1.99
Predect	43	31	72.1%	2.01

[14] The last column is the citation impact of only the internationally collaborative papers.

Project	Number of papers	Number of internationally collaborative papers	% of internationally collaborative papers	Citation impact (normalised at field level)
RAPP-ID	43	22	51.2%	0.89
COMBACTE-CARE	42	28	66.7%	2.60
ENABLE	41	17	41.5%	1.60
ZAPI	40	30	75.0%	2.54
eTRIKS	36	34	94.4%	2.86
iPiE	34	11	32.4%	1.41
GETREAL	34	28	82.4%	1.91
PRECISESADS	32	26	81.3%	1.85
APPROACH	32	27	84.4%	2.58
AIMS-2-TRIALS	31	23	74.2%	2.71
PRISM	31	20	64.5%	2.96
IMPRiND	30	18	60.0%	9.85
FLUCOP	28	17	60.7%	1.40
PROACTIVE	27	23	85.2%	2.69
RHAPSODY	26	18	69.2%	3.95
EBOVAC1	25	16	64.0%	2.49
BigData@Heart	25	19	76.0%	2.96
EPAD	24	14	58.3%	1.59
EBiSC	23	17	73.9%	1.83
RADAR-CNS	21	19	90.5%	1.54
EbolaMoDRAD	20	13	65.0%	2.02
SAFE-T	19	11	57.9%	4.07
PHAGO	18	14	77.8%	5.56
EHR4CR	17	12	70.6%	1.30
TransQST	15	11	73.3%	3.72
COMBACTE	14	2	14.3%	8.00
iABC	14	9	64.3%	2.22
ADVANCE	14	10	71.4%	0.84
WEB-RADR	13	11	84.6%	2.71
ROADMAP	12	9	75.0%	0.65
ADAPTED	12	9	75.0%	3.28
EBOVAC2	11	6	54.5%	2.02
AMYPAD	11	8	72.7%	2.91
eTRANSAFE	10	5	50.0%	1.29
VSV-EBOVAC	9	6	66.7%	1.22
PREFER	8	7	87.5%	2.88
HARMONY	8	5	62.5%	1.62
VSV-EBOPLUS	8	6	75.0%	0.76
LITMUS	7	6	85.7%	1.71
TRISTAN	7	6	85.7%	1.52
EUPATI	6	6	100.0%	0.97
IMI-PainCare	5	2	40.0%	0.00

Project	Number of papers	Number of internationally collaborative papers	% of internationally collaborative papers	Citation impact (normalised at field level)
RESCEU	5	3	60.0%	0.79
DRIVE	4	2	50.0%	3.81
SafeSciMET	4	4	100.0%	0.95
EBODAC	4	3	75.0%	2.05
ADAPT-SMART	4	2	50.0%	1.82
VAC2VAC	3	1	33.3%	0.00
Eu2P	3	2	66.7%	0.00
PD-MitoQUANT	3	3	100.0%	0.68
PERISCOPE	3	0	0.0%	0.00
DO->IT	3	3	100.0%	1.87
EBOMAN	2	2	100.0%	3.49
IMMUCAN	2	1	50.0%	0.40
ITCC-P4	2	1	50.0%	0.00
MACUSTAR	2	1	50.0%	6.25
MOPEAD	2	1	50.0%	0.00
ND4BB	2	2	100.0%	2.11
COMBACTE-CDI	2	2	100.0%	0.63
COMBACTE-NEt	1	0	0.0%	0.00
BIOMAP	1	1	100.0%	0.00
FAIRplus	1	0	0.0%	0.00
EHDEN	1	0	0.0%	0.00
EMTRAIN	1	1	100.0%	0.14
RADAR-AD	1	1	100.0%	0.00
Pharmatrain	1	1	100.0%	0.12
PEVIA	1	1	100.0%	0.00
PARADIGM	1	1	100.0%	0.00
EBOVAC	1	1	100.0%	4.66
EBOVAC3	1	1	100.0%	0.00
EQIPD	0	0	0.0%	0.00
ConcePTION	0	0	0.0%	0.00
PIONEER	0	0	0.0%	0.00
Hypo-RESOLVE	0	0	0.0%	0.00
FILODIAG	0	0	0.0%	0.00
c4c	0	0	0.0%	0.00

TABLE 7.2.2 NUMBER, PERCENTAGE AND CITATION IMPACT[15] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE INSTITUTION, 2010-2019

Project	Number of papers	Number of papers from more than one institution	% of papers from more than one institution	Citation impact (normalised at field level)
BTCure	634	516	81.4%	2.26
EU-AIMS	420	390	92.9%	2.49
ULTRA-DD	276	247	89.5%	2.37
EMIF	248	230	92.7%	3.05
NEWMEDS	194	160	82.5%	2.45
EUROPAIN	171	115	67.3%	2.85
ORBITO	148	113	76.4%	2.08
TRANSLOCATION	138	100	72.5%	1.81
IMIDIA	135	112	83.0%	1.84
CANCER-ID	128	112	87.5%	4.75
STEMBANCC	120	94	78.3%	2.54
SUMMIT	120	105	87.5%	1.94
CHEM21	119	64	53.8%	2.02
ELF	110	79	71.8%	1.16
MIP-DILI	103	76	73.8%	2.12
PreDiCT-TB	100	81	81.0%	1.43
Quic-Concept	99	94	94.9%	3.75
PROTECT	98	96	98.0%	1.15
INNODIA	92	89	96.7%	2.61
eTOX	91	51	56.0%	1.59
COMPACT	80	61	76.2%	2.19
U-BIOPRED	78	69	88.5%	3.41
SPRINTT	77	61	79.2%	2.12
Pharma-Cog	76	70	92.1%	1.39
DDMoRe	72	59	81.9%	1.12
Open PHACTS	70	57	81.4%	3.48
ABIRISK	68	60	88.2%	1.68
COMBACTE-NET	68	59	86.8%	1.32
BioVacSafe	63	37	58.7%	1.52
COMBACTE-MAGNET	62	52	83.9%	1.82
K4DD	61	50	82.0%	2.55
DIRECT	61	58	95.1%	3.16
Onco Track	59	48	81.4%	2.55
AETIONOMY	57	57	100.0%	1.80
MARCAR	54	38	70.4%	1.38
BEAT-DKD	53	50	94.3%	1.71
RTCure	50	46	92.0%	3.87
DRIVE-AB	47	42	89.4%	1.97
Predect	43	34	79.1%	1.97

[15] The last column in is only the citation impact of the papers from more than one institution.

Project	Number of papers	Number of papers from more than one institution	% of papers from more than one institution	Citation impact (normalised at field level)
RAPP-ID	43	34	79.1%	0.91
COMBACTE-CARE	42	41	97.6%	2.69
ENABLE	41	36	87.8%	1.62
ZAPI	40	34	85.0%	2.39
eTRIKS	36	36	100.0%	2.78
iPiE	34	29	85.3%	1.67
GETREAL	34	33	97.1%	2.08
PRECISESADS	32	30	93.8%	1.68
APPROACH	32	31	96.9%	2.47
AIMS-2-TRIALS	31	30	96.8%	2.48
PRISM	31	27	87.1%	3.02
IMPRiND	30	24	80.0%	8.00
FLUCOP	28	26	92.9%	1.43
PROACTIVE	27	27	100.0%	2.36
RHAPSODY	26	23	88.5%	3.62
EBOVAC1	25	19	76.0%	2.54
BigData@Heart	25	24	96.0%	2.96
EPAD	24	18	75.0%	1.65
EBiSC	23	20	87.0%	9.68
RADAR-CNS	21	20	95.2%	1.54
EbolaMoDRAD	20	19	95.0%	1.82
SAFE-T	19	18	94.7%	2.98
PHAGO	18	15	83.3%	5.83
EHR4CR	17	16	94.1%	1.16
TransQST	15	13	86.7%	3.29
COMBACTE	14	12	85.7%	2.43
iABC	14	12	85.7%	2.27
ADVANCE	14	12	85.7%	1.25
WEB-RADR	13	12	92.3%	2.57
ROADMAP	12	11	91.7%	0.78
ADAPTED	12	12	100.0%	2.70
EBOVAC2	11	11	100.0%	1.38
AMYPAD	11	10	90.9%	2.70
eTRANSAFE	10	7	70.0%	1.12
VSV-EBOVAC	9	7	77.8%	1.06
PREFER	8	8	100.0%	2.84
HARMONY	8	5	62.5%	1.62
VSV-EBOPLUS	8	7	87.5%	0.65
LITMUS	7	6	85.7%	1.71
TRISTAN	7	7	100.0%	1.91
EUPATI	6	6	100.0%	0.97
IMI-PainCare	5	4	80.0%	0.48
RESCEU	5	5	100.0%	0.89

Project	Number of papers	Number of papers from more than one institution	% of papers from more than one institution	Citation impact (normalised at field level)
DRIVE	4	4	100.0%	2.54
SafeSciMET	4	4	100.0%	0.95
EBODAC	4	4	100.0%	1.37
ADAPT-SMART	4	3	75.0%	1.21
VAC2VAC	3	2	66.7%	1.81
Eu2P	3	3	100.0%	2.61
PD-MitoQUANT	3	3	100.0%	0.68
PERISCOPE	3	1	33.3%	0.23
DO->IT	3	3	100.0%	1.87
EBOMAN	2	2	100.0%	3.49
IMMUCAN	2	2	100.0%	0.20
ITCC-P4	2	2	100.0%	0.00
MACUSTAR	2	1	50.0%	6.25
MOPEAD	2	2	100.0%	0.70
ND4BB	2	2	100.0%	2.11
COMBACTE-CDI	2	2	100.0%	0.63
COMBACTE-NEt	1	1	100.0%	2.06
BIOMAP	1	1	100.0%	0.00
FAIRplus	1	0	0.0%	0.00
EHDEN	1	0	0.0%	0.00
EMTRAIN	1	1	100.0%	0.14
RADAR-AD	1	1	100.0%	0.00
Pharmatrain	1	1	100.0%	0.12
PEVIA	1	1	100.0%	0.00
PARADIGM	1	1	100.0%	0.00
EBOVAC	1	1	100.0%	4.66
EBOVAC3	1	1	100.0%	0.00
EQIPD	0	0	0.0%	0.00
ConcePTION	0	0	0.0%	0.00
PIONEER	0	0	0.0%	0.00
Hypo-RESOLVE	0	0	0.0%	0.00
FILODIAG	0	0	0.0%	0.00
c4c	0	0	0.0%	0.00

TABLE 7.2.3 NUMBER, PERCENTAGE AND CITATION IMPACT[16] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE SECTOR, 2010-2019

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
BTCure	634	407	64.2%	2.41
EU-AIMS	420	302	71.9%	2.61
ULTRA-DD	276	177	64.1%	2.67
EMIF	248	199	80.2%	2.86
NEWMEDS	194	124	63.9%	2.62
EUROPAIN	171	91	53.2%	2.93
ORBITO	148	88	59.5%	2.30
TRANSLOCATION	138	51	37.0%	2.04
IMIDIA	135	71	52.6%	2.06
CANCER-ID	128	96	75.0%	5.02
STEMBANCC	120	60	50.0%	2.49
SUMMIT	120	90	75.0%	1.95
CHEM21	119	28	23.5%	2.33
ELF	110	43	39.1%	0.96
MIP-DILI	103	69	67.0%	2.09
PreDiCT-TB	100	58	58.0%	1.49
Quic-Concept	99	74	74.7%	2.50
PROTECT	98	95	96.9%	1.15
INNODIA	92	76	82.6%	2.85
eTOX	91	27	29.7%	1.84
COMPACT	80	20	25.0%	3.54
U-BIOPRED	78	63	80.8%	3.63
SPRINTT	77	49	63.6%	2.20
Pharma-Cog	76	63	82.9%	1.46
DDMoRe	72	45	62.5%	1.17
Open PHACTS	70	42	60.0%	4.19
ABIRISK	68	54	79.4%	1.75
COMBACTE-NET	68	49	72.1%	1.40
BioVacSafe	63	26	41.3%	1.64
COMBACTE-MAGNET	62	38	61.3%	1.71
K4DD	61	33	54.1%	2.50
DIRECT	61	45	73.8%	3.54
Onco Track	59	36	61.0%	2.68
AETIONOMY	57	35	61.4%	2.21
MARCAR	54	24	44.4%	1.41
BEAT-DKD	53	38	71.7%	1.84
RTCure	50	34	68.0%	4.52
DRIVE-AB	47	36	76.6%	2.02
Predect	43	30	69.8%	1.96

[16] The last column is only field-normalised citation impact for cross sector papers only.

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
RAPP-ID	43	14	32.6%	0.98
COMBACTE-CARE	42	38	90.5%	2.76
ENABLE	41	23	56.1%	1.96
ZAPI	40	26	65.0%	2.63
eTRIKS	36	31	86.1%	3.00
iPiE	34	20	58.8%	1.54
GETREAL	34	30	88.2%	2.23
PRECISESADS	32	24	75.0%	1.91
APPROACH	32	25	78.1%	2.08
AIMS-2-TRIALS	31	24	77.4%	2.77
PRISM	31	22	71.0%	3.33
IMPRiND	30	15	50.0%	2.94
FLUCOP	28	24	85.7%	1.43
PROACTIVE	27	27	100.0%	2.36
RHAPSODY	26	16	61.5%	2.07
EBOVAC1	25	17	68.0%	2.52
BigData@Heart	25	22	88.0%	2.99
EPAD	24	16	66.7%	1.65
EBiSC	23	15	65.2%	12.71
RADAR-CNS	21	12	57.1%	2.26
EbolaMoDRAD	20	14	70.0%	2.36
SAFE-T	19	18	94.7%	2.98
PHAGO	18	12	66.7%	6.83
EHR4CR	17	16	94.1%	1.16
TransQST	15	9	60.0%	3.96
COMBACTE	14	7	50.0%	3.07
iABC	14	11	78.6%	2.29
ADVANCE	14	10	71.4%	1.29
WEB-RADR	13	11	84.6%	2.45
ROADMAP	12	11	91.7%	0.78
ADAPTED	12	11	91.7%	2.90
EBOVAC2	11	5	45.5%	1.77
AMYPAD	11	9	81.8%	2.84
eTRANSAFE	10	4	40.0%	1.38
VSV-EBOVAC	9	4	44.4%	1.01
PREFER	8	8	100.0%	2.84
HARMONY	8	5	62.5%	1.62
VSV-EBOPLUS	8	4	50.0%	0.42
LITMUS	7	6	85.7%	1.71
TRISTAN	7	5	71.4%	1.50
EUPATI	6	6	100.0%	0.97
IMI-PainCare	5	3	60.0%	0.00

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
RESCEU	5	5	100.0%	0.89
DRIVE	4	4	100.0%	2.54
SafeSciMET	4	4	100.0%	0.95
EBODAC	4	3	75.0%	1.74
ADAPT-SMART	4	3	75.0%	1.21
VAC2VAC	3	2	66.7%	1.81
Eu2P	3	1	33.3%	0.00
PD-MitoQUANT	3	3	100.0%	0.68
PERISCOPE	3	0	0.0%	0.00
DO->IT	3	3	100.0%	1.87
EBOMAN	2	2	100.0%	3.49
IMMUCAN	2	1	50.0%	0.40
ITCC-P4	2	2	100.0%	0.00
MACUSTAR	2	1	50.0%	6.25
MOPEAD	2	2	100.0%	0.70
ND4BB	2	1	50.0%	2.44
COMBACTE-CDI	2	2	100.0%	0.63
COMBACTE-NEt	1	1	100.0%	2.06
BIOMAP	1	1	100.0%	0.00
FAIRplus	1	0	0.0%	0.00
EHDEN	1	0	0.0%	0.00
EMTRAIN	1	1	100.0%	0.14
RADAR-AD	1	1	100.0%	0.00
Pharmatrain	1	1	100.0%	0.12
PEVIA	1	1	100.0%	0.00
PARADIGM	1	1	100.0%	0.00
EBOVAC	1	1	100.0%	4.66
EBOVAC3	1	0	0.0%	0.00
EQIPD	0	0	0.0%	0.00
ConcePTION	0	0	0.0%	0.00
PIONEER	0	0	0.0%	0.00
Hypo-RESOLVE	0	0	0.0%	0.00
FILODIAG	0	0	0.0%	0.00
c4c	0	0	0.0%	0.00

FIGURE 7.2.1 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: BTCURE, 2010-2019

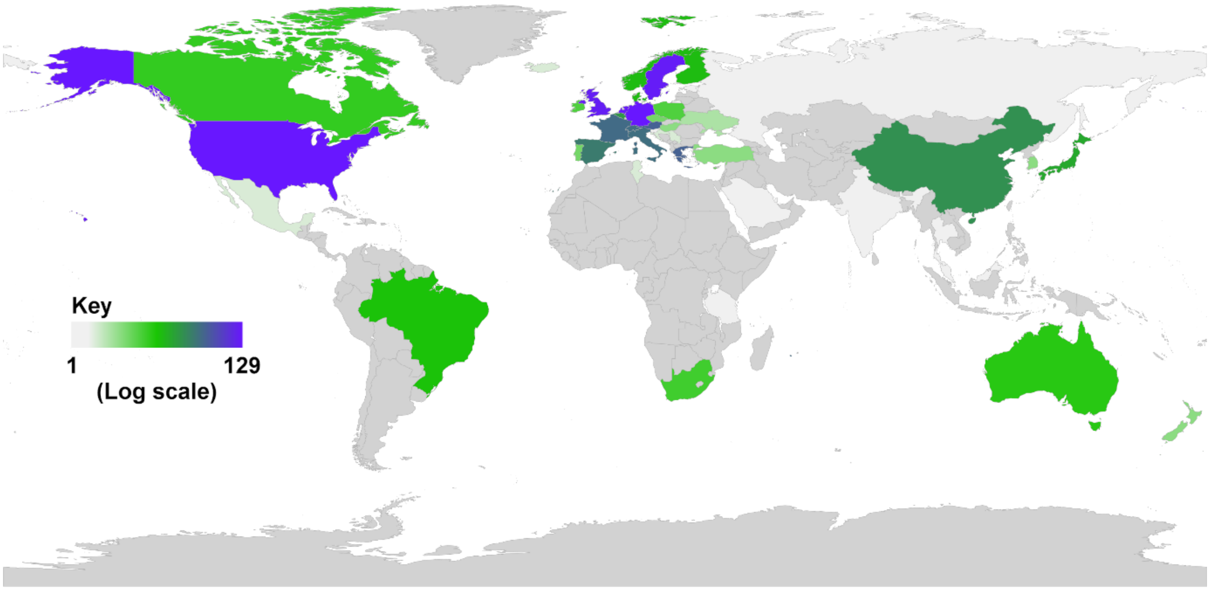


FIGURE 7.2.2 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: EMIF, 2010-2019

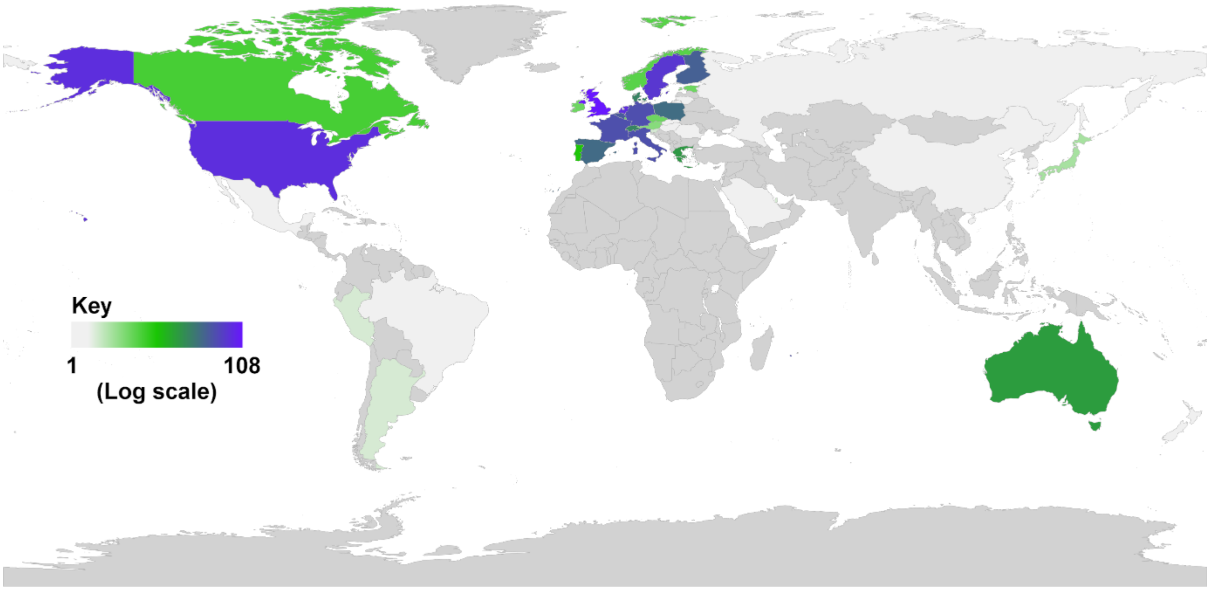


FIGURE 7.2.3 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: EU-AIMS, 2010-2019

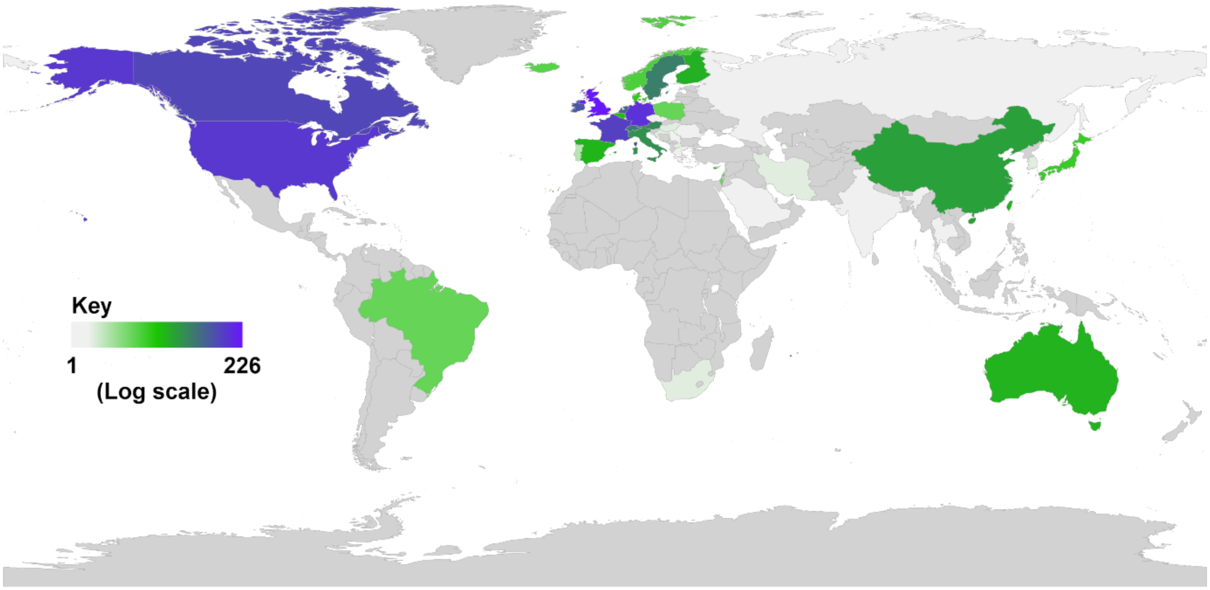


FIGURE 7.2.4 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: NEWMEDS, 2010-2019

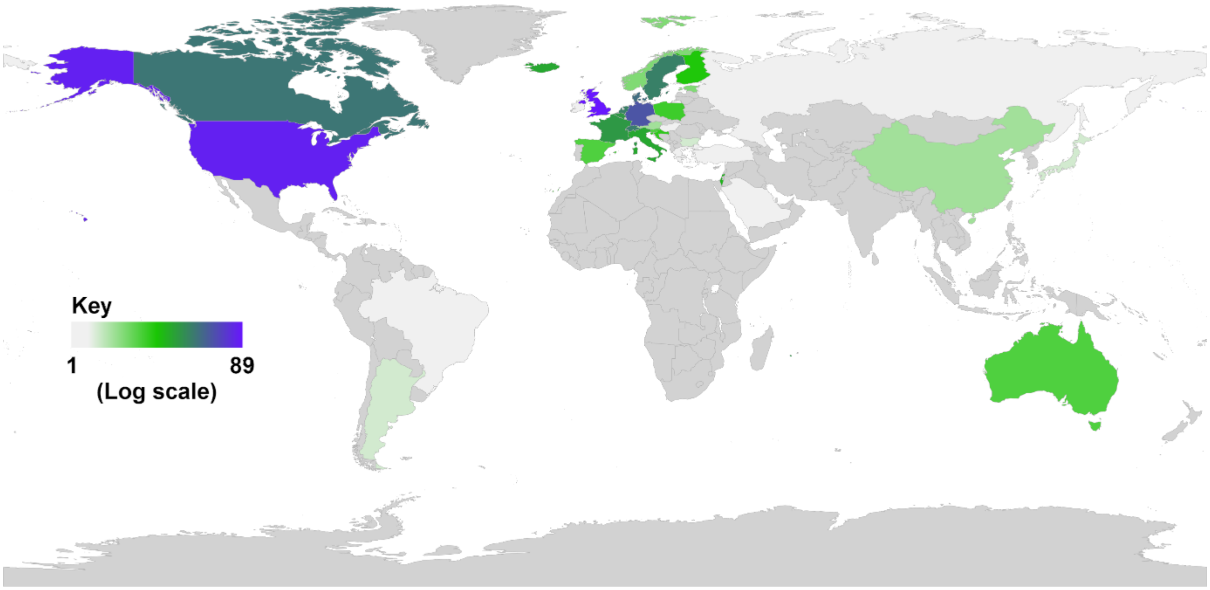
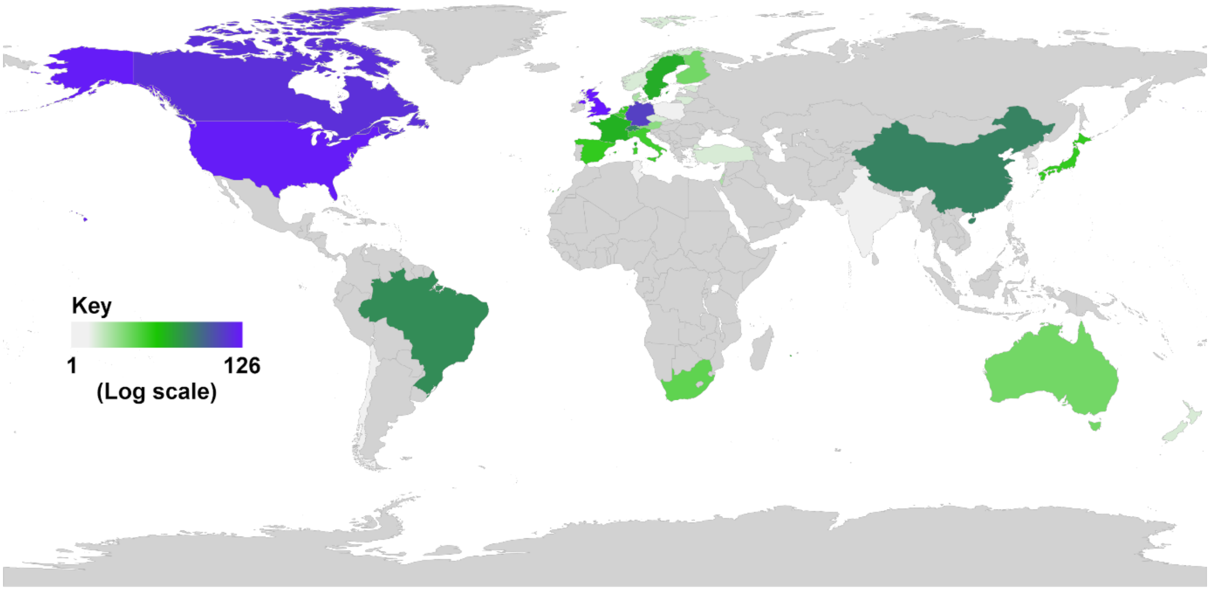


FIGURE 7.2.5 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: ULTRA-DD, 2010-2019



7.3 COLLABORATION METRICS FOR IMI RESEARCH

This section of the report analyses the types of collaboration that occurred within each IMI project and examines the stability of institutional collaborations within each project.

In common with other metrics based on papers and citations, the indicators we present here work best with larger sample sizes. Indicators based on small numbers of papers will be less informative than those calculated for larger bodies of work. Therefore, the analysis presented in this section is for projects with at least 20 papers published between 2010 and 2019.

In the ninth (2018) and earlier versions of this report metric 3 indicated the intensity of international collaboration, the tenth report (2019) it was updated to measure the stability of institutional collaborations which is what it shows in this report.

The results for all projects are shown in Annex 5.

Three metrics were used to evaluate the collaborative nature of IMI projects:

- Metric 1 (Cross-sector Score) – Fraction of “cross-sector” papers with co-authors affiliated to institutions in different sectors (Figure 7.3.1.1). The institutions affiliated with each author on a IMI project papers were manually assigned by Clarivate to the relevant sector. Author affiliations were obtained through the Web of Science.
- Metric 2 (International Score) – Percentage of internationally collaborative papers. In calculating the international score for each project, greater weighting is given to papers with multilateral collaboration (co-authors from more than two countries), compared to bilateral collaboration (co-authors from two countries) (Figure 7.3.2.1). The country location of each author was determined using author addresses extracted in the Web of Science.
- Metric 3 (Stability Score) – Stability of institutional collaboration over the lifetime of the project. The collaboration stability for pairs of collaborating institutions was calculated following the method proposed by Y. Bu et al.[17] A stable institutional collaboration has a stable output, i.e. pairs of institutions co-publish a similar volume of papers in consecutive years for the duration of a project. The stability score for each project is the mean average stability of all the collaborating intuitional pairs that have contributed to that IMI project research.

Each metric is calculated for an IMI project and can take a value between 0 and 1, with 1 indicating more collaborative activity. The collaboration index is a sum of all three metrics and the maximum possible value for a project is 3.

[17] Bu, Y., Murray, D.S., Ding, Y. et al. (2018) Measuring the stability of scientific collaboration. *Scientometrics,* **114**, 463.

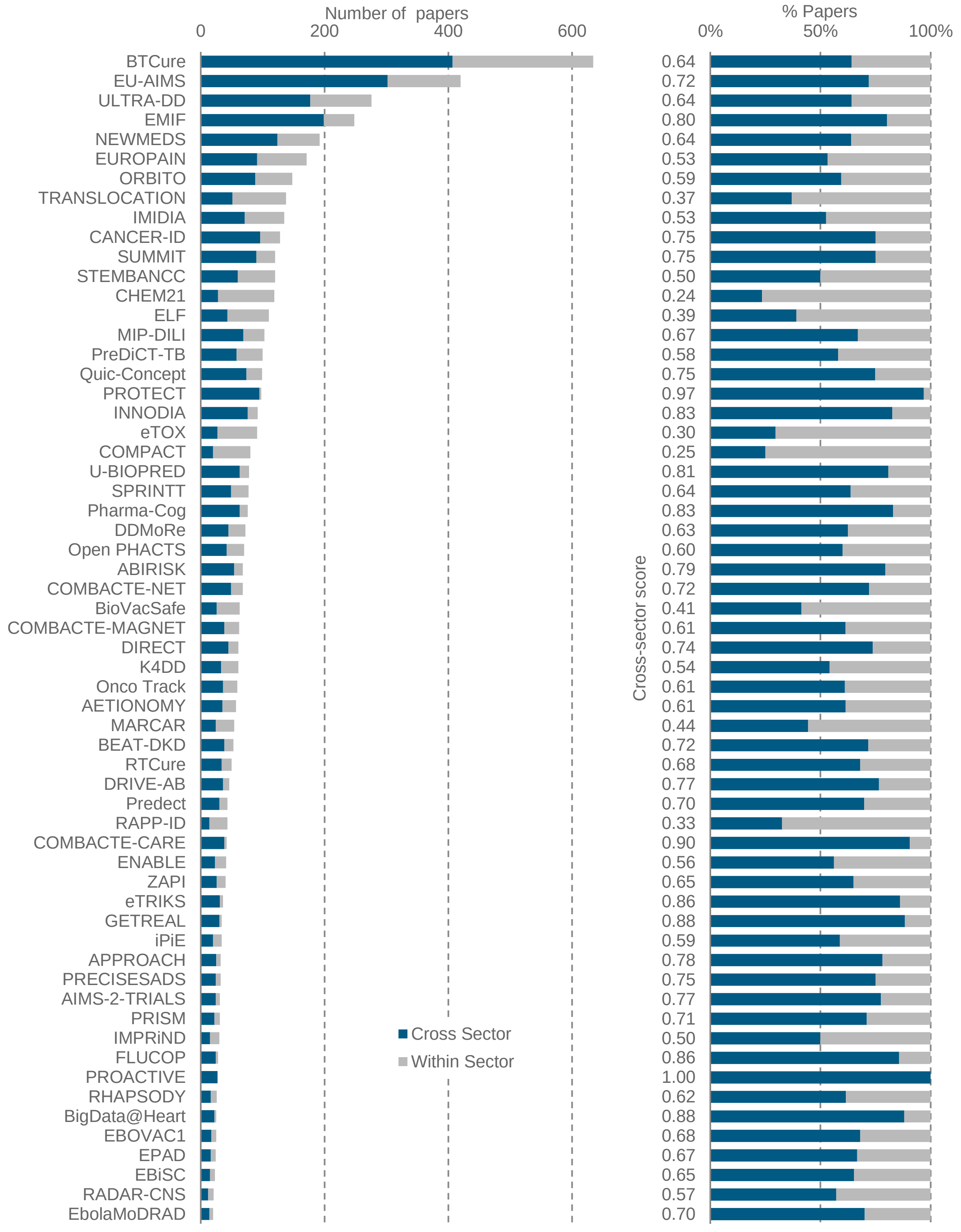
7.3.1 METRIC 1 (CROSS-SECTOR SCORE): FRACTION OF CROSS SECTOR COLLABORATIVE PAPERS

Authors institutional affiliations, as they appear on IMI project research were assigned to sectors. Sector assignments were then used to classify each paper as “within one sector”, when all co-authors work within the same sector or “cross-sector” when co-authors work in two or more different sectors. The number and percentage of cross-sector papers for projects are presented in Table 7.2.3.

Figure 7.3.1.1 shows the total number of “within one sector” and “cross-sector” papers for each project. Projects are ordered by the number of cross-sector collaborative papers. The dark blue bars represent the number or fraction of “cross-sector” papers. The fraction of cross-sector papers in each project is referred to in the figure as “Cross-Sector Score”. Only projects with more than 20 associated papers are shown.

- BTCURE had the greatest number of cross-sector collaborative papers, 407 out of a total of 634. PRO-active, Protect and COMBACTE-CARE had the highest percentage of cross-sector collaborative papers (100%, 96.9% and 90.5% respectively).

FIGURE 7.3.1.1 NUMBER AND FRACTION OF CROSS-SECTOR COLLABORATIVE PAPERS BY PROJECT, 2010-2019. ORDERED BY NUMBER OF CROSS-SECTOR PAPERS



7.3.2 METRIC 2 (INTERNATIONAL SCORE): FRACTION OF INTERNATIONALLY COLLABORATIVE PAPERS

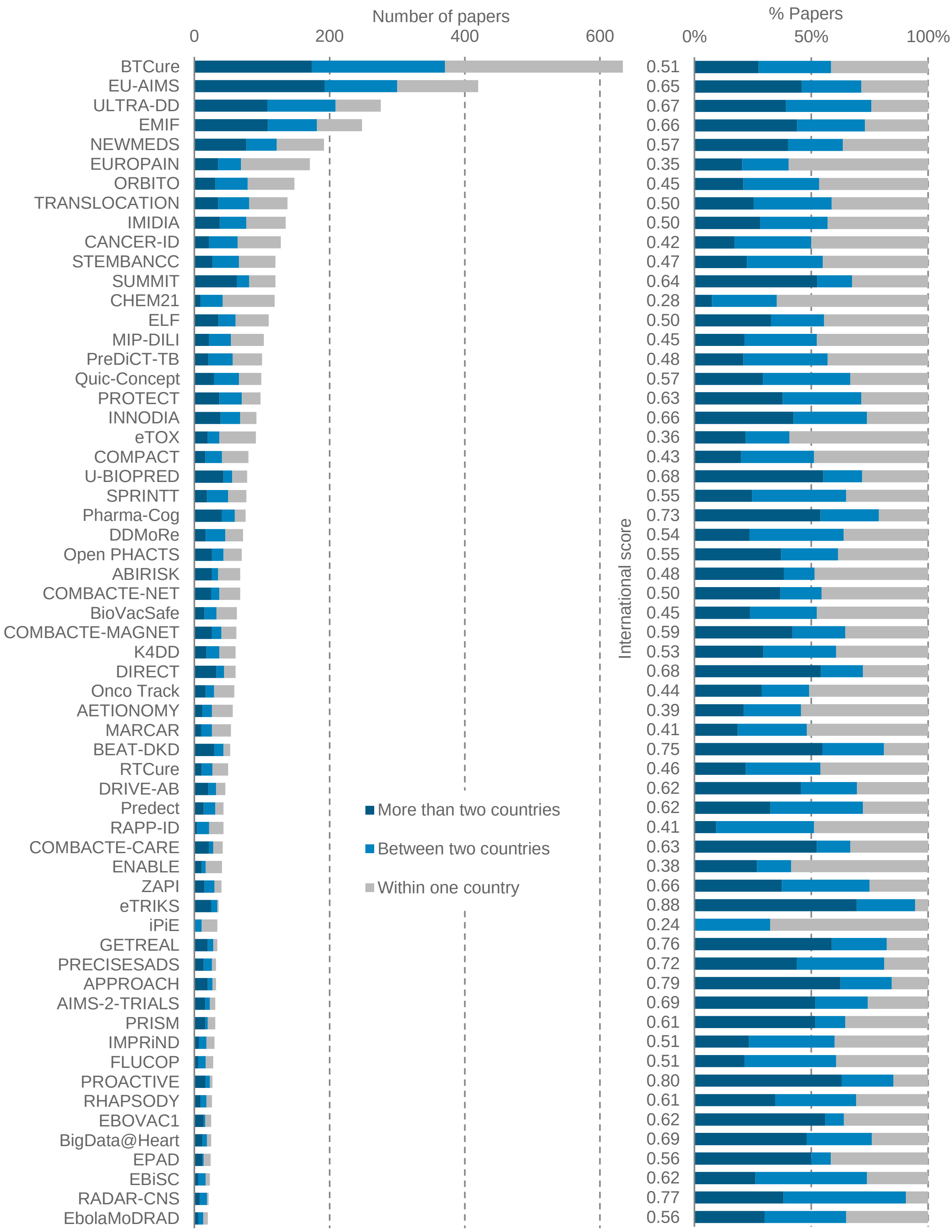
Author names and affiliations were extracted for all IMI project papers. The number of countries in the author affiliations for each paper was counted and used to classify the papers as "more than two countries", "two countries" or "within one country" (same as domestic in the Section 7.1).

Figure 7.3.2.1 below shows the total number of papers for each project. Projects are ordered by the number of papers with author affiliations from more than one country. The bar colours reflect the fraction of papers that include international collaboration between "two countries" (bilateral) and "more than two countries" (multilateral). Only projects with more than 20 associated papers are shown.

The International Score was calculated by weighting each paper that involved only two countries by 0.75 and each paper that involved more than two countries by 1.00. The sum of the weighted papers was then divided by the total number of project papers. Total number of internationally collaborative papers for each project is shown in Table 7.2.1.

- BTCURE had the most internationally collaborative papers involving two or more countries (371 out of 634), with an International Score of 0.51. eTRICKS, APPROACH and RADAR-CNS, had the highest International Scores (0.88, 0.79 and 0.0.77 respectively).

FIGURE 7.3.2.1 NUMBER AND FRACTION OF INTERNATIONALLY COLLABORATIVE PAPERS BY PROJECT, 2010-2019

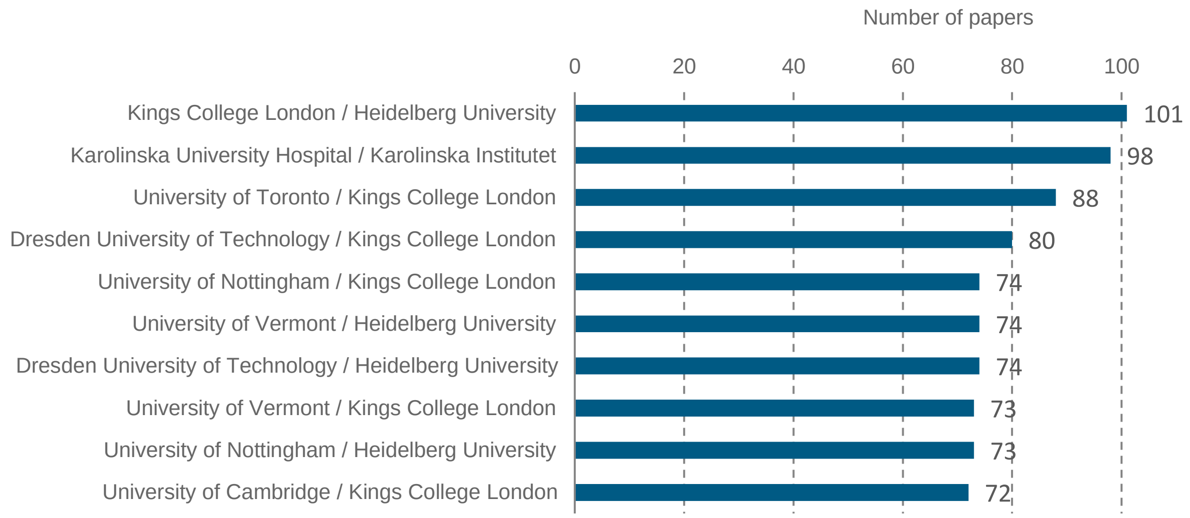


7.3.3 METRIC 3 (STABILITY SCORE): STABILITY OF INSTITUTIONAL COLLABORATION

This section looks in depth at institutional collaboration activities in IMI funded research. Figure 7.3.3.1 shows the ten most productive, collaborating institution pairs, by total number of collaborative papers. Figure 7.3.3.2 shows the ten institutions that collaborate with the highest number of other institutions. Figure 7.3.3.3 shows the distribution of Metric 3 scores for IMI projects. Table 7.3.3.1 is an expansion of the data in Figure 7.3.3.3, showing the Metric 3 score for all projects with at least 20 papers and the number of collaborating institution pairs. The number and proportion of papers with authors from more than one institution for each project is shown in Table 7.2.2.

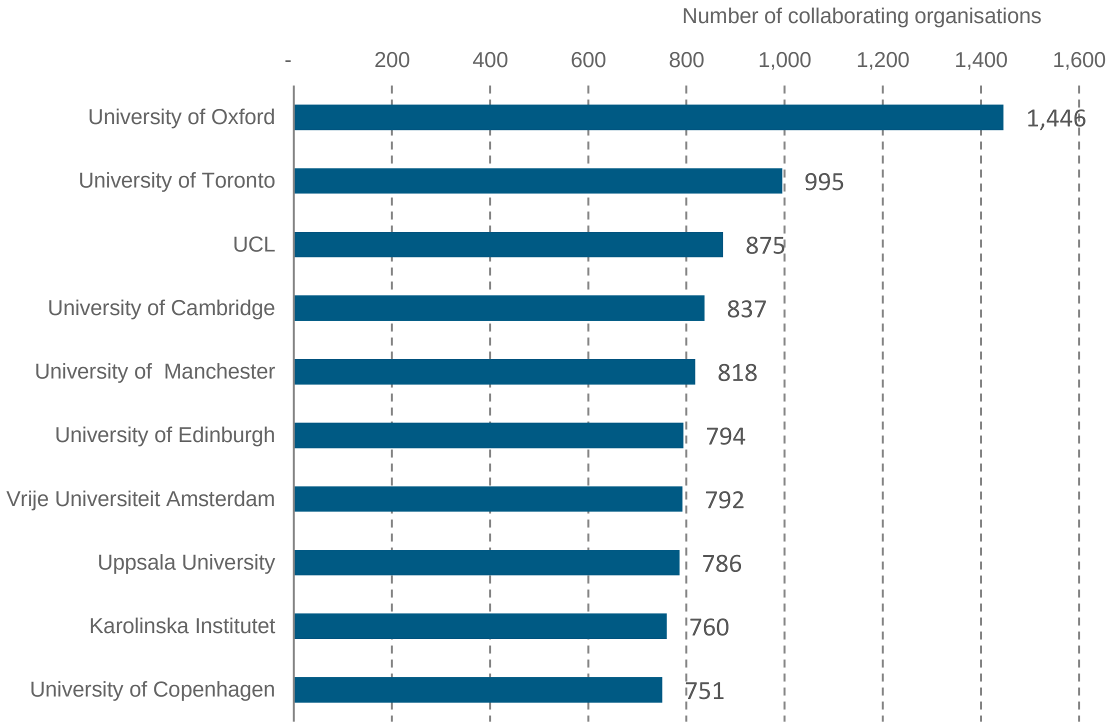
A projects Metric 3 is the mean average stability of collaborations between pairs of institutions that have co-authored papers that belong to that IMI project. Pairs of institutions had to have publishing two or more papers together as part of the same IMI project to be considered. A second requirement is that the IMI projects had to have started in, or before, 2017. If a project started after 2017, too little time has elapsed for most pairs of institutions to have published more than one paper.

FIGURE 7.3.3.1 THE TEN MOST PRODUCTIVE PAIRS OF COLLABORATING INSTITUTIONS, 2010-2019



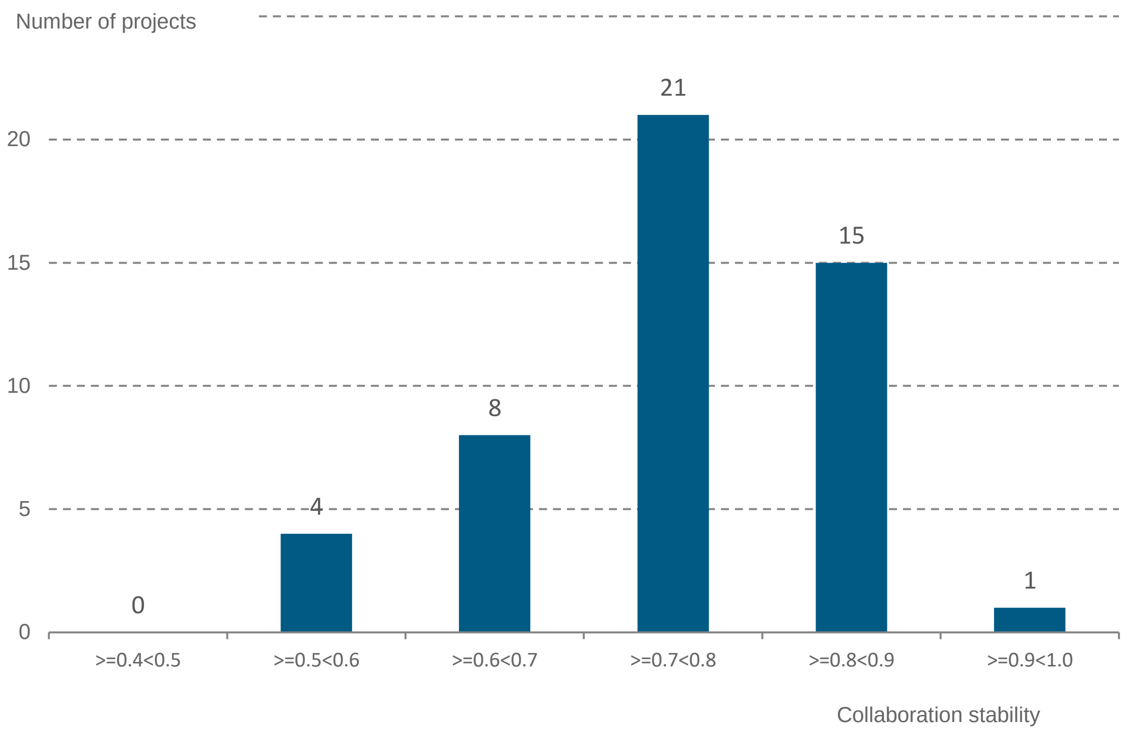
- The institutions that collaborated most frequently on IMI project papers were Kings College London and Heidelberg University, researchers at these institutions together, co-authored 101 publications.

FIGURE 7.3.3.2 THE TEN INSTITUTIONS THAT HAVE COLLABORATED WITH THE GREATEST NUMBER OF OTHER INSTITUTIONS, 2010-2019



- The University of Oxford has collaborated with 1,446 other institutions on IMI project papers.
- Half of the ten most collaborative institutions are located in the United Kingdom.

FIGURE 7.3.3.3 METRIC 3: STABILITY SCORE DISTRIBUTION, 2010-2019



- Most IMI project have stability score of between 0.70 and 0.90.

TABLE 7.3.1 STABILITY SCORE FOR IMI PROJECTS, NUMBER OF COLLABORATING INSTITUTION PAIRS, TOTAL NUMBER OF PAPERS AND PROJECT START YEAR FOR ALL PROJECTS WITH AT LEAST 20 PAPERS THAT STARTED IN OR BEFORE 2017, 2010-2019

Project	Stability score (Metric 3)	Number of collaborating institution pairs	Number of papers	Project start year
BTCure	0.81	1,024	634	2011
EU-AIMS	0.80	2,707	420	2012
ULTRA-DD	0.73	237	276	2015
EMIF	0.82	1,807	248	2012
NEWMEDS	0.79	618	194	2010
EUROPAIN	0.84	298	171	2010
ORBITO	0.74	298	148	2013
TRANSLOCATION	0.80	68	138	2013
IMIDIA	0.82	150	135	2010
CANCER-ID	0.71	121	128	2015
STEMBANCC	0.78	47	120	2013
SUMMIT	0.84	6,797	120	2011
CHEM21	0.76	20	119	2013
ELF	0.69	37	110	2014
MIP-DILI	0.80	109	103	2012
PreDiCT-TB	0.77	61	100	2013
Quic-Concept	0.77	113	99	2012
PROTECT	0.84	299	98	2010
INNODIA	0.90	161	92	2010
eTOX	0.85	126	91	2010
COMPACT	0.69	25	80	2014
U-BIOPRED	0.89	812	78	2010
SPRINTT	0.75	117	77	2014
Pharma-Cog	0.83	850	76	2010
DDMoRe	0.77	32	72	2012
Open PHACTS	0.76	63	70	2011
ABIRISK	0.83	320	68	2012
COMBACTE-NET	0.78	98	68	2013
BioVacSafe	0.77	15	63	2012
COMBACTE-MAGNET	0.70	89	62	2015
DIRECT	0.79	325	61	2012
K4DD	0.80	31	61	2013
Onco Track	0.81	71	59	2011
AETIONOMY	0.76	52	57	2014
MARCAR	0.79	34	54	2011
BEAT-DKD	0.57	248	53	2017
RTCure	0.67	64	50	2017
DRIVE-AB	0.71	56	47	2015
Predect	0.77	25	43	2012
RAPP-ID	0.86	8	43	2011

Project	Stability score (Metric 3)	Number of collaborating institution pairs	Number of papers	Project start year
COMBACTE-CARE	0.67	546	42	2015
ENABLE	0.76	18	41	2015
ZAPI	0.68	34	40	2015
eTRIKS	0.72	648	36	2014
GETREAL	0.56	36	34	2015
iPiE	0.79	19	34	2016
APPROACH	0.69	54	32	2015
PRECISESADS	0.65	130	32	2015
PRISM	0.64	33	31	2017
IMPRiND	0.57	5	30	2017
FLUCOP	0.63	16	28	2015
PROACTIVE	0.84	165	27	2011
RHAPSODY	0.71	25	26	2016
BigData@Heart	0.67	3,024	25	2017
EBOVAC1	0.65	17	25	2015
EPAD	0.67	56	24	2015
EBiSC	0.72	9	23	2015
RADAR-CNS	0.79	42	21	2016
EbolaMoDRAD	0.55	19	20	2016

- INNODIA has the highest stability score (0.90) while EbolaMoDRAD has the lowest (0.55).
- There is considerable variation in the number collaborating institution pairs that does not appear to be proportional to the number of project papers or dependent on the project start year. For example, BTCure started in 2011 and has the highest output of papers (634), only has 1,024 institution pairs compared with SUMMIT that started in the same year, has only produced 120 papers but has 6,797 institution pairs.

7.4 COLLABORATION INDEX

The cross-sector score (Metrics 1) and international score (Metric 2) (described above) measure different types of collaboration. The first measures the fraction of papers that involve cross-sector collaborations, and the second reflects the fraction of papers that involve multilateral and bilateral international collaborations. Metric 3 or stability score is based on the collaboration stability of pairs of institutional collaborators that contribute to IMI project research. We compute a "collaboration index" across IMI projects as the sum of all three of the metrics. These data are shown in Table 7.4.1 for all IMI projects with 20 or more papers.

This year's collaboration index is not comparable with the collaboration index in the ninth (2018) and earlier versions of this report as Metric 3 was updated in the tenth report (2019) to indicate the stability of institutional collaboration rather than intensity.

- PROACTIVE had the highest overall collaboration index score (2.63) followed by eTRIKS (2.47).

TABLE 7.4.1 SUMMARY SCORE FOR COLLABORATION METRICS, TOTAL NUMBER OF PAPERS AND FIELD-NORMALISED CITATION IMPACT FOR IMI PROJECTS WITH AT LEAST 20 PAPERS, 2010-2019

Project	Cross-sector Score (Metric 1)	International Score (Metric 2)	Stability score (Metric 3)	Collaboration index	Number of papers	Citation impact (field-normalised)
BTCure	0.64	0.51	0.81	1.96	634	2.00
EU-AIMS	0.72	0.65	0.80	2.17	420	2.12
ULTRA-DD	0.64	0.67	0.73	2.04	276	1.92
EMIF	0.80	0.66	0.82	2.28	248	2.70
NEWMEDS	0.64	0.57	0.79	2.00	194	2.13
EUROPAIN	0.53	0.35	0.84	1.73	171	2.51
ORBITO	0.59	0.45	0.74	1.79	148	1.79
TRANSLOCATION	0.37	0.50	0.80	1.67	138	1.42
IMIDIA	0.53	0.50	0.82	1.84	135	1.68
CANCER-ID	0.75	0.42	0.71	1.88	128	3.92
STEMBANCC	0.50	0.47	0.78	1.75	120	2.15
SUMMIT	0.75	0.64	0.84	2.23	120	1.73
CHEM21	0.24	0.28	0.76	1.28	119	1.72
ELF	0.39	0.50	0.69	1.58	110	1.10
MIP-DILI	0.67	0.45	0.80	1.91	103	1.81
PreDiCT-TB	0.58	0.48	0.77	1.83	100	1.32
Quic-Concept	0.75	0.57	0.77	2.09	99	3.33
PROTECT	0.97	0.63	0.84	2.44	98	1.11
INNODIA	0.83	0.66	0.90	2.39	92	1.72
eTOX	0.30	0.36	0.85	1.50	91	1.74
COMPACT	0.25	0.43	0.69	1.37	80	1.95
U-BIOPRED	0.81	0.68	0.89	2.37	78	3.09
SPRINTT	0.64	0.55	0.75	1.94	77	2.20
Pharma-Cog	0.83	0.73	0.83	2.39	76	1.26
DDMoRe	0.63	0.54	0.77	1.94	72	1.03
Open PHACTS	0.60	0.55	0.76	1.92	70	3.39

Project	Cross-sector Score (Metric 1)	International Score (Metric 2)	Stability score (Metric 3)	Collaboration index	Number of papers	Citation impact (field-normalised)
ABIRISK	0.79	0.48	0.83	2.11	68	1.43
COMBACTE-NET	0.72	0.50	0.78	2.00	68	1.11
BioVacSafe	0.41	0.45	0.77	1.63	63	1.36
COMBACTE-MAGNET	0.61	0.59	0.70	1.90	62	1.36
DIRECT	0.74	0.68	0.79	2.20	61	2.84
K4DD	0.54	0.53	0.80	1.87	61	2.07
Onco Track	0.61	0.44	0.81	1.86	59	2.44
AETIONOMY	0.61	0.39	0.76	1.77	57	1.62
MARCAR	0.44	0.41	0.79	1.64	54	1.16
BEAT-DKD	0.72	0.75	0.57	2.04	53	1.22
RTCure	0.68	0.46	0.67	1.81	50	2.58
DRIVE-AB	0.77	0.62	0.71	2.10	47	1.67
Predect	0.70	0.62	0.77	2.09	43	2.22
RAPP-ID	0.33	0.41	0.86	1.60	43	0.86
COMBACTE-CARE	0.90	0.63	0.67	2.21	42	2.34
ENABLE	0.56	0.38	0.76	1.70	41	1.48
ZAPI	0.65	0.66	0.68	1.99	40	1.94
eTRIKS	0.86	0.88	0.72	2.47	36	2.78
GETREAL	0.88	0.76	0.56	2.21	34	1.95
iPiE	0.59	0.24	0.79	1.62	34	1.40
APPROACH	0.78	0.79	0.69	2.26	32	2.39
PRECISESADS	0.75	0.72	0.65	2.12	32	1.60
PRISM	0.71	0.61	0.64	1.96	31	2.26
IMPRiND	0.50	0.51	0.57	1.58	30	6.69
FLUCOP	0.86	0.51	0.63	2.00	28	1.19
PROACTIVE	1.00	0.80	0.84	2.63	27	2.36
RHAPSODY	0.62	0.61	0.71	1.93	26	2.58
BigData@Heart	0.88	0.69	0.67	2.24	25	1.58
EBOVAC1	0.68	0.62	0.65	1.95	25	2.01
EPAD	0.67	0.56	0.67	1.89	24	1.29
EBiSC	0.65	0.62	0.72	1.99	23	9.35
RADAR-CNS	0.57	0.77	0.79	2.13	21	1.14
EbolaMoDRAD	0.70	0.56	0.55	1.81	20	1.41

8 BENCHMARKING ANALYSIS – IMI PROJECT RESEARCH AGAINST RESEARCH FROM SELECTED COMPARATORS

This section of the report analyses the output and citation impact of IMI project research benchmarked against research supported by other Public-Private Partnerships, and funders of biomedical research across Europe, Asia, Australia and North America.

The publications funded by each comparator were identified using specific searches of the funding acknowledgment data provided by authors and extracted in Web of Science. This is the same process by which IMI project publications have been identified. Authors may not always acknowledge their sources of funding and may not always do so correctly. Therefore, the coverage of the datasets used in these analyses may not be complete and may not be entirely accurate; however, the sample represented by these datasets is sufficient to allow a comparison to be made.

8.1 IDENTIFYING COMPARATORS

The seven funders listed in Table 8.1.1 are used as comparators for IMI in this report. They are the same comparators as in the previous tenth report produced in 2019. Each comparator had sufficient publications to allow a meaningful analysis.

TABLE 8.1.1 SUMMARY OF INFORMATION OF IMI-SELECTED COMPARATORS, 2010-2019

Comparator	Number of publications (2010-2019)	Number of papers (2010-2019)	Country	Region
Critical Path (C-Path)	473	445	USA	North America
Commonwealth Scientific and Industrial Research Organisation (CSIRO) [18]	821	795	Australia	Australia
Foundation for the National Institutes of Health (FNIH)	3,605	3,438	USA	North America
Grand Challenges in Global Health (GCGH)	869	868	USA	North America
Indian Council of Medical Research (ICMR)	13,154	12,853	India	Asia
Medical Research Council (MRC)	103,808	94,100	UK	Europe
Wellcome Trust (WT)	74,143	69,191	UK	Europe

[18] The dataset containing all publications attributed to CSIRO between 2010 and 2018 has been reduced to include only medically related publications for these analyses. A list of Web of Science journal categories which capture medically related publications is given in Annex 2.

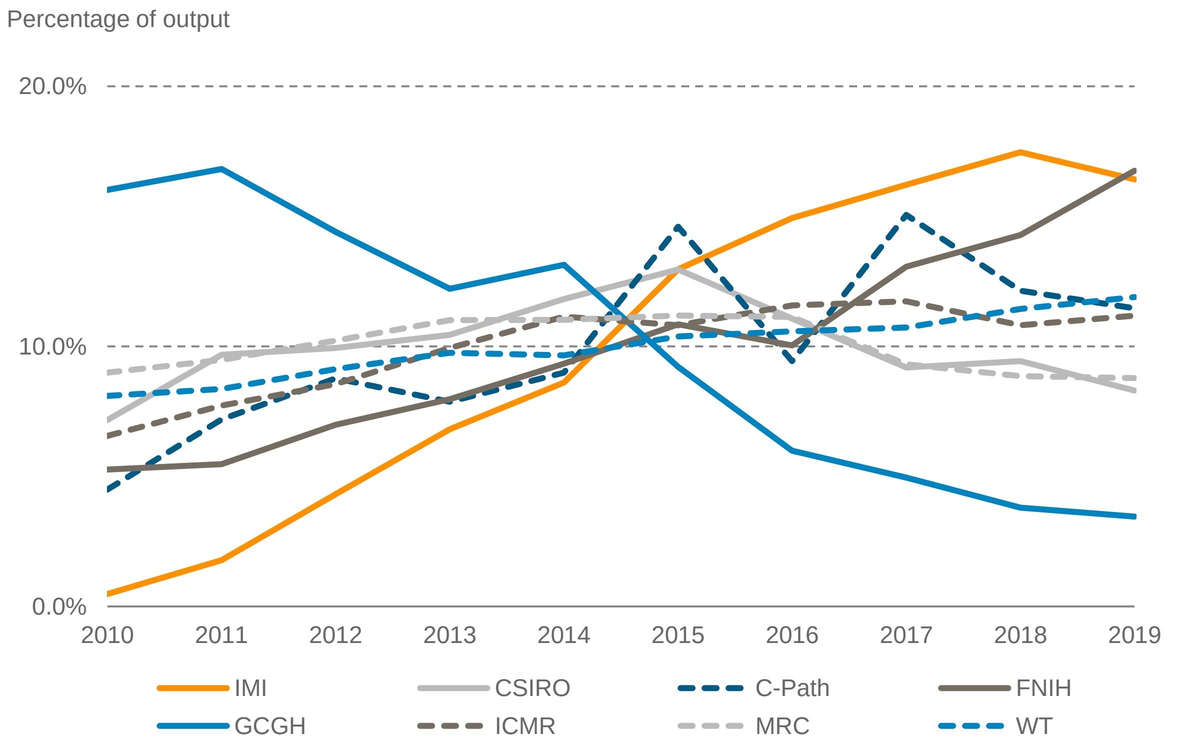
8.2 TRENDS IN OUTPUT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

This section of the report analyses trends in the performance of IMI project research and the selected comparators.

8.2.1 TRENDS IN OUTPUT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

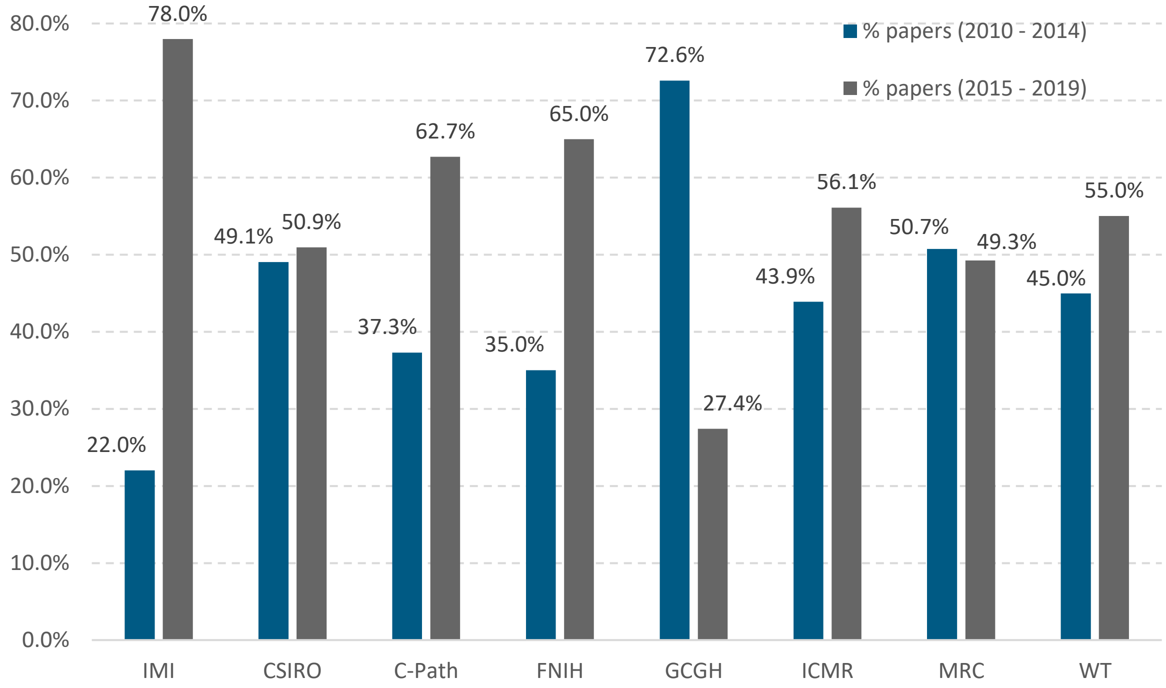
The output of IMI and the comparators varies widely (some produced many papers and some relatively few), therefore a visual comparison of absolute paper counts would not provide an understanding of their growth relative to one another. To provide a more easily interpretable comparison, Figure 8.2.1.1 shows the percentage of each organisation's total paper count between 2010 and 2018 published in each year. Figure 8.2.1.2 compares the percentage of each organisation's total paper count, in the five years between, 2010 to 2014 and the most recent five years 2015 to 2019. Table 8.2.1.1 shows the same data as in Figure 8.2.1.1 and Table 8.2.1.2 show the number of papers per year for IMI and the selected comparators.

FIGURE 8.2.1.1 TRENDS IN OUTPUT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The papers IMI project research published in the last three years, 2017 to 2019, accounts for over 50% of all IMI papers.
- Generally, IMI and the other comparators percentage of output increased between 2010 and 2019. However, IMI has experienced the most rapid increase in percentage of output, only in 2019 seeing a slight decrease.
- GCGH has sustained a decreasing percentage of output since 2010 and CSIRO had a peak percentage of output in 2015 which has decreased in subsequent years.

FIGURE 8.2.1.2 COMPARING PERCENTAGE OUTPUT IN THE FIRST FIVE YEARS (2010–2014) TO MOST RECENT FIVE YEARS (2015-2019) – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019.



- IMI had nearly a four times higher output in the four years between 2015-2019 compared to 2010-2014.
- All the comparators had a higher output in the most recent four years (2015-2019) compared with the first four years (2010-2014). Except GCGH that showed a decrease in output and MRC which had small 2% drop in output.

TABLE 8.2.1.1 SHARE OF OUTPUT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	2010	0.5%	7.2%	4.5%	5.3%	16.0%	6.6%	9.0%
2011	2011	1.8%	9.7%	7.2%	5.5%	16.8%	7.7%	9.5%
2012	2012	4.3%	9.9%	8.8%	7.0%	14.4%	8.5%	10.2%
2013	2013	6.8%	10.4%	7.9%	8.0%	12.2%	9.9%	11.0%
2014	2014	8.6%	11.8%	9.0%	9.3%	13.1%	11.1%	11.0%
2015	2015	13.0%	13.0%	14.6%	10.8%	9.2%	10.8%	11.2%
2016	2016	14.9%	11.1%	9.4%	10.0%	6.0%	11.6%	11.1%
2017	2017	16.2%	9.2%	15.1%	13.1%	5.0%	11.7%	9.3%
2018	2018	17.5%	9.4%	12.1%	14.3%	3.8%	10.8%	8.9%
2019	2019	16.4%	8.3%	11.5%	16.8%	3.5%	11.2%	8.8%

TABLE 8.2.1.2 NUMBER OF PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

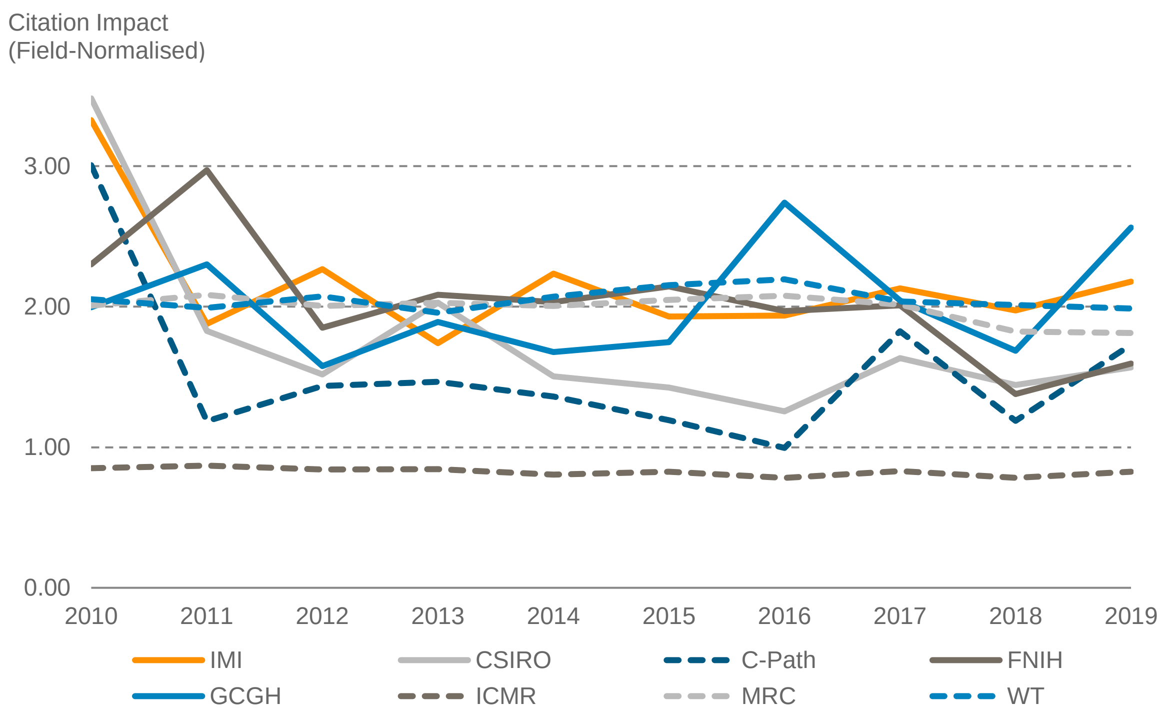
Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	26	57	20	181	139	843	8,463	5,602
2011	97	77	32	188	146	992	8,929	5,785
2012	235	79	39	240	125	1,098	9,620	6,312
2013	371	83	35	274	106	1,277	10,363	6,749
2014	469	94	40	321	114	1,432	10,368	6,679
2015	706	103	65	373	80	1,390	10,526	7,184
2016	813	88	42	345	52	1,487	10,474	7,315
2017	883	73	67	449	43	1,508	8,762	7,422
2018	951	75	54	491	33	1,389	8,332	7,912
2019	894	66	51	576	30	1,437	8,263	8,231
Total	**5,445**	**795**	**445**	**3,438**	**868**	**12,853**	**94,100**	**69,191**

8.2.2 TRENDS IN FIELD-NORMALISED CITATION IMPACT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

As discussed in Section 3, citations accumulate over time at a rate that is dependent upon the field of research. Therefore, it is standard bibliometric practice to normalise citation counts for these two factors. In this report, field-normalised citation impact has been calculated by dividing the citations received by each publication by the world average citations per publication for the relevant year and field.

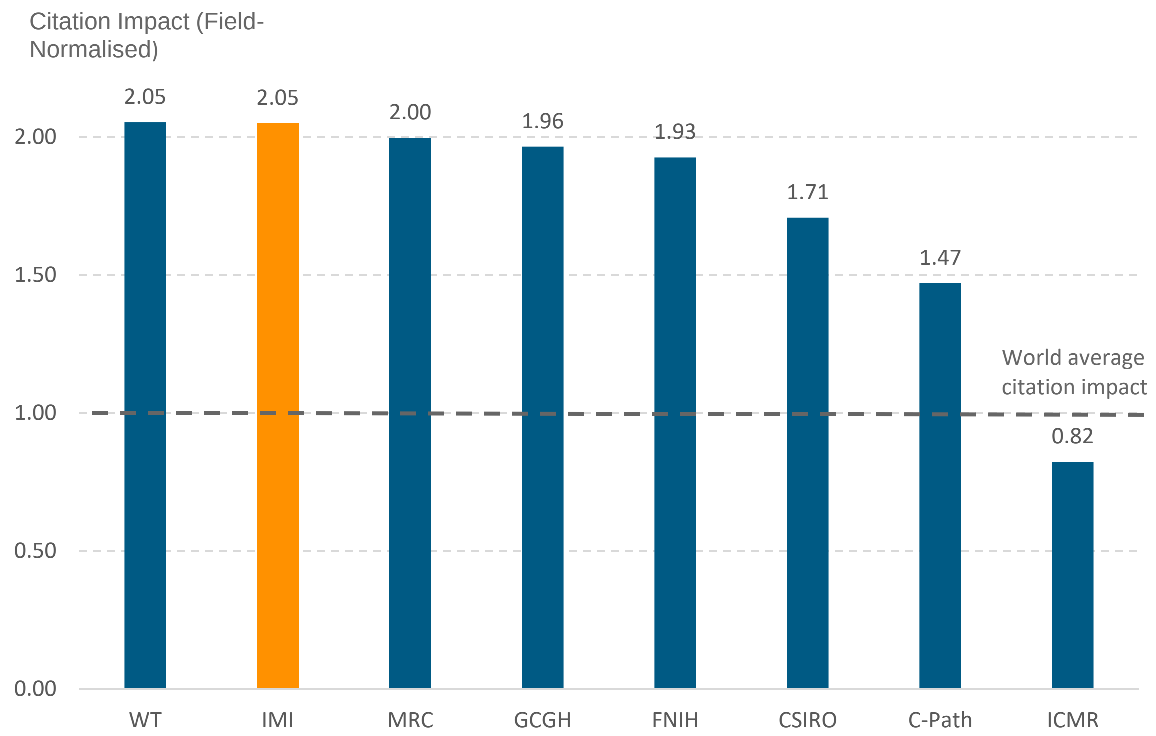
Figure 8.2.2.1 shows the annual trends in field-normalised citation impact of IMI and the comparators between 2010 and 2019 and Figure 8.2.2.2 shows the average field-normalised citation impact of IMI and the comparators between 2010 and 2019. Table 8.2.2.1 has the same data as in Figure 8.2.2.1 and Figure 8.2.2.2.

FIGURE 8.2.2.1 TRENDS IN FIELD-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The field-normalised citation impact of MRC and the WT were stable at close to twice the world average between 2010 and 2019, indicating highly cited, internationally significant research.
- The exceptionally high field-normalised citation impact of IMI, CSIRO and C-Path project research in 2010 was driven by a small number of highly cited papers.

FIGURE 8.2.2.2 AVERAGE FIELD-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The average field-normalised citation impact of IMI project research (2.05) between 2010 and 2019 was equal to the WT's citation impact and ahead of all the other comparators.
- Only ICMR's average field-normalised citation impact (0.82) was below world average impact (1.00).

TABLE 8.2.2.1 FIELD-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	3.33	3.48	3.01	2.30	2.00	0.85	2.01	2.05
2011	1.88	1.83	1.19	2.97	2.30	0.87	2.08	1.99
2012	2.27	1.52	1.44	1.85	1.58	0.84	2.00	2.07
2013	1.74	2.03	1.46	2.08	1.89	0.84	2.03	1.96
2014	2.24	1.51	1.36	2.03	1.68	0.80	2.01	2.07
2015	1.93	1.43	1.19	2.14	1.75	0.83	2.05	2.15
2016	1.94	1.26	1.00	1.97	2.74	0.78	2.08	2.19
2017	2.13	1.63	1.83	2.01	2.04	0.83	2.01	2.04
2018	1.97	1.44	1.19	1.38	1.69	0.78	1.82	2.01
2019	2.18	1.57	1.73	1.59	2.56	0.83	1.81	1.99
Average	**2.05**	**1.71**	**1.47**	**1.93**	**1.96**	**0.82**	**2.00**	**2.05**

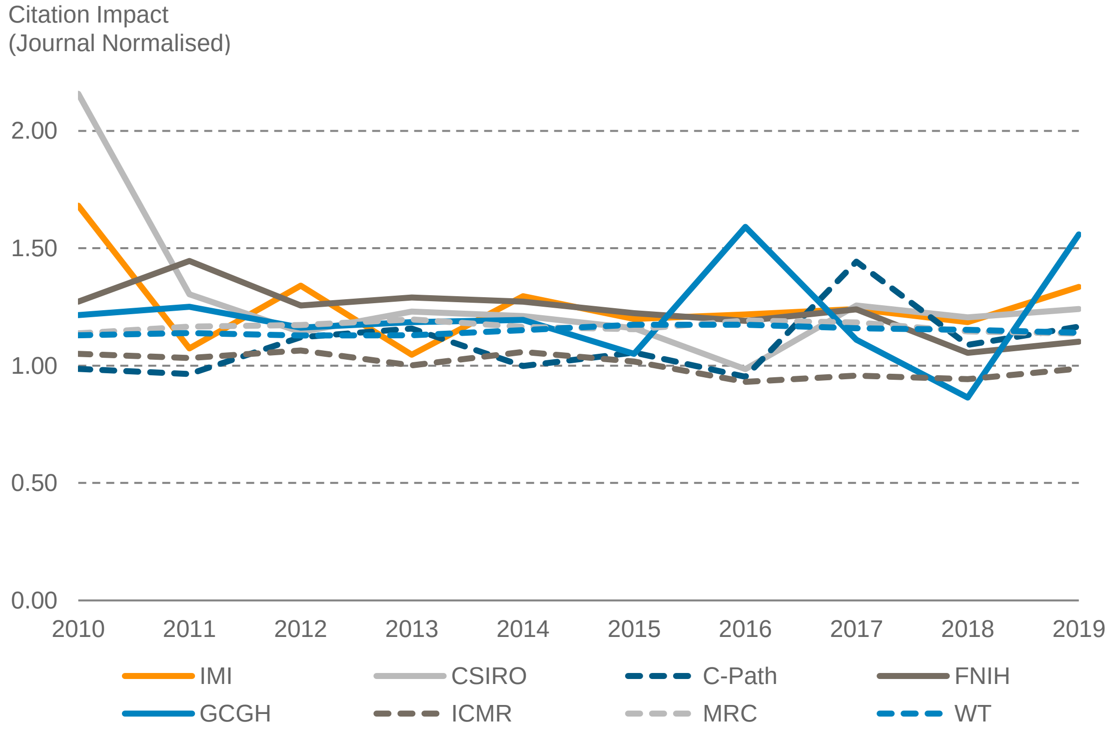
- In 2012, 2014 and 2017 IMI had the highest field-normalised citation impact (2.77, 2.24 and 2.13 respectively) of the funding organisations analysed.

8.2.3 TRENDS IN JOURNAL-NORMALISED CITATION IMPACT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

As discussed in Section 3, an alternative indicator to field-normalised citation impact is citation impact normalised at the journal level. The journal-normalised citation impact is calculated by dividing the number of citations a paper received by the average number of citations for the year and the journal in which the paper is published. As for the field-normalised citation impact, the world average for journal-normalised citation impact is 1.00.

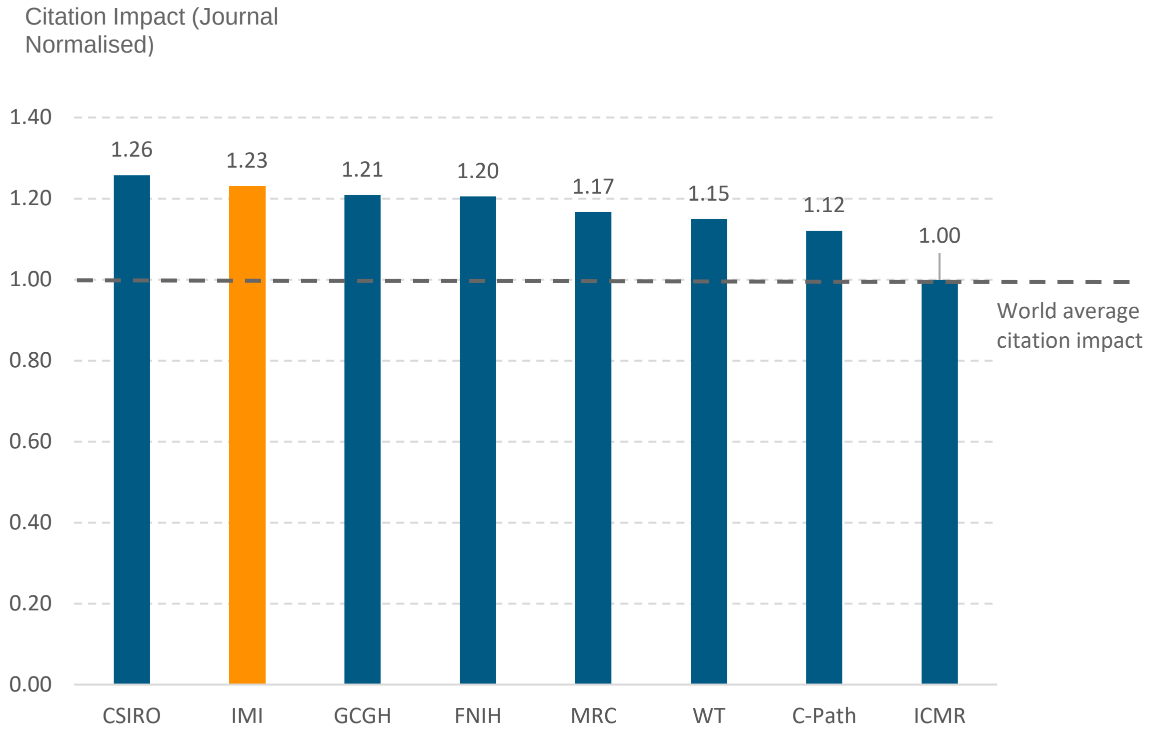
Figure 8.2.3.1 shows the annual trends in journal-normalised citation impact of IMI and the comparators between 2010 and 2019. Figure 8.2.2.2 shows the average field-normalised citation impact of IMI and the comparators between 2010 and 2019. Table 8.2.3.1 shows the same data as in Figure 8.2.3.1 and Figure 8.2.3.2.

FIGURE 8.2.3.1 TRENDS IN JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- IMI project research has a The journal-normalised citation impact of IMI project research has remained above the world average between 2010 and 2019 and since 2014 has been relatively stable.
- The journal-normalised citation impact of ICMR, MRC and WT remained relatively stable between 2010 and 2019, while that of CSIRO and GCGH showed greater variability. This is to be expected given the smaller number of papers funded by CSIRO and GCGH relative to the output of more research institutions like the MRC and WT.
- Since 2015 IMCR’s journal normalised citation impact has been below the world average.

FIGURE 8.2.3.2 AVERAGE JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- IMI had the second highest average journal-normalised citation impact (1.23) between 2010 and 2019, below CSIRO (1.26).

TABLE 8.2.3.1 JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

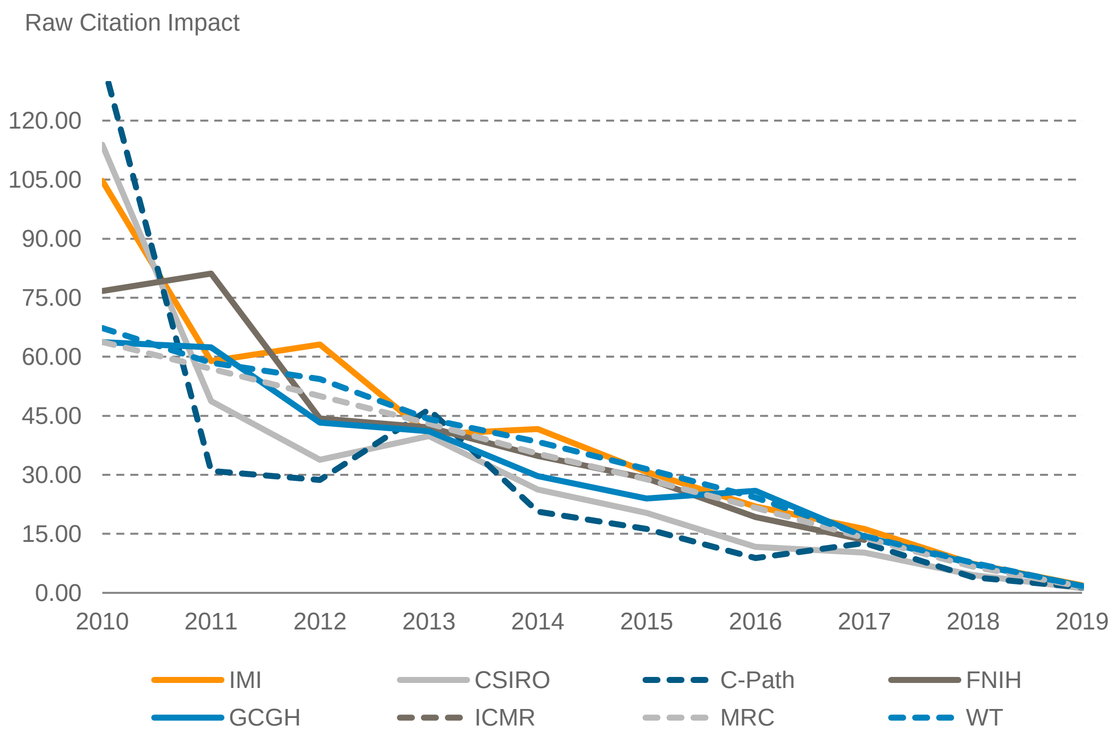
Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	1.68	2.16	0.99	1.27	1.22	1.05	1.14	1.13
2011	1.07	1.30	0.96	1.45	1.25	1.03	1.17	1.14
2012	1.34	1.14	1.12	1.26	1.16	1.06	1.17	1.13
2013	1.05	1.23	1.16	1.29	1.19	1.00	1.20	1.13
2014	1.30	1.21	1.00	1.27	1.19	1.06	1.17	1.15
2015	1.20	1.16	1.06	1.22	1.05	1.02	1.15	1.17
2016	1.22	0.99	0.95	1.19	1.59	0.93	1.19	1.17
2017	1.24	1.26	1.44	1.24	1.11	0.96	1.18	1.16
2018	1.19	1.21	1.09	1.05	0.86	0.94	1.15	1.15
2019	1.34	1.24	1.17	1.10	1.56	0.99	1.14	1.14
Average	**1.23**	**1.26**	**1.12**	**1.20**	**1.21**	**1.00**	**1.17**	**1.15**

8.2.4 TRENDS IN RAW CITATION IMPACT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

The raw (un-normalised) citation impact of a group of papers is calculated by dividing the sum of citations by the total number of papers published. As such it is the mean average number of citations to a paper. This indicator must be used with caution as it is not normalised to field or year.

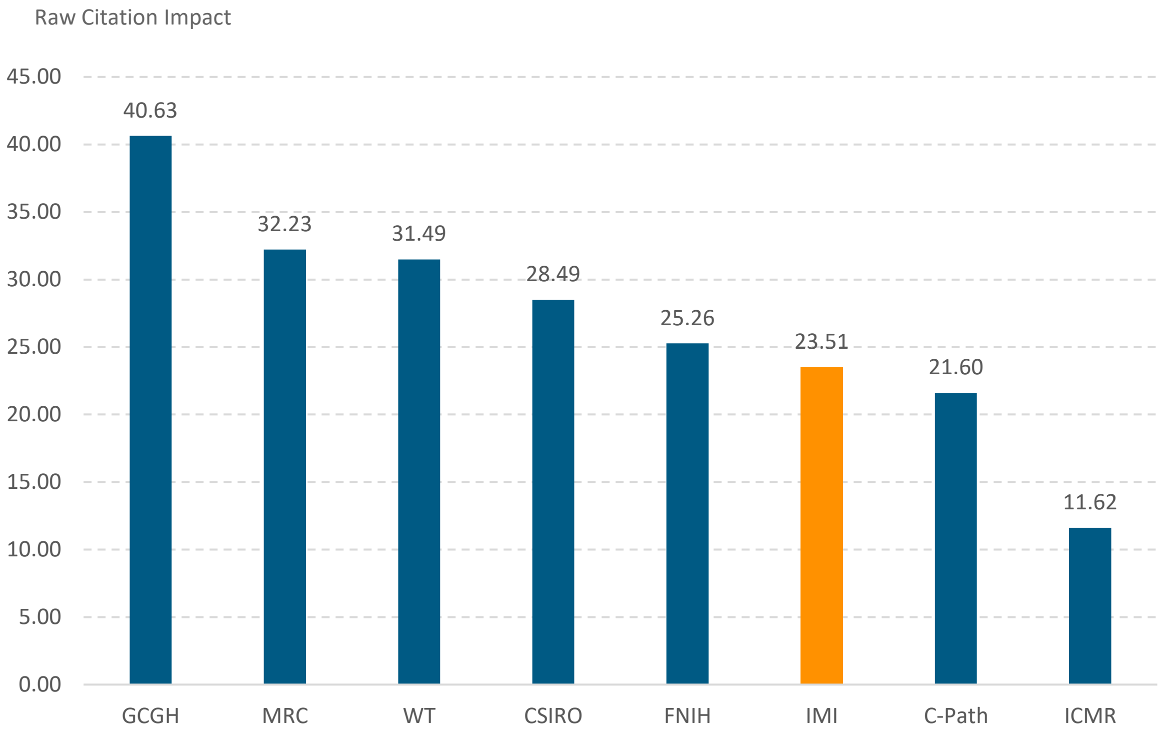
Figure 8.2.4.1 shows the annual trends in average raw citation impact of IMI and the comparators for papers published each year between 2010 and 2019. Figure 8.2.4.2 shows the average raw citation impact of IMI and the comparators for papers published between 2010 and 2010. Table 8.2.4.1 has the same data as in Figure 8.2.4.1 and Figure 8.2.4.2.

FIGURE 8.2.4.1 TRENDS IN RAW CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The raw citation impact of all organisations decreased from 2010 to 2019. This is expected as more recent publications have had less time to accumulate citations, and the raw citation impact is not normalised.
- IMI's 2019 raw citation impact (1.92) is higher the comparators raw citation impacts.

FIGURE 8.2.4.2 AVERAGE RAW CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- IMI's average raw citation impact between 2010 and 2019 (23.51) is higher than C-Path (21.30) and double ICMR (11.62).
- GCGH had the highest raw citation impact (40.63).

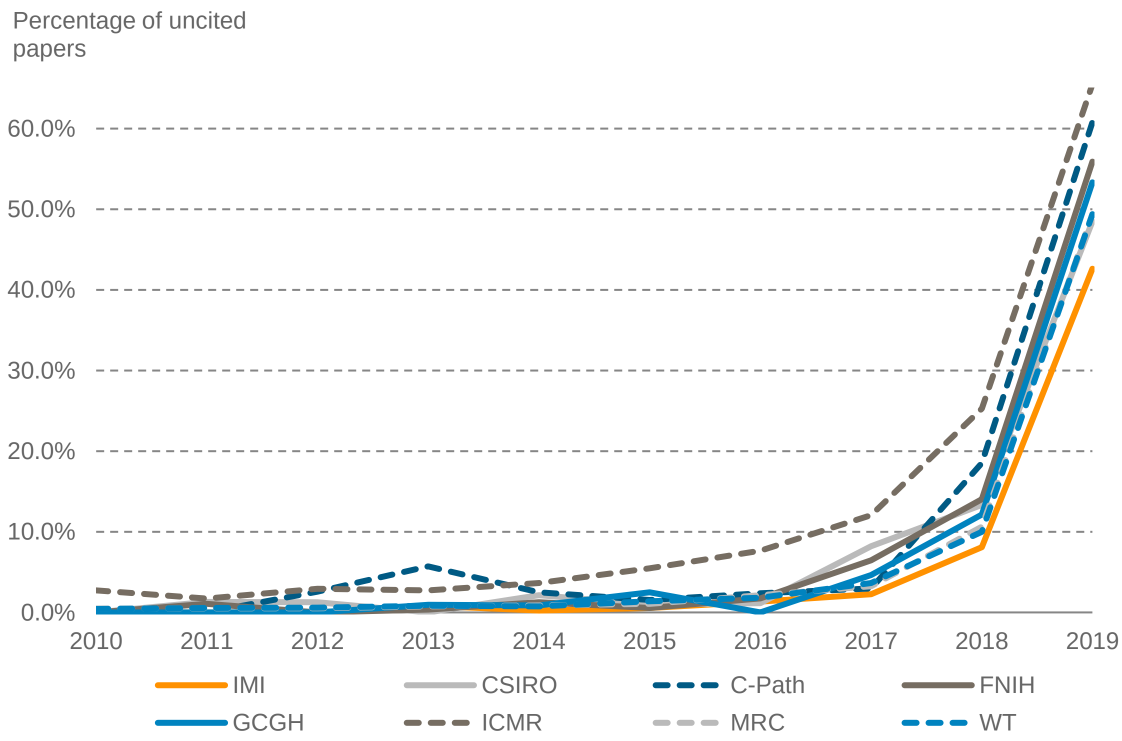
TABLE 8.2.4.1 RAW CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	104.70	113.88	135.48	76.72	63.72	23.83	63.76	67.29
2011	58.86	48.72	31.00	81.13	62.36	22.52	56.91	58.51
2012	63.11	33.78	28.73	44.35	43.30	20.07	50.02	54.35
2013	40.25	39.80	46.57	42.02	41.05	17.46	43.04	44.14
2014	41.65	26.22	20.66	34.76	29.70	15.01	35.34	38.37
2015	30.72	20.27	16.26	29.06	24.01	11.82	28.83	31.43
2016	21.91	11.70	8.85	19.22	25.89	8.48	21.65	24.25
2017	16.26	10.18	12.63	13.45	14.26	5.82	13.94	14.45
2018	7.40	4.54	3.98	4.51	7.30	2.82	6.65	7.62
2019	1.92	1.17	1.41	1.23	1.73	0.74	1.55	1.70
Average	**23.51**	**28.49**	**21.60**	**25.26**	**40.63**	**11.62**	**32.23**	**31.49**

8.2.5 TRENDS IN UNCITED RESEARCH: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

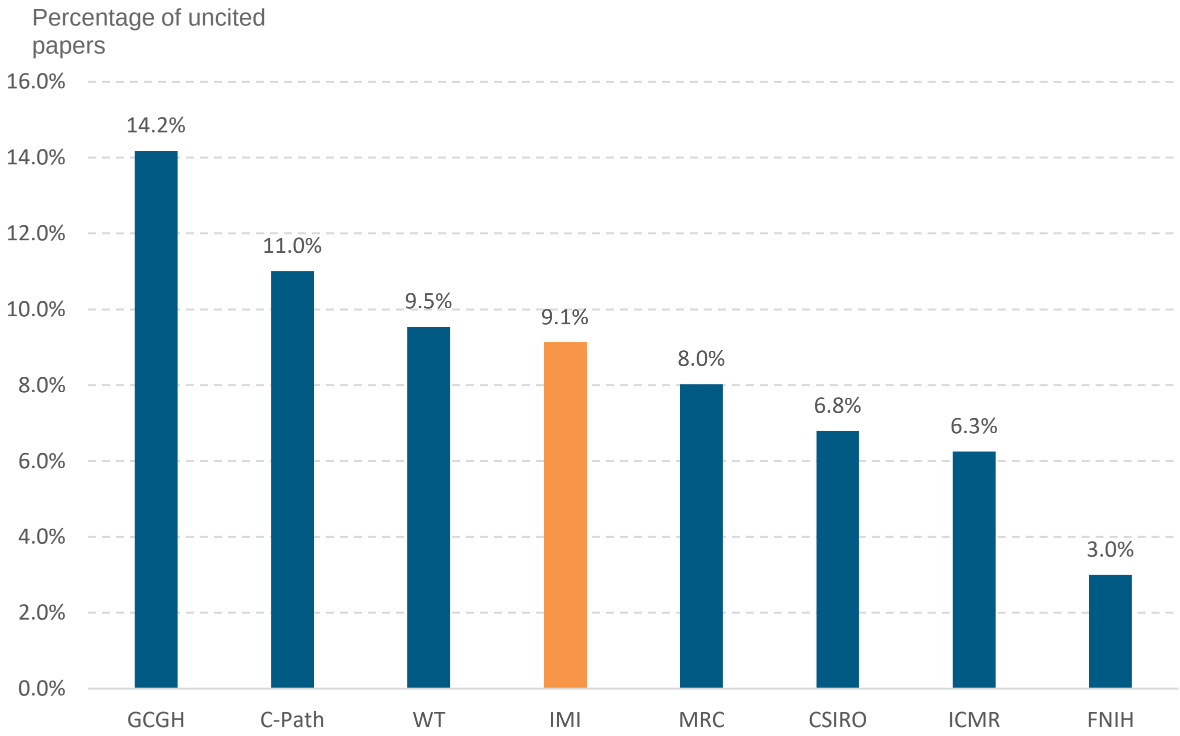
Most publication datasets will include papers which have no citations. Figure 8.2.5.1 shows the percentage of uncited papers between 2010 and 2019 for IMI and the selected comparators. Figure 8.2.5.1 shows the trend in average percentage of uncited papers between 2010 and 2019 for IMI and the selected comparators. Figure 8.2.5.2 shows the average percentage of uncited papers between 2010 and 2019 for IMI and the selected comparators. Table 8.2.5.1 has the same data as in Figure 8.2.5.1 and Figure 8.2.5.2.

FIGURE 8.2.5.1 TRENDS IN UNCITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The similar trends in uncited papers indicate the similar citation life-cycle for biomedical research funded across all the benchmarking organisations. More recent publications are less likely to be cited than older publications. Therefore, the higher percentage of uncited papers in most recent years should not be taken as evidence that these articles are more likely to remain uncited.
- Since 2017 IMI has had the lowest percentage of uncited papers

FIGURE 8.2.5.1 AVERAGE PERCENTAGE OF UNCITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- Around 9% of IMI project papers remained uncited between 2010 and 2019, similar to the Wellcome Trust. GCGH is an exception; between 2010 and 2019 FNIH only had 3.0% of papers uncited.

TABLE 8.2.5.1 PERCENTAGE OF UNCITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.5%	0.4%
2011	0.0%	1.3%	0.0%	1.1%	0.0%	1.7%	0.5%	0.5%
2012	0.0%	1.3%	2.6%	0.0%	0.0%	2.9%	0.5%	0.6%
2013	0.8%	0.0%	5.7%	0.4%	0.9%	2.7%	0.7%	0.8%
2014	0.2%	2.1%	2.5%	1.2%	0.9%	3.6%	0.9%	0.7%
2015	0.6%	1.0%	1.5%	0.5%	2.5%	5.5%	1.1%	1.4%
2016	1.4%	1.1%	2.4%	1.7%	0.0%	7.7%	2.1%	1.8%
2017	2.3%	8.2%	3.0%	6.5%	4.7%	12.1%	3.2%	3.6%
2018	8.1%	13.3%	18.5%	14.1%	12.1%	25.3%	10.6%	10.0%
2019	42.6%	48.5%	60.8%	55.9%	53.3%	65.5%	49.4%	49.4%
Total	**9.1%**	**6.8%**	**11.0%**	**3.0%**	**14.2%**	**6.3%**	**8.0%**	**9.5%**

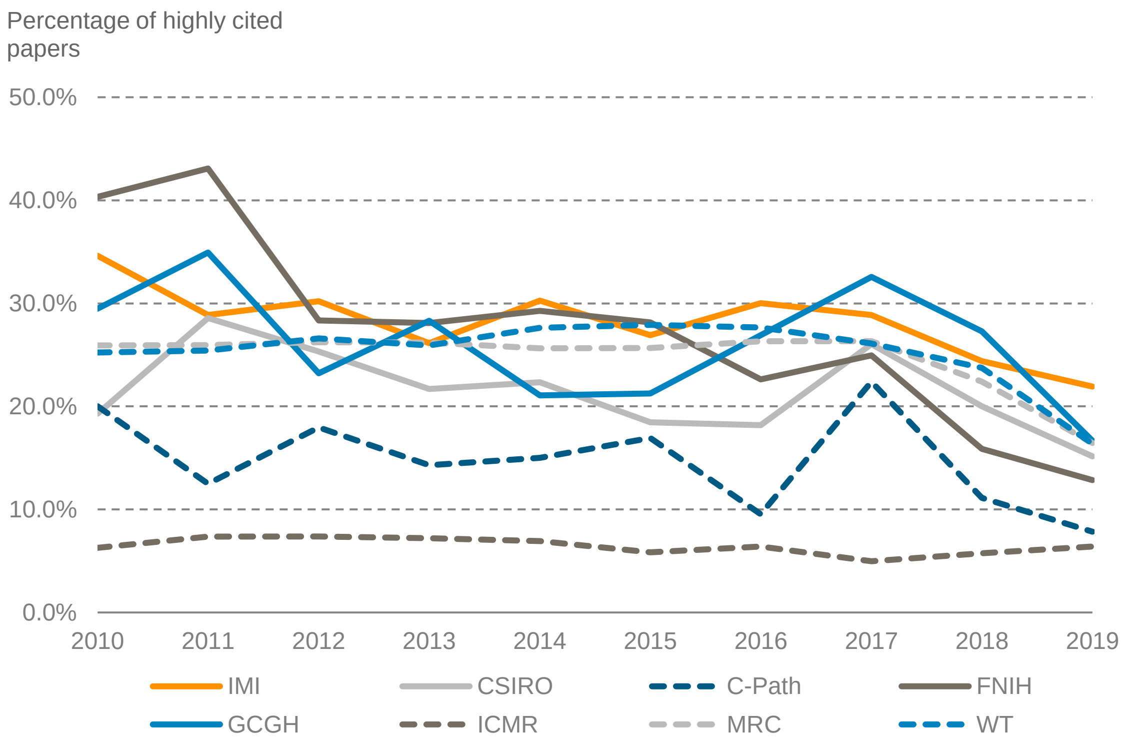
- No IMI project papers published between 2010 and 2012 are uncited. IMI's share of uncited research in the most recent years, 2017 to 2019, is the lowest of the comparators.

8.2.6 TRENDS IN HIGHLY- CITED RESEARCH: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

As discussed in Section 3, highly cited work is recognised as having a greater impact, and citation counts have been correlated this with other qualitative evaluations of research performance, such as peer review. For institutional research evaluation, we have found that the world's top 10% of most highly cited papers is often a suitable definition of highly cited work. Therefore, if more than 10% of an entity's publications are in the top 10% of the world's most highly cited papers, then it has performed better than expected.

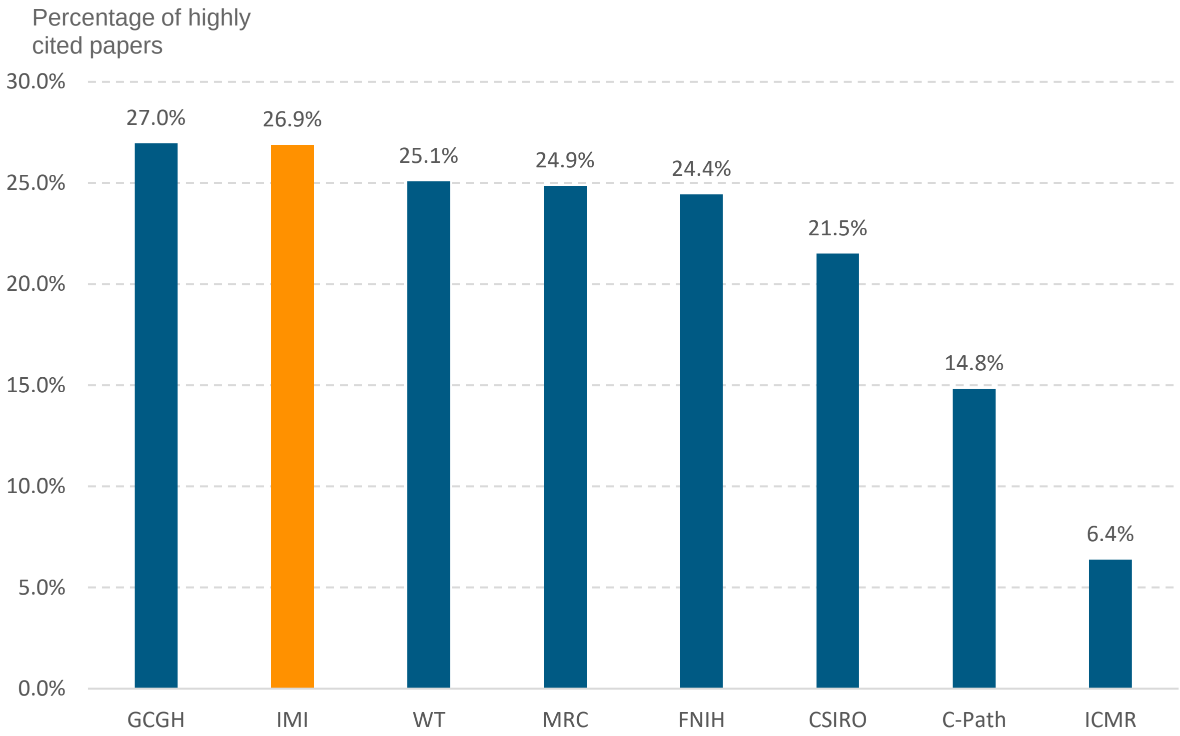
Figure 8.2.6.1 shows the annual trends in percentage of highly cited papers between 2010 and 2019 for IMI and the selected comparators. Figure 8.2.6.2 shows the total percentage of highly cited papers between 2010 and 2019 for IMI and the selected comparators. Table 8.2.6.1 has the same data as in Figure 8.2.6.1 and Figure 8.2.6.2.

FIGURE 8.2.6.1 TRENDS IN HIGHLY CITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- Between 2010 and 2019, IMI and most of the comparators had an above average (10%) percentage of high-cited papers the exceptions being ICMR, which was consistently below the world average, and C-Path, which was below average in 2014 and 2019.
- In most years, IMI is among the organisations with the highest percentage of high-cited papers.

FIGURE 8.2.6.2 PERCENTAGE OF HIGHLY CITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- Only GCGH had a slightly higher percentage of highly cited papers (27.0%) compared to IMI (26.9%).
- Around a quarter of papers published by IMI and the comparators between 2010 and 2019 were highly cited. C-Path had a comparatively lower proportions of highly cited papers (14.8%) while ICMR was well below world average performance.

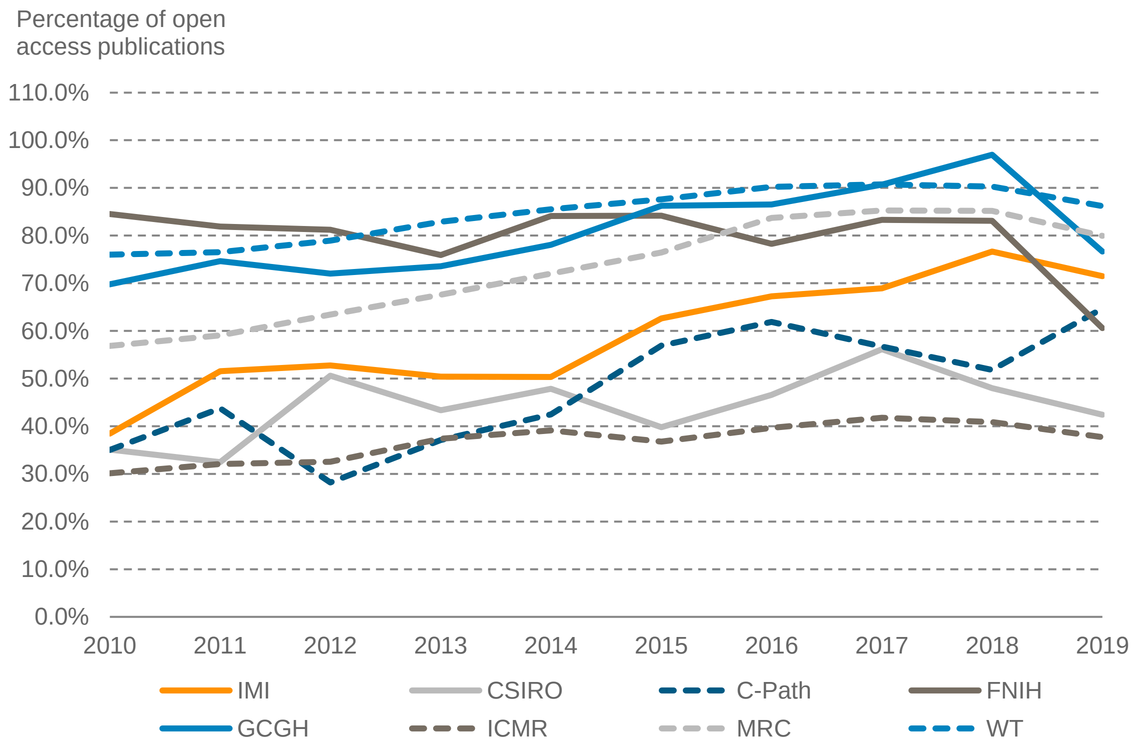
TABLE 8.2.6.1 PERCENTAGE OF HIGHLY CITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	34.6%	19.3%	20.0%	40.3%	29.5%	6.3%	25.9%	25.2%
2011	28.9%	28.6%	12.5%	43.1%	34.9%	7.4%	25.9%	25.4%
2012	30.2%	25.3%	17.9%	28.3%	23.2%	7.4%	26.2%	26.6%
2013	26.1%	21.7%	14.3%	28.1%	28.3%	7.2%	26.2%	25.9%
2014	30.3%	22.3%	15.0%	29.3%	21.1%	6.9%	25.6%	27.6%
2015	26.9%	18.4%	16.9%	28.2%	21.2%	5.8%	25.7%	27.9%
2016	30.0%	18.2%	9.5%	22.6%	26.9%	6.4%	26.3%	27.7%
2017	28.9%	26.0%	22.4%	24.9%	32.6%	5.0%	26.3%	26.1%
2018	24.4%	20.0%	11.1%	15.9%	27.3%	5.8%	22.4%	23.7%
2019	21.9%	15.2%	7.8%	12.8%	16.7%	6.4%	16.4%	16.4%
Total	**26.9%**	**21.5%**	**14.8%**	**24.4%**	**27.0%**	**6.4%**	**24.9%**	**25.1%**

8.2.7 TRENDS IN OPEN ACCESS RESEARCH: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

Figure 8.2.7.1 shows annual trends in the percentage of open access publications between 2010 and 2019 for IMI and the selected comparators. Figure 8.2.7.2 shows the total percentage of open access publications between 2010 and 2019 for IMI and the selected comparators. Table 8.2.7.1 shows the same data as in Figure 8.2.7.1 and Figure 8.2.7.2.[19]

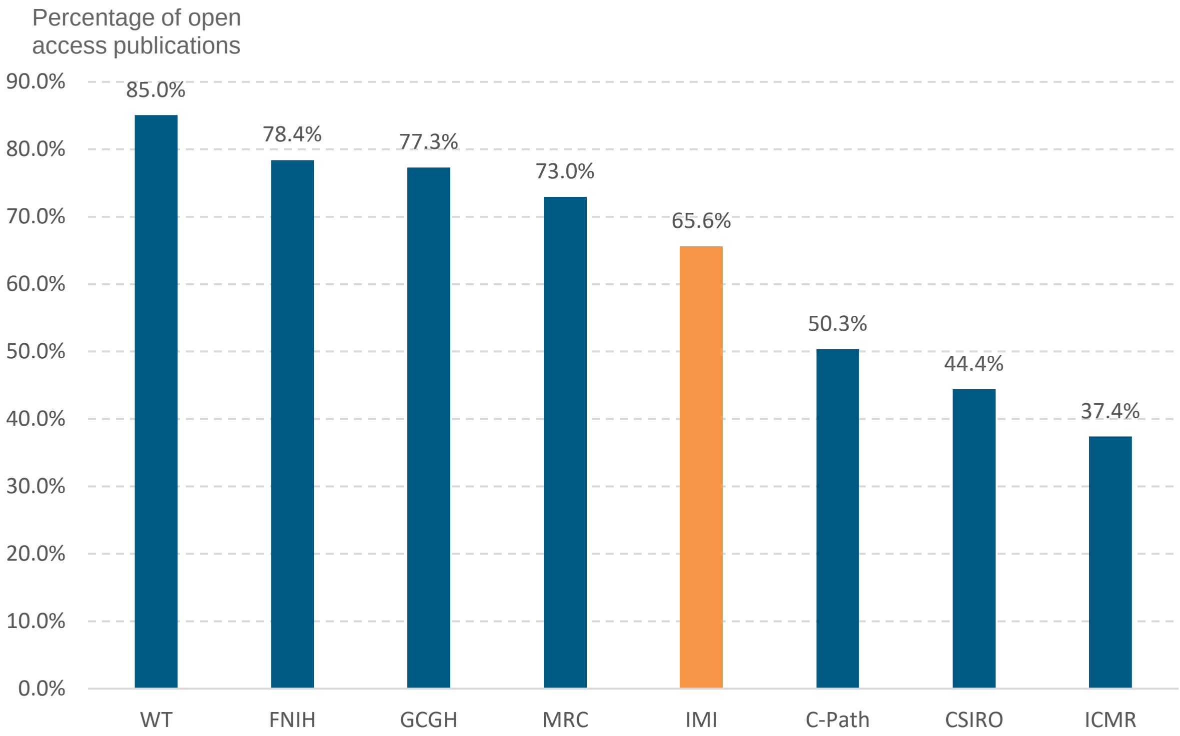
FIGURE 8.2.7.1 TRENDS IN OPEN ACCESS PUBLICATIONS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- IMI and most of the comparators have increased their output of open access publications between 2010 and 2019.

[19] The Web of Science open access data come from the Directory of Open Access Journals (DOAJ) and collaborations with Impact Story and Our Research's Unpaywall services. The Web of Science therefore provides unrivalled coverage of open access publications that are published through DOAJ Gold, Other Gold, Green Published, Green Accepted or Bronze routes. It is also possible that some publishers make publications available without following a recognised open access route. In these cases publications will not be indexed as open access in the Web of Science or in this report.

FIGURE 8.2.7.2 TOTAL PERCENTAGE OF OPEN ACCESS PUBLICATIONS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019



- The majority of organisations, including IMI, have published more than half of their of publications as open access. IMI had a lower share of open access publications compared to FNIH, GCGH, MRC, and WT.
- WT has the highest percentage of open access publications in all years between 2010 and 2019, with an average of 85.0% of all publications.

TABLE 8.2.7.1 PERCENTAGE OF OPEN ACCESS PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	38.5%	35.1%	35.0%	84.5%	69.8%	30.1%	56.9%	76.0%
2011	51.5%	32.5%	43.8%	81.9%	74.7%	32.1%	59.0%	76.5%
2012	52.8%	50.6%	28.2%	81.3%	72.0%	32.5%	63.4%	79.0%
2013	50.4%	43.4%	37.1%	75.9%	73.6%	37.4%	67.6%	82.9%
2014	50.3%	47.9%	42.5%	84.1%	78.1%	39.1%	72.0%	85.5%
2015	62.6%	39.8%	56.9%	84.2%	86.3%	36.8%	76.5%	87.6%
2016	67.3%	46.6%	61.9%	78.3%	86.5%	39.7%	83.7%	90.2%
2017	69.0%	56.2%	56.7%	83.3%	90.7%	41.8%	85.3%	90.8%
2018	76.7%	48.0%	51.9%	83.1%	97.0%	40.9%	85.2%	90.3%
2019	71.5%	42.4%	64.7%	60.6%	76.7%	37.7%	80.0%	86.2%
Total	**65.6%**	**44.4%**	**50.3%**	**78.4%**	**77.3%**	**37.4%**	**73.0%**	**85.0%**

8.3 SUMMARY OF BIBLIOMETRIC INDICATORS: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

Although IMI has only been funding research for just over a decade, its performance is on par with well-established funding bodies that have been operating for much longer, like the MRC and the Wellcome Trust, as indicated by comparable citation impacts, and percentages of highly cited papers (Table 8.3.1).

TABLE 8.3.1 SUMMARY OF BIBLIOMETRIC INDICATORS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2019

	Number of papers	Citation impact (normalised at field level)	Percentage of uncited papers	Percentage of highly cited papers
IMI	5,445	2.05	9.1%	26.9%
CSIRO	445	1.47	11.0%	14.8%
C-Path	795	1.71	6.8%	21.5%
FNIH	3,438	1.93	3.0%	24.4%
GCGH	868	1.96	14.2%	27.0%
ICMR	12,853	0.82	6.3%	6.4%
MRC	94,100	2.00	8.0%	24.9%
WT	69,191	2.05	9.5%	25.1%

ANNEX 1: BIBLIOMETRICS AND CITATION ANALYSIS

Bibliometrics are about publications and their citations. The academic field emerged from 'information science' and now usually refers to the methods used to study and index texts and information.

Publications cite other publications. These citation links grow into networks, and their numbers are likely to be related to the significance or impact of the publication. The meaning of the publication is determined from keywords and content. Citation analysis and content analysis have therefore become a common part of bibliometric methodology. Historically, bibliometric methods were used to trace relationships amongst academic journal citations. Now, bibliometrics are important in indexing research performance.

Bibliometric data have particular characteristics of which the user should be aware, and these are considered here.

Journal papers (publications, sources) report research work. Papers refer to or 'cite' earlier work relevant to the material being reported. New papers are cited in their turn. Papers that accumulate more citations are thought of as having greater 'impact', which is interpreted as significance or influence on their field. Citation counts are therefore recognised as a measure of impact, which can be used to index the excellence of the research from a particular group, institution or country.

The origins of citation analysis as a tool that could be applied to research performance can be traced to the mid-1950s, when Eugene Garfield proposed the concept of citation indexing and introduced the Science Citation Index, the Social Sciences Citation Index and the Arts & Humanities Citation Index, produced by the Institute of Scientific Information (now Clarivate).[20]

We can count citations, but they are only 'indicators' of impact or quality – not metrics. Most impact indicators use average citation counts from groups of papers, because some individual papers may have unusual or misleading citation profiles. These outliers are diluted in larger samples.

Data source

The data we use come from the Clarivate Web of Science databases which give access not only to journals but also to conference proceedings, books, patents, websites, and chemical structures, compounds and reactions. It has a unified structure that integrates all data and search terms together and therefore provides a level of comparability not found in other databases. It is widely acknowledged to be the world's leading source of citation and bibliometric data. The Clarivate Web of Science Core Collection is part of the Web of Science, and focuses on research published in journals and conferences in science, medicine, arts, humanities and social sciences.

The Web of Science was originally created as an awareness and information retrieval tool but it has acquired an important primary use as a tool for research evaluation, using citation analysis and bibliometrics. Data coverage is both current and retrospective in the sciences, social sciences, arts and humanities, in some cases back to 1900. Within the research community this data source was previously referred to by the acronym 'ISI'.

Unlike other databases, the Web of Science and underlying databases are selective, that is: the journals abstracted are selected using rigorous editorial and quality criteria. The authoritative, multidisciplinary content covers over 12,000 of the highest impact journals worldwide, including open access journals, and over 150,000 conference proceedings. The abstracted journals encompass the majority of significant, frequently cited scientific reports and, more importantly, an even greater proportion of the scientific research output which is cited. This selective process ensures that the citation counts remain

[20] Garfield, E (1955) Citation Indexes for Science – New dimension in documentation through association of ideas. *Science*: **122**, 108-111.

relatively stable in given research fields and do not fluctuate unduly from year to year, which increases the usability of such data for performance evaluation.

Clarivate has extensive experience with databases on research inputs, activity and outputs and has developed innovative analytical approaches for benchmarking and interpreting international, national and institutional research impact.

Database categories

The source data can be grouped in various classification systems. Most of these are based on groups of journals that have a relatively high cross-citation linkage and naturally cluster together. Custom classifications use subject maps in third-party data such as the OECD categories set out in the Frascati manual.

Clarivate frequently uses the broader field categories in the InCites: Essential Science Indicators^{TM} and the finer journal categories in the Web of Science. There are 22 fields in Essential Science Indicators and 254 fields in Web of Science. In either case, our bibliometric analyses draw on the full range of data available in the underlying database, so analyses in our reports will differ slightly from anything created 'on the fly' from data in the web interface.

The lists of journal categories in these systems are attached at the end of this document.

Most analyses start with an overall view across the data, then move to a view across broad categories and only then focus in at a finer level in the areas of greatest interest to policy, programme or organisational purpose.

Assigning papers to addresses

A paper is assigned to each country and each organisation whose address appears at least once for any author on that paper. One paper counts once and only once for each assignment, however many address variants occur for the country or organisation. No weighting is applied.

For example, a paper has five authors, thus:

Author	Organisation	Country		
Gurney, KA	Univ Leeds	UK	**Counts for Univ Leeds**	**Counts for UK**
Adams, J	Univ Leeds	UK	No gain for Univ Leeds	No gain for UK
Kochalko, D	Univ C San Diego	USA	**Counts for UCSD**	**Counts for USA**
Munshi, S	Gujarat Univ	India	**Counts for Gujarat Univ**	**Counts for India**
Pendlebury, D	Univ Oregon	USA	**Counts for Univ Oregon**	No gain for USA

So this one paper with five authors would be included once in the tallies for each of four universities and once in the tallies for each of three countries.

Work carried out within Clarivate, and research published elsewhere, indicates that fractional weighting based on the balance of authors by organisation and country makes little difference to the conclusions of an analysis at an aggregate level. Such fractional analysis can introduce unforeseen errors in the attempt to create a detailed but uncertain assignment. Partitioning credit would make a greater difference at a detailed, group level but the analysis can then be manually validated.

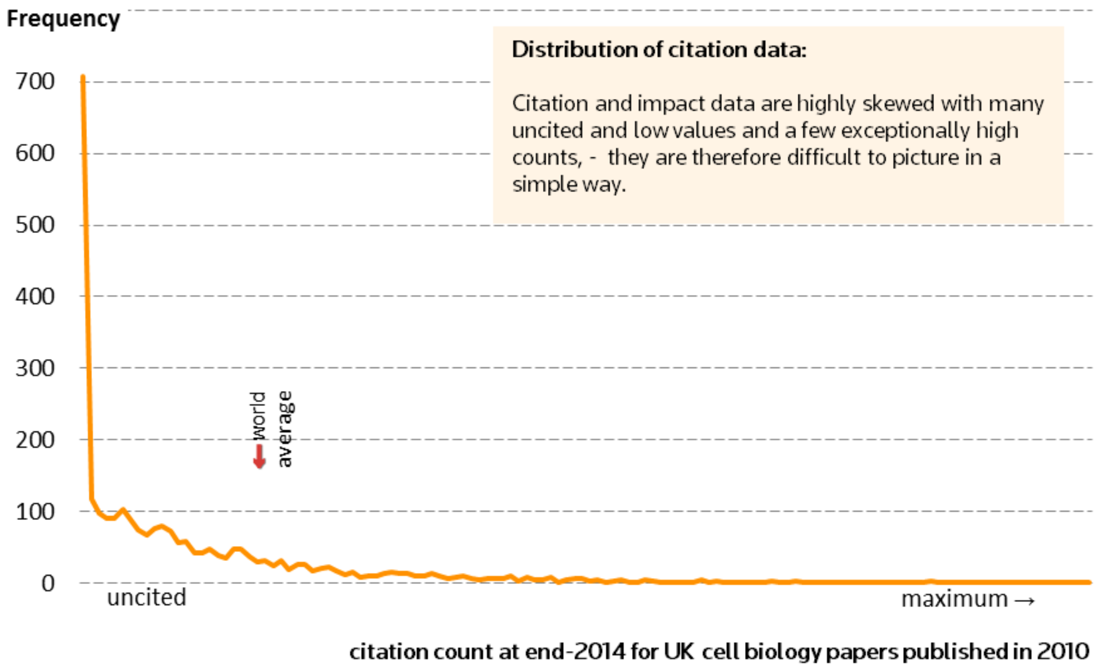
Citation counts

A publication accumulates citation counts when it is referred to by more recent publications. Some papers get cited frequently and many get cited rarely or never, so the distribution of citations is highly skewed.

Why are many papers never cited? Certainly some papers remain uncited because their content is of little or no impact, but that is not the only reason. It might be because they have been published in a journal not read by researchers to whom the paper might be interesting. It might be that they represent important but ‘negative’ work reporting a blind alley to be avoided by others. The publication may be a commentary in an editorial, rather than a normal journal article and thus of general rather than research interest. Or it might be that the work is a ‘sleeping beauty’ that has yet to be recognised for its significance.

Other papers can be very highly cited: hundreds, even thousands of times. Again, there are multiple reasons for this. Most frequently cited work is being recognised for its innovative significance and impact on the research field of which it speaks. Impact here is a good reflection of quality: it is an indicator of excellence. But there are other papers which are frequently cited because their significance is slightly different: they describe key methodology; they are a thoughtful and wide-ranging review of a field; or they represent contentious views which others seek to refute.

Citation analysis cannot make value judgments about why an article is uncited nor about why it is highly cited. The analysis can only report the citation impact that the publication has achieved. We normally assume, based on many other studies linking bibliometric and peer judgments, that high citation counts correlate on average with the quality of the research.



The figure shows the skewed distribution of more or less frequently cited papers from a sample of UK authored publications in cell biology. The skew in the distribution varies from field to field. It is to compensate for such factors that actual citation counts must be normalised, or rebased, against a world baseline.

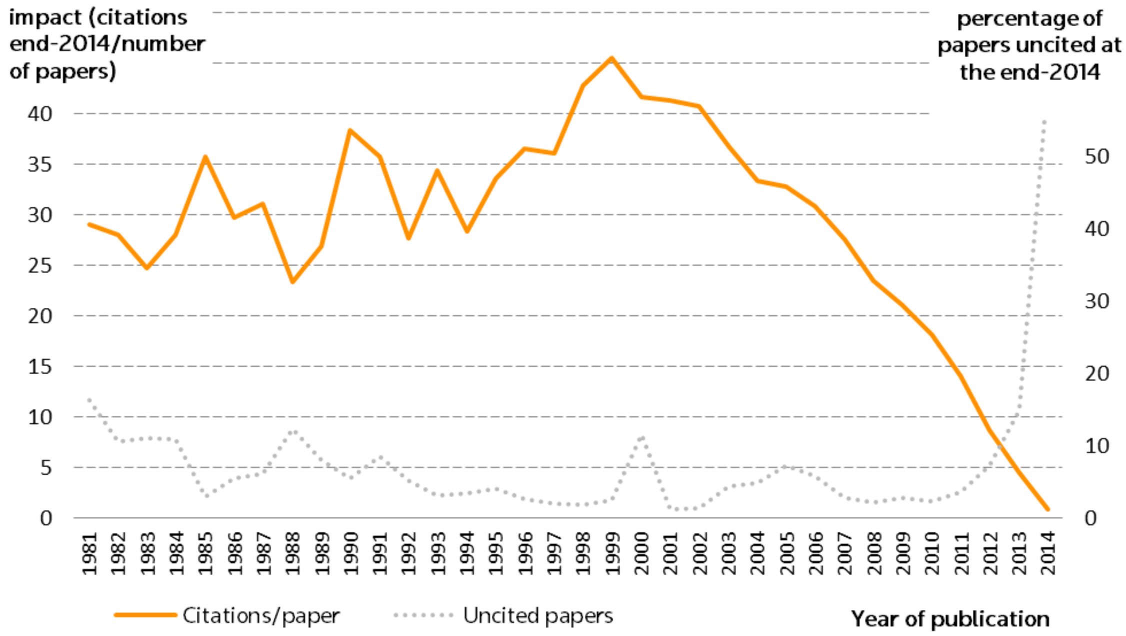
We do not seek to account separately for the effect of self-citation. If the citation count is significantly affected by self-citation then the paper is likely to have been infrequently cited. This is therefore only of consequence for low impact activity. Studies show that for large samples at national and organisational level the effect of self-citation has little or no effect on the analytical outcomes and would not alter interpretation of the results.

Time factors

Citations accumulate over time. Older papers therefore have, on average, more citations than more recent work. The graph below shows the pattern of citation accumulation for a set of 33 journals in the journal category ***Materials Science, Biomaterials***. Papers less than eight years old are, on average, still accumulating additional citations. The citation count goes on to reach a plateau for older sources.

The graph shows that the percentage of papers that have never been cited drops over about five years. Beyond five years, between 5% and 10% or more of papers remain uncited.

Account must be taken of these time factors in comparing current research with historical patterns. For these reasons, it is sometimes more appropriate to use a fixed five-year window of papers and citations to compare two periods than to look at the longer term profile of citations and of uncitedness for a recent year and an historical year.



Discipline factors

Citation rates vary between disciplines and fields. For the UK science base as a whole, ten years produces a general plateau beyond which few additional citations would be expected. On the whole, citations accumulate more rapidly and plateau at a higher level in biological sciences than physical sciences, and natural sciences generally cite at a higher rate than social sciences.

Papers are assigned to disciplines (journal categories or research fields) by Clarivate, bringing cognate research areas together. The journal category classification scheme has been recently revised and updated. Before 2007, journals were assigned to the older, well established Current Contents categories which were informed by extensive work by Thomson and with the research community since the early 1960s. This scheme has been superseded by the 252 Web of Science journal categories which allow for greater disaggregation for the growing volume of research which is published and abstracted.

Papers are allocated according to the journal in which the paper is published. Some journals may be considered to be part of the publication record for more than one research field. As the example below illustrates, the journal *Acta Biomaterialia* is assigned to two journal categories: ***Materials Science, Biomaterials*** and ***Engineering, Biomedical***.

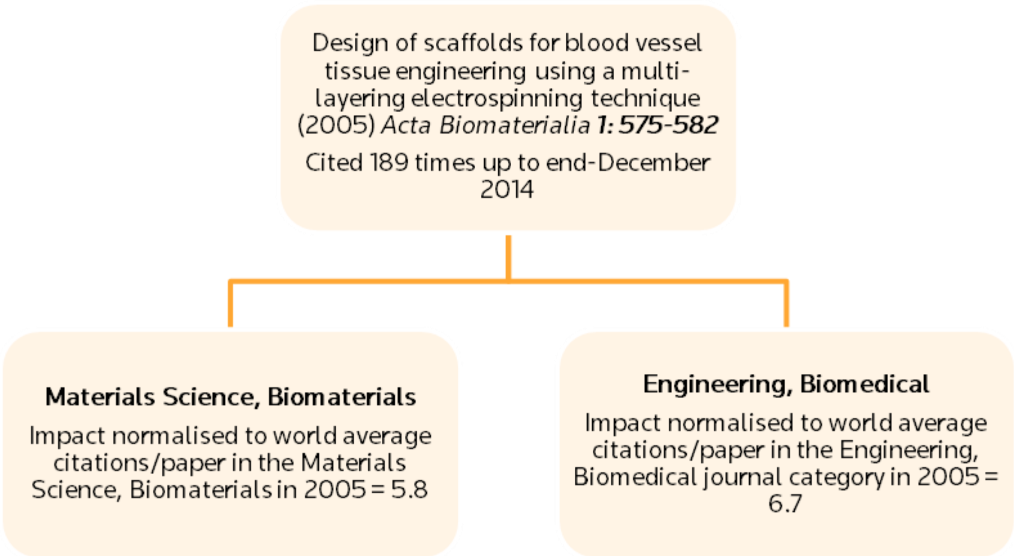
Very few papers are not assigned to any research field and as such will not be included in specific analyses using normalised citation impact data. The journals included in the Clarivate databases and how they are selected are detailed heremjl.clarivate.com/.
Some journals with a very diverse content, including the prestigious journals *Nature* and *Science* were classified as ***Multidisciplinary*** in databases created prior to 2007. The papers from these ***Multidisciplinary*** journals are now re-assigned to more specific research fields using an algorithm based on the research area(s) of the references cited by the article.

Normalised citation impact

Because citations accumulate over time at a rate that is dependent upon the field of research, all analyses must take both field and year into account. In other words, because the absolute citation count for a specific article is influenced by its field and by the year it was published, we can only make comparisons of indexed data after normalising with reference to these two variables.

We only use citation counts for reviews and articles in calculations of impact, because document type influences the citation count. For example, a review will often be cited more frequently than an article in the same field, but editorials and meeting abstracts are rarely cited and citation rates for conference proceedings are extremely variable. The most common normalisation factors are the average citations per paper for (1) the year and (2) either the field or the journal in which the paper was published. This normalisation is also referred to as 'rebasing' the citation count.

Impact is therefore most commonly analysed in terms of 'normalised impact', or NCI. The following schematic illustrates how the normalised citation impact is calculated at paper level and journal category level.



This article in the journal *Acta Biomaterialia* is assigned to two journal categories: ***Materials Science, Biomaterials*** and ***Engineering, Biomedical***. The world average baselines for, as an example, ***Materials science, Biomaterials*** are calculated by summing the citations to all the articles and reviews published worldwide in the journal *Acta Biomaterialia* and the other 32 journals assigned to this category for each year, and dividing this by the total number of articles and reviews published in the journal category. This gives the category-specific normalised citation impact (in the above example the category-specific field-normalised citation impact for ***Materials Science, Biomaterials*** is 5.8 and the category-specific field-normalised citation impact for ***Engineering, Biomedical*** is higher at 6.7). Most papers (nearly two-thirds) are assigned to a single journal category whilst a minority are assigned to more than 5.

Citation data provided by Clarivate are assigned on an annual census date referred to as the Article Time Period. For the majority of publications the Article Time Period is the same as the year of publication, but for a few publications (especially those published at the end of the calendar year in less main-stream journals) the Article Time Period may vary from the actual year of publication.

World average impact data are sourced from the Clarivate National Science Indicators baseline data for 2016.

Mean normalised citation impact

Research performance has historically been indexed by using average citation impact, usually compared to a world average that accounts for time and discipline. As noted, however, the distribution of citations amongst papers is highly skewed because many papers are never cited while a few papers accumulate very large citation counts. That means that an average may be misleading if assumptions are made about the distribution of the underlying data.

In fact, almost all research activity metrics are skewed: for research income, PhD numbers and publications there are many low activity values and a few exceptionally high values. In reality, therefore, the skewed distribution means that average impact tends to be greater than and often significantly different from either the median or mode in the distribution. This should be borne in mind when reviewing analytical outcomes.

The average (normalised) citation impact can be calculated at an individual paper level where it can be associated with more than one journal category. It can also be calculated for a set of papers at any level from a single country to an individual researcher's output. In the example above, the average citation impact of the *Acta Biomaterialia* paper can be expressed as ((5.8 + 6.7)/2) = 6.3.

What are uncited papers?

It may be a surprise that some journal papers are never subsequently cited after publication, even by their authors. This accounts for about half the total global output for a typical, recent 10-year period. We cannot tell why papers are not cited. It is likely that a significant proportion of papers remain uncited because they are reporting negative results which are an essential matter of record in their field but make the content less likely to be referenced in other papers. Inevitably, other papers are uncited because their content is trivial or marginal to the mainstream. However, it should not be assumed that this is the case for all such papers.

There is variation in non-citation between countries and between fields. For example, relatively more engineering papers tend to remain uncited than papers in other sciences, indicative of a disciplinary factor but not a quality factor. While there is also an obvious increase in the likelihood of citation over time, most papers that are going to be cited will be cited within a few years of publication.

Journal category systems used in our analyses

WEB OF SCIENCE

Acoustics	Classics	Engineering, multidisciplinary
Agricultural economics & policy	Clinical neurology	Engineering, ocean
Agricultural engineering	Communication	Engineering, petroleum
Agriculture, dairy & animal science	Computer science, artificial intelligence	Entomology
Agriculture, multidisciplinary	Computer science, cybernetics	Environmental sciences
Agriculture, soil science	Computer science, hardware & architecture	Environmental studies
Agronomy	Computer science, information systems	Ergonomics
Allergy	Computer science, interdisciplinary applications	Ethics
Anatomy & morphology	Computer science, software engineering	Ethnic studies
Andrology	Computer science, theory & methods	Evolutionary biology
Anesthesiology	Construction & building technology	Family studies
Anthropology	Criminology & penology	Film, radio, television
Applied linguistics	Critical care medicine	Fisheries
Archaeology	Crystallography	Folklore
Architecture	Dance	Food science & technology
Area studies	Demography	Forestry
Art	Dentistry, oral surgery & medicine	Gastroenterology & hepatology
Asian studies	Dermatology	Genetics & heredity
Astronomy & astrophysics	Developmental biology	Geochemistry & geophysics
Automation & control systems	Ecology	Geography
Behavioral sciences	Economics	Geography, physical
Biochemical research methods	Education & educational research	Geology
Biochemistry & molecular biology	Education, scientific disciplines	Geosciences, multidisciplinary
Biodiversity conservation	Education, special	Geriatrics & gerontology
Biology	Electrochemistry	Health care sciences & services
Biology, miscellaneous	Emergency medicine	Health policy & services
Biophysics	Endocrinology & metabolism	Hematology
Biotechnology & applied microbiology	Energy & fuels	History
Business	Engineering, aerospace	History & philosophy of science
Business, finance	Engineering, biomedical	History of social sciences
Cardiac & cardiovascular systems	Engineering, chemical	Horticulture
Cell biology	Engineering, civil	Humanities, multidisciplinary
Chemistry, analytical	Engineering, electrical & electronic	Imaging science & photographic technology
Chemistry, applied	Engineering, environmental	Immunology
Chemistry, inorganic & nuclear	Engineering, geological	Industrial relations & labor
Chemistry, medicinal	Engineering, industrial	Infectious diseases

Chemistry, multidisciplinary	Engineering, manufacturing	Information & library science
Chemistry, organic	Engineering, marine	Instruments & instrumentation
Chemistry, physical	Engineering, mechanical	Integrative & complementary medicine
International relations	Mining & mineral processing	Psychology
Language & linguistics	Multidisciplinary sciences	Psychology, applied
Language & linguistics theory	Music	Psychology, biological
Law	Mycology	Psychology, clinical
Limnology	Nanoscience & nanotechnology	Psychology, developmental
Linguistics	Neuroimaging	Psychology, educational
Literary reviews	Neurosciences	Psychology, experimental
Literary theory & criticism		Psychology, mathematical
Literature	Nuclear science & technology	Psychology, multidisciplinary
Literature, African, Australian, Canadian	Nursing	Psychology, psychoanalysis
Literature, American	Nutrition & dietetics	Psychology, social
Literature, British Isles	Obstetrics & gynecology	Public administration
Literature, German, Dutch, Scandinavian	Oceanography	Public, environmental & occupational health
Literature, romance	Oncology	Radiology, nuclear medicine & medical imaging
Literature, Slavic	Operations research & management science	Rehabilitation
Management	Ophthalmology	Religion
Marine & freshwater biology	Optics	Remote sensing
Materials science, biomaterials	Ornithology	Reproductive biology
Materials science, ceramics	Orthopedics	Respiratory system
Materials science, characterization & testing	Otorhinolaryngology	Rheumatology
Materials science, coatings & films	Paleontology	Robotics
Materials science, composites	Parasitology	Social issues
Materials science, multidisciplinary	Pathology	Social sciences, biomedical
Materials science, paper & wood	Pediatrics	Social sci, interdisciplinary
Materials science, textiles	Peripheral vascular disease	Social sci, mathematical methods
Math & computational biology	Pharmacology & pharmacy	Social work
Mathematics	Philosophy	Sociology
Mathematics, applied	Physics, applied	Soil science
Mathematics, interdisciplinary applications	Physics, atomic, molecular & chemical	Spectroscopy
Mechanics	Physics, condensed matter	Sport sciences
Medical ethics	Physics, fluids & plasmas	Statistics & probability
Medical informatics	Physics, mathematical	Substance abuse
Medical laboratory technology	Physics, multidisciplinary	Surgery
Medicine, general & internal	Physics, nuclear	Telecommunications
Medicine, legal	Physics, particles & fields	Theater
Medicine, research & experimental	Physiology	Thermodynamics
Medieval & renaissance studies	Planning & development	Toxicology

Metallurgy & metallurgical engineering	Plant sciences	Transplantation
Meteorology & atmospheric sci	Poetry	Transportation
Microbiology	Political science	Transportation science & technology
Microscopy	Polymer science	Tropical medicine
Mineralogy	Psychiatry	
Urban studies		
Urology & nephrology		
Veterinary		
Veterinary sciences		
Virology		
Water resources		
Women's studies		
Zoology		

ESSENTIAL SCIENCE INDICATORS

Agricultural Sciences	Geosciences	Pharmacology
Biology & Biochemistry	Immunology	Physics
Chemistry	Law	Plant & Animal Science
Clinical Medicine	Materials Science	Psychology/Psychiatry
Computer Science	Mathematics	Social Sciences, general
Ecology/Environment	Microbiology	Space Science
Economics & Business	Molecular Biology & Genetics	
Education	Multidisciplinary	
Engineering	Neurosciences & Behaviour	

ANNEX 2: BIOMEDICALLY RELATED JOURNAL CATEGORIES

This Annex lists the Web of Science journal categories which capture biomedically related publications.

- Allergy
- Anaesthesiology
- Anatomy & Morphology
- Andrology
- Audiology & Speech-Language Pathology
- Behavioural Sciences
- Cardiac & Cardiovascular Systems
- Cell & Tissue Engineering
- Clinical Neurology
- Critical Care Medicine
- Dentistry, Oral Surgery & Medicine
- Dermatology
- Emergency Medicine
- Endocrinology & Metabolism
- Ergonomics
- Gastroenterology & Hepatology
- Geriatrics & Gerontology
- Gerontology
- Haematology
- Health Care Sciences & Services
- Health Policy & Services
- Immunology
- Infectious Diseases
- Integrative & Complementary Medicine
- Medical Ethics
- Medical Informatics
- Medical Laboratory Technology
- Medicine, General & Internal
- Medicine, Legal
- Medicine, Research & Experimental
- Neuroimaging
- Neurosciences
- Nursing
- Nutrition & Dietetics
- Obstetrics & Gynaecology
- Oncology
- Ophthalmology
- Orthopaedics
- Otorhinolaryngology
- Paediatrics
- Pathology
- Peripheral Vascular Disease
- Pharmacology & Pharmacy
- Physiology
- Primary Health Care
- Psychiatry
- Psychology
- Psychology, Applied
- Psychology, Biological
- Psychology, Clinical
- Psychology, Developmental
- Psychology, Educational
- Psychology, Experimental
- Psychology, Mathematical
- Psychology, Psychoanalysis
- Psychology, Social
- Public, Environmental & Occupational Health
- Radiology, Nuclear Medicine & Medical Imaging
- Rehabilitation
- Reproductive Biology
- Respiratory System
- Rheumatology
- Substance Abuse
- Surgery
- Transplantation
- Tropical Medicine
- Urology & Nephrology
- Virology

ANNEX 3: TOTAL NUMBER OF WEB OF SCIENCE PUBLICATIONS FROM IMI PROJECTS BETWEEN 2010 AND 2019 BY COUNTRY

Country	Number of publications
United Kingdom	2,404
Germany	1,844
USA	1,374
Netherlands	1,369
Sweden	995
France	975
Italy	773
Switzerland	730
Spain	633
Belgium	531
Denmark	432
Canada	382
Austria	344
Finland	264
Greece	187
Australia	177
China	155
Ireland	139
Poland	129
Norway	122
Japan	106
Brazil	87
Portugal	82
Israel	76
Estonia	56
Hungary	56
South Africa	50
Czech Republic	45
Singapore	42
Luxembourg	38
Iceland	33
India	33
Saudi Arabia	32
Taiwan	32
New Zealand	28
Turkey	27
Cyprus	27
South Korea	27
Croatia	25

Country	Number of publications
Argentina	22
Slovenia	21
Lithuania	18
Russia	16
Romania	15
Qatar	14
Serbia	13
Egypt	13
Thailand	13
Iran	11
Kenya	8
Bulgaria	8
Lebanon	7
Tanzania	6
Mexico	6
Tunisia	5
Malta	5
Latvia	5
Chile	4
Nigeria	4
Kuwait	4
Gambia	4
Pakistan	4
Ukraine	4
Vietnam	4
Uruguay	4
Peru	4
Uganda	4
Guinea	3
Liechtenstein	3
Sierra Leone	3
Sri Lanka	2
Gabon	2
Ethiopia	2
Iraq	2
Jordan	2
Macedonia	2
Malaysia	2
Oman	2
Colombia	2
Philippines	2
Slovakia	2
Bosnia & Herzeg	2
Belarus	2

Country	Number of publications
Senegal	1
Cook Islands	1
Cote Ivoire	1
Cambodia	1
Zambia	1
Mozambique	1
Morocco	1
Mongolia	1
Botswana	1
Guatemala	1
Zimbabwe	1
Bolivia	1
Moldova	1
Mali	1
Malawi	1
Libya	1
Liberia	1
United Arab Emirates	1
Kazakhstan	1
Ghana	1
Democratic Republic of the Congo	1
Ecuador	1
Bangladesh	1
Uzbekistan	1
Indonesia	1
Cameroon	1
Palestine	1
Algeria	1

ANNEX 4: TOTAL NUMBER OF WEB OF SCIENCE PUBLICATIONS, PAPERS AND OPEN-ACCESS PUBLICATIONS BETWEEN 2010 AND 2019 BY PROJECT

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
BTCure	689	634	406	58.9%
EU-AIMS	457	420	308	67.4%
ULTRA-DD	321	276	209	65.1%
EMIF	279	248	201	72.0%
NEWMEDS	207	194	107	51.7%
EUROPAIN	174	171	61	35.1%
CANCER-ID	168	128	106	63.1%
ORBITO	157	148	38	24.2%
IMIDIA	147	135	114	77.6%
TRANSLOCATION	142	138	76	53.5%
STEMBANCC	129	120	91	70.5%
U-BIOPRED	129	78	54	41.9%
SUMMIT	129	120	88	68.2%
CHEM21	127	119	43	33.9%
INNODIA	121	92	68	56.2%
ELF	115	110	70	60.9%
PreDiCT-TB	113	100	87	77.0%
MIP-DILI	112	103	59	52.7%
Quic-Concept	101	99	73	72.3%
PROTECT	101	98	38	37.6%
eTOX	97	91	62	63.9%
SPRINTT	88	77	37	42.0%
ABIRISK	87	68	36	41.4%
DIRECT	87	61	47	54.0%
COMPACT	84	80	36	42.9%
Pharma-Cog	83	76	24	28.9%
COMBACTE-MAGNET	80	62	53	66.2%
COMBACTE-NET	79	68	57	72.2%
DDMoRe	78	72	49	62.8%
Open PHACTS	73	70	60	82.2%
BioVacSafe	69	63	49	71.0%
BEAT-DKD	64	53	46	71.9%
AETIONOMY	64	57	44	68.8%
K4DD	63	61	39	61.9%
Onco Track	63	59	41	65.1%
RTCure	63	50	41	65.1%
MARCAR	56	54	41	73.2%
DRIVE-AB	54	47	41	75.9%
None	51	27	19	37.3%

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
AIMS-2-TRIALS	51	31	29	56.9%
PRECISESADS	51	32	24	47.1%
RADAR-CNS	50	21	16	32.0%
COMBACTE-CARE	49	42	39	79.6%
RHAPSODY	48	26	26	54.2%
Predect	47	43	36	76.6%
eTRIKS	47	36	36	76.6%
ZAPI	47	40	41	87.2%
RAPP-ID	46	43	22	47.8%
APPROACH	46	32	27	58.7%
ENABLE	42	41	35	83.3%
PRISM	41	31	24	58.5%
GETREAL	40	34	30	75.0%
IMPRiND	39	30	28	71.8%
iPiE	37	34	21	56.8%
BigData@Heart	34	25	23	67.6%
PROACTIVE	32	27	24	75.0%
EPAD	31	24	15	48.4%
FLUCOP	31	28	20	64.5%
iABC	29	14	12	41.4%
EBiSC	28	23	23	82.1%
EBOVAC1	28	25	27	96.4%
TransQST	26	15	13	50.0%
EbolaMoDRAD	23	20	14	60.9%
PHAGO	22	18	18	81.8%
SAFE-T	21	19	6	28.6%
HARMONY	20	8	11	55.0%
EHR4CR	20	17	11	55.0%
AMYPAD	19	11	9	47.4%
eTRANSAFE	18	10	9	50.0%
ROADMAP	18	12	13	72.2%
PREFER	18	8	11	61.1%
WEB-RADR	16	13	9	56.3%
ADVANCE	16	14	11	68.8%
COMBACTE	15	14	9	60.0%
LITMUS	15	7	9	60.0%
ADAPTED	13	12	12	92.3%
EBOVAC2	13	11	10	76.9%
VSV-EBOPLUS	12	8	6	50.0%
VSV-EBOVAC	11	9	6	54.5%
IMI-PainCare	10	5	2	20.0%
TRISTAN	9	7	6	66.7%
RESCEU	9	5	6	66.7%
DRIVE	7	4	3	42.9%

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
EQIPD	7	0	2	28.6%
EUPATI	7	6	7	100.0%
BIOMAP	6	1	1	16.7%
Hypo-RESOLVE	5	0	0	0.0%
PERISCOPE	5	3	3	60.0%
MOBILISE-D	5	0	0	0.0%
MACUSTAR	5	2	5	100.0%
SafeSciMET	5	4	2	40.0%
VAC2VAC	5	3	3	60.0%
EBODAC	4	4	4	100.0%
ADAPT-SMART	4	4	1	25.0%
PD-MitoQUANT	4	3	3	75.0%
ITCC-P4	4	2	2	50.0%
EHDEN	3	1	0	0.0%
DO->IT	3	3	3	100.0%
Eu2P	3	3	2	66.7%
RADAR-AD	3	1	0	0.0%
MOPEAD	2	2	2	100.0%
EMTRAIN	2	1	0	0.0%
IMMUCAN	2	2	2	100.0%
ND4BB	2	2	1	50.0%
EBOMAN	2	2	2	100.0%
PEVIA	2	1	1	50.0%
PIONEER	2	0	1	50.0%
ConcePTION	2	0	0	0.0%
COMBACTE-CDI	2	2	1	50.0%
CARDIATEAM	2	0	0	0.0%
c4c	1	0	1	100.0%
COMBACTE-NEt	1	1	0	0.0%
3TR	1	0	0	0.0%
Pharmatrain	1	1	1	100.0%
PARADIGM	1	1	1	100.0%
NECESSITY	1	0	0	0.0%
ERA4TB	1	0	0	0.0%
EBOVAC	1	1	1	100.0%
EBOVAC3	1	1	1	100.0%
VHFMoDRAD	1	0	0	0.0%
VITAL	1	0	0	0.0%
IM2PACT	1	0	0	0.0%
FILODIAG	1	0	1	100.0%
FAIRplus	1	1	1	100.0%
EU-PEARL	1	0	0	0.0%

ANNEX 5: COLLABORATION INDEX FOR ALL IMI SUPPORTED RESEARCH PROJECTS

This Annex provides the calculation of the collaboration indicators for all IMI supported research projects with at least one paper. Collaboration index only calculated for projects with a Stability score and at least 20 papers.

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
BTCure	0.64	0.51	0.81	1.96	634	2.00
EU-AIMS	0.72	0.65	0.80	2.17	420	2.12
ULTRA-DD	0.64	0.67	0.73	2.04	276	1.92
EMIF	0.80	0.66	0.82	2.28	248	2.70
NEWMEDS	0.64	0.57	0.79	2.00	194	2.13
EUROPAIN	0.53	0.35	0.84	1.73	171	2.51
ORBITO	0.59	0.45	0.74	1.79	148	1.79
TRANSLOCATION	0.37	0.50	0.80	1.67	138	1.42
IMIDIA	0.53	0.50	0.82	1.84	135	1.68
CANCER-ID	0.75	0.42	0.71	1.88	128	3.92
STEMBANCC	0.50	0.47	0.78	1.75	120	2.15
SUMMIT	0.75	0.64	0.84	2.23	120	1.73
CHEM21	0.24	0.28	0.76	1.28	119	1.72
ELF	0.39	0.50	0.69	1.58	110	1.10
MIP-DILI	0.67	0.45	0.80	1.91	103	1.81
PreDiCT-TB	0.58	0.48	0.77	1.83	100	1.32
Quic-Concept	0.75	0.57	0.77	2.09	99	3.33
PROTECT	0.97	0.63	0.84	2.44	98	1.11
INNODIA	0.83	0.66	0.90	2.39	92	1.72
eTOX	0.30	0.36	0.85	1.50	91	1.74
COMPACT	0.25	0.43	0.69	1.37	80	1.95
U-BIOPRED	0.81	0.68	0.89	2.37	78	3.09
SPRINTT	0.64	0.55	0.75	1.94	77	2.20
Pharma-Cog	0.83	0.73	0.83	2.39	76	1.26
DDMoRe	0.63	0.54	0.77	1.94	72	1.03
Open PHACTS	0.60	0.55	0.76	1.92	70	3.39
ABIRISK	0.79	0.48	0.83	2.11	68	1.43
COMBACTE-NET	0.72	0.50	0.78	2.00	68	1.11
BioVacSafe	0.41	0.45	0.77	1.63	63	1.36
COMBACTE-MAGNET	0.61	0.59	0.70	1.90	62	1.36
DIRECT	0.74	0.68	0.79	2.20	61	2.84
K4DD	0.54	0.53	0.80	1.87	61	2.07
Onco Track	0.61	0.44	0.81	1.86	59	2.44
AETIONOMY	0.61	0.39	0.76	1.77	57	1.62
MARCAR	0.44	0.41	0.79	1.64	54	1.16
BEAT-DKD	0.72	0.75	0.57	2.04	53	1.22

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
RTCure	0.68	0.46	0.67	1.81	50	2.58
DRIVE-AB	0.77	0.62	0.71	2.10	47	1.67
Predect	0.70	0.62	0.77	2.09	43	2.22
RAPP-ID	0.33	0.41	0.86	1.60	43	0.86
COMBACTE-CARE	0.90	0.63	0.67	2.21	42	2.34
ENABLE	0.56	0.38	0.76	1.70	41	1.48
ZAPI	0.65	0.66	0.68	1.99	40	1.94
eTRIKS	0.86	0.88	0.72	2.47	36	2.78
GETREAL	0.88	0.76	0.56	2.21	34	1.95
iPiE	0.59	0.24	0.79	1.62	34	1.40
APPROACH	0.78	0.79	0.69	2.26	32	2.39
PRECISESADS	0.75	0.72	0.65	2.12	32	1.60
PRISM	0.71	0.61	0.64	1.96	31	2.26
AIMS-2-TRIALS	0.77	0.69	N/A	N/A	31	1.21
IMPRiND	0.50	0.51	0.57	1.58	30	6.69
FLUCOP	0.86	0.51	0.63	2.00	28	1.19
PROACTIVE	1.00	0.80	0.84	2.63	27	2.36
RHAPSODY	0.62	0.61	0.71	1.93	26	2.58
EBOVAC1	0.68	0.62	0.65	1.95	25	2.01
BigData@Heart	0.88	0.69	0.67	2.24	25	1.58
EPAD	0.67	0.56	0.67	1.89	24	1.29
EBiSC	0.65	0.62	0.72	1.99	23	9.35
RADAR-CNS	0.57	0.77	0.79	2.13	21	1.14
EbolaMoDRAD	0.70	0.56	0.55	1.81	20	1.41
SAFE-T	0.95	0.55	N/A	N/A	19	2.87
PHAGO	0.67	0.71	N/A	N/A	18	4.27
EHR4CR	0.94	0.65	N/A	N/A	17	1.14
TransQST	0.60	0.67	N/A	N/A	15	2.21
iABC	0.79	0.57	N/A	N/A	14	1.36
ADVANCE	0.71	0.66	N/A	N/A	14	1.05
COMBACTE	0.50	0.13	N/A	N/A	14	2.52
WEB-RADR	0.85	0.77	N/A	N/A	13	2.56
ROADMAP	0.92	0.71	N/A	N/A	12	0.86
ADAPTED	0.92	0.69	N/A	N/A	12	2.70
EBOVAC2	0.45	0.45	N/A	N/A	11	1.57
AMYPAD	0.82	0.70	N/A	N/A	11	1.72
eTRANSAFE	0.40	0.47	N/A	N/A	10	0.70
VSV-EBOVAC	0.44	0.56	N/A	N/A	9	0.99
PREFER	1.00	0.88	N/A	N/A	8	2.49
VSV-EBOPLUS	0.50	0.63	N/A	N/A	8	0.55
HARMONY	0.63	0.56	N/A	N/A	8	1.01
TRISTAN	0.71	0.75	N/A	N/A	7	1.91
LITMUS	0.86	0.82	N/A	N/A	7	1.32

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
EUPATI	1.00	1.00	N/A	N/A	6	0.85
RESCEU	1.00	0.50	N/A	N/A	5	0.71
IMI-PainCare	0.60	0.30	N/A	N/A	5	0.98
EBODAC	0.75	0.69	N/A	N/A	4	1.90
DRIVE	1.00	0.44	N/A	N/A	4	1.91
SafeSciMET	1.00	1.00	N/A	N/A	4	0.95
ADAPT-SMART	0.75	0.50	N/A	N/A	4	0.91
VAC2VAC	0.67	0.33	N/A	N/A	3	1.20
PERISCOPE	0.00	0.00	N/A	N/A	3	2.07
PD-MitoQUANT	1.00	0.75	N/A	N/A	3	0.68
Eu2P	0.33	0.67	N/A	N/A	3	1.74
DO->IT	1.00	0.83	N/A	N/A	3	1.87
ITCC-P4	1.00	0.38	N/A	N/A	2	0.00
MOPEAD	1.00	0.50	N/A	N/A	2	0.70
EBOMAN	1.00	0.88	N/A	N/A	2	3.49
COMBACTE-CDI	1.00	0.75	N/A	N/A	2	0.63
MACUSTAR	0.50	0.50	N/A	N/A	2	3.37
ND4BB	0.50	0.88	N/A	N/A	2	2.11
IMMUCAN	0.50	0.50	N/A	N/A	2	0.20
EBOVAC	1.00	1.00	N/A	N/A	1	4.66
FAIRplus	0.00	0.00	N/A	N/A	1	0.00
PARADIGM	1.00	1.00	N/A	N/A	1	0.00
EBOVAC3	0.00	1.00	N/A	N/A	1	0.00
Pharmatrain	1.00	1.00	N/A	N/A	1	0.12
EHDEN	0.00	0.00	N/A	N/A	1	0.00
RADAR-AD	1.00	1.00	N/A	N/A	1	0.00
COMBACTE-NEt	1.00	0.00	0.78	1.78	1	2.06
PEVIA	1.00	0.75	N/A	N/A	1	0.00
EMTRAIN	1.00	1.00	N/A	N/A	1	0.14
BIOMAP	1.00	1.00	N/A	N/A	1	0.00

ANNEX 6: BIBLIOGRAPHY OF HOT PAPERS AND HIGHLY CITED PAPERS

This Annex provides bibliographic data for hot and highly cited papers. Hot papers are papers that receive citations soon after publication, relative to other papers of the same field and age. For the purpose of this report, highly cited papers have been defined as those articles and reviews which belong to the world's top decile of papers in that journal category and year of publication, when ranked by number of citations received. A percentage that is above 10 indicates above-average performance.

Papers are listed in ascending alphabetical order (project, first author) and unassigned papers, are listed at the end of each section.

This section lists papers that have been identified as current hot papers or that have been identified as highly cited in the IMI project publication dataset.

HOT PAPERS ASSOCIATED WITH IMI PROJECTS

BioVacSafe: Bartenschlager, Ralf et al. Host-directed therapies for bacterial and viral infections, NAT REV DRUG DISCOV (2018) 17: 35-56

CANCER-ID: Pantel, Klaus et al. Liquid biopsy and minimal residual disease - latest advances and implications for cure, NAT REV CLIN ONCOL (2019) 16: 409-424

CANCER-ID: BARDELLI, Alberto et al. Liquid versus tissue biopsy for detecting acquired resistance and tumor heterogeneity in gastrointestinal cancers, (2019) NAT MED 25: 1415-+

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