Bibliometric analysis of ongoing projects

12th Report
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1 EXECUTIVE SUMMARY

This report presents a bibliometric analysis of the Innovative Medicine Initiative Joint Undertaking's (IMI JU) research published between 2010 and 2020, using citations as an index of academic impact and co-authorship as an index of collaboration. This is the twelfth report commissioned by IMI from Clarivate.

The data show that IMI continues to perform well. To date, IMI projects have produced 7,177 publications which have been matched to the Clarivate Web of Science™. This represents a 21% increase from the 5,943 publications matched to the Web of Science in the eleventh report, which covered IMI project research published between 2010 and 2019.

The number of IMI research publications has generally increased year on year, except for the year 2019 where output fell by almost 8% as noted in the eleventh report. Publication growth has since recovered and in 2020, the most recent publication year, publication output has increased by 19% from 2019 and 10% from 2018. This recovery was likely driven by new IMI 2 projects and other IMI 2 projects such as AIMS-2-Trials, RESCEU, and RHAPSODY which all published more than double the number of papers in 2020 than in 2019.

The majority of IMI research (67%) continues to be published in high impact journals, i.e., those journals in the highest quartile (Q1) when ranked by Journal Impact Factor, and the average Journal Impact Factor of all IMI project publications was 6.93. 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) remains around twice (1.99) the world average (1.00), which indicates that the research was internationally influential. Between 2010 and 2020, the field-normalised citation impact of IMI papers was considerably higher (73%) than the European Union's (EU) average citation impact (1.15) in similar biomedical fields (journal subject categories). Around a quarter (25.7%) of IMI project papers were highly cited; that is, the papers were in the world's top 10% of papers (taking journal category and year of publication into account), when ranked by number of citations.

The output of individual IMI projects has also increased between 2010 and 2020. BTCure (Call 2) has remained the most prolific IMI project, with 703 publications as of this report. This is a 2% increase on the 689 publications attributed to BTCure in the previous report. However, this growth is slower than then last year's growth of 5.4%, supporting the fact that the BTCure project ended in early 2017. It's also worth noting that INNODIA is new to the Top 10 projects, ranking 9th, as its publication output has grown by 31% since the previous report. Although this project is not the fastest growing project as the publication output of the AIMS-2-TRIALS (ranked 20th) project grew by 110% (from 51 publications in 2019 to 107 in 2020.)

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 (65.2%) of all IMI project papers were co-authored by researchers working in different sectors, more than three-quarters (84.8%) involved collaboration between institutions and more than half (63.3%) were internationally collaborative. Internationally collaborative IMI project research had an average citation impact (2.71) well over twice the world average (1.00) and higher than non-internationally collaborative IMI project research (1.85).

Research in both Europe and North America tends to be clustered in major cities with an existing strong academic research base. The citation impact of IMI papers within these clusters is higher than national averages and rates of international co-authorship are very high (70-100%) compared to the averages for EU-28 biomedical research (40%). The European and North American clusters with the highest proportion of open access publications are Oxford, UK (86.2%) and Seattle (90.4%) respectively.

IMI's field-normalised citation impact (1.99) fell by 3%, although this decrease is also seen with other well-established funding bodies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Critical Path Institute and the Grand Challenges in Global Health who had a 6%, 5% and 3% decrease, respectively. The only exception is the Medical Research Council (MRC) which saw a 1% increase of its field-normalised citation impact (2.03). Even with this decrease IMI still exceeds many other funding bodies except for the MRC (2.03) and the Wellcome Trust (2.04). IMI's journal-normalised citation impact (1.21) is the highest among the comparators but only slightly outperforms CSIRO (1.20) and FNIH (1.19). IMI's percentage of highly cited papers (25.7%) outperforms all the comparators, except GCGH (26.4%).

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 172 projects from a total of 34 funding calls. 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 7,177 unique Web of Science publications (Figure 4.1.1).
- IMI's publication growth has since recovered from its dip in 2019. (Figure 4.3.1).
- A quarter (25.7%) 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 almost twice the world average (1.99) between 2010 and 2020, only slightly lower than last years (2.05). (Figure 4.6.1)
- More IMI project publications appeared in *Annals of the Rheumatic Diseases* (178 publications) and *PLOS One* (178 publications) than in other journals. Of the 20 journals in which IMI-funded projects published most frequently, nearly three-quarters (14 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 *Nature Reviews Molecular Cell Biology* (1 publication), which has a Journal Impact Factor of 94.44. Of the Top 20 journals by Impact Factor, IMI published most frequently in *Nature* (49.96) with 22 publications, followed by *Lancet Neurology* (44.18) with 18 publications (Table 4.7.2).
- IMI project research was most frequently published in Pharmacology & Pharmacy journals (Figure 4.8.1). Of the 771 papers published in this field, 19.8% were highly cited, 50.2% were open access, and the average citation impact of these papers was 1.45 times the world average for the year and field of publication (Table 4.8.2 and Table 4.8.3).
- IMI 2 project research was most frequently published in Endocrinology & Metabolism journals (177 publications), suggesting that IMI 2 projects have had a slightly different focus to IMI 1 projects (Figure 4.8.2).
- IMI research in the Clinical Neurology category has the highest percentage of highly cited papers. (Table 4.8.3)
- 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).
- Early IMI 1 calls (1-4) follow a similar pattern of initial growth in publication output for 3 to 6 years followed by a decline as projects end (Figure 5.1.1).
- The publication output of most of IMI 2 calls is currently growing. Especially Call 10 which published 100 papers in 2020, more than any other call. This growth was largely driven by the AIMS-2-Trials project which published 73 publications in 2020. (Figure 5.1.3)
- Papers assigned to IMI 2 call 7 had the highest average field-normalised citation impact (3.19); more than three times the world average. This is mainly driven by six highly cited papers mainly within the IMPRIND project, which were cited between 20 and 40 times the world average. (Table 5.1.1)
- The largest geographic clusters of research supported by IMI in Europe are London (1,454 publications), Amsterdam (1,221 publications) and Stockholm (685 publications). The largest clusters in North America are Toronto (310 publications), Boston (296 publications) and Bethesda (172 publications). (Table 6.1.1 and Table 6.1.3)
- IMI research in all the European and North American geographic clusters performs well above the national averages in terms of citation impact. The highest citation impact European clusters are Maastricht (3.69) and Cambridge (3.43), both more than twice their respective national averages of 1.70 and 1.52. (Table 6.1.2 and Table 6.1.4)
- Around 40% of all EU-28 biomedical research involves international co-authorship while in comparison rates of international collaboration for IMI project research are very high for most clusters, especially in North America where most clusters have around 90% international collaboration which is expected as IMI is European funding organisation that primarily funds researchers working in EU-28. The European cluster with the highest rate of internationally collaborative papers was Dresden, with 95.5% of its research involving international co-authorship. While the European cluster, Uppsala, remained the lowest at 70% international collaboration. (Table 6.1.1 and Table 6.1.3).
- IMI project research is collaborative across sectors, institutions, and countries. Nearly two-thirds (65%) of IMI project papers were co-authored by researchers from different sectors. More than three-quarters (85%) of IMI project papers involved collaboration between different institutions. And more than half (63%) of all IMI project papers were internationally collaborative (Table 7.1.1).
- IMI's collaborative research for sectors, institutions, and countries has an average field-normalised citation impact that is almost 50% higher than IMI's non-collaborative research. (sectors: 2.67 vs 1.84, institutions: 2.57 vs 1.63, and countries: 2.71 vs 1.84) (Figure 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. This may be due to these projects having the highest and second highest overall number of papers. (Table 7.1.1-Table 7.2.3)
- For those projects with at least 100 papers, AIMS-2-TRIALS has the highest percentage of its papers with co-authors from more than one country (76.2%) and institution (96%). While INNODIA has the highest percentage of its papers (82.5%) with co-authors from more than one sector. (Table 7.2.1-Table 7.2.3).
- King's College London is part of seven out of the ten most productive pairs of collaborating institutions, including the top pair where King's College London collaborated with Heidelberg University on 120 publications. (Figure 7.3.3.1)
- PROACTIVE has the highest collaboration index score of 2.62. (Table 7.4.1)
- IMI's research output grew faster between 2010 and 2020 than any of the seven selected comparators (Table 8.2.1.1).
- IMI's field-normalised citation impact (1.99) was only very slightly lower than the Wellcome Trust's (2.04) and the MRC's (2.03) and higher than all the other comparators (Figure 8.2.2.2).

- IMI's percentage of uncited research (44.6%) has remained the lowest of all the comparators since 2017. (Table 8.2.5.1)
- IMI has a higher percentage of highly cited papers (25.7%) than all the comparators except GCGH (26.4%). (Figure 8.2.6.2)

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 twelfth 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) calls for proposals under its second phase. The first funding call was announced in 2008 and the final calls were launched in June 2020. In February 2021, the Innovative Health Initiative (IHI), a new public-private partnership in health was announced that will run under Horizon Europe, the new European framework programme for research and innovation. This new partnership will build upon the Innovative Medicines Initiative (IMI) but will have a greater focus on cross sectoral collaborations involving biopharmaceutical, medical technology, and biotechnology sectors. This report covers the research output (publications and papers) of a total of 61 projects from IMI phase one and 111 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.
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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 2021, 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 increasingly uses bibliometric data and analyses to assess performance. 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

[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.

Highly Cited Papers: Highly cited papers are papers that are recognized as having a greater impact than other papers published in a similar year and field. For a paper to be considered highly cited they must be in the Top 10% in terms of citation frequency, considering the field and year of publication. High citation rates have shown to be correlated with other qualitative research performance evaluations, such as peer reviews.

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 value 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

[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.

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. 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 172 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 funders.

The datasets analysed in this, the twelfth report, include IMI-supported publications identified in Clarivate Web of Science up to 31st December 2020. The census point for inclusion of publications into the eleventh report was 31st December 2019. Therefore, this report reflects changes in IMI activity between these points. Citations to these publications were counts up to 31st December 2020. 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 5,943 publications which were previously identified as IMI publications and used as the IMI publication dataset in the previous report. Separately, 1,602 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 7,545 unique publication records associated with IMI-supported projects. Of these 7,545 publications, 368 were eliminated as they were either published in 2021 or could not be distinguished as IMI from a manual review of the dataset. Therefore, 7,177 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 2020. Normalised bibliometric indicators were calculated using standard methodology and the Clarivate National Science Indicators (NSI) database for 2020.

FIGURE 4.1.1 PROCESS FOR IDENTIFYING PUBLICATIONS FROM IMI-SUPPORTED PROJECTS, 2010-2020

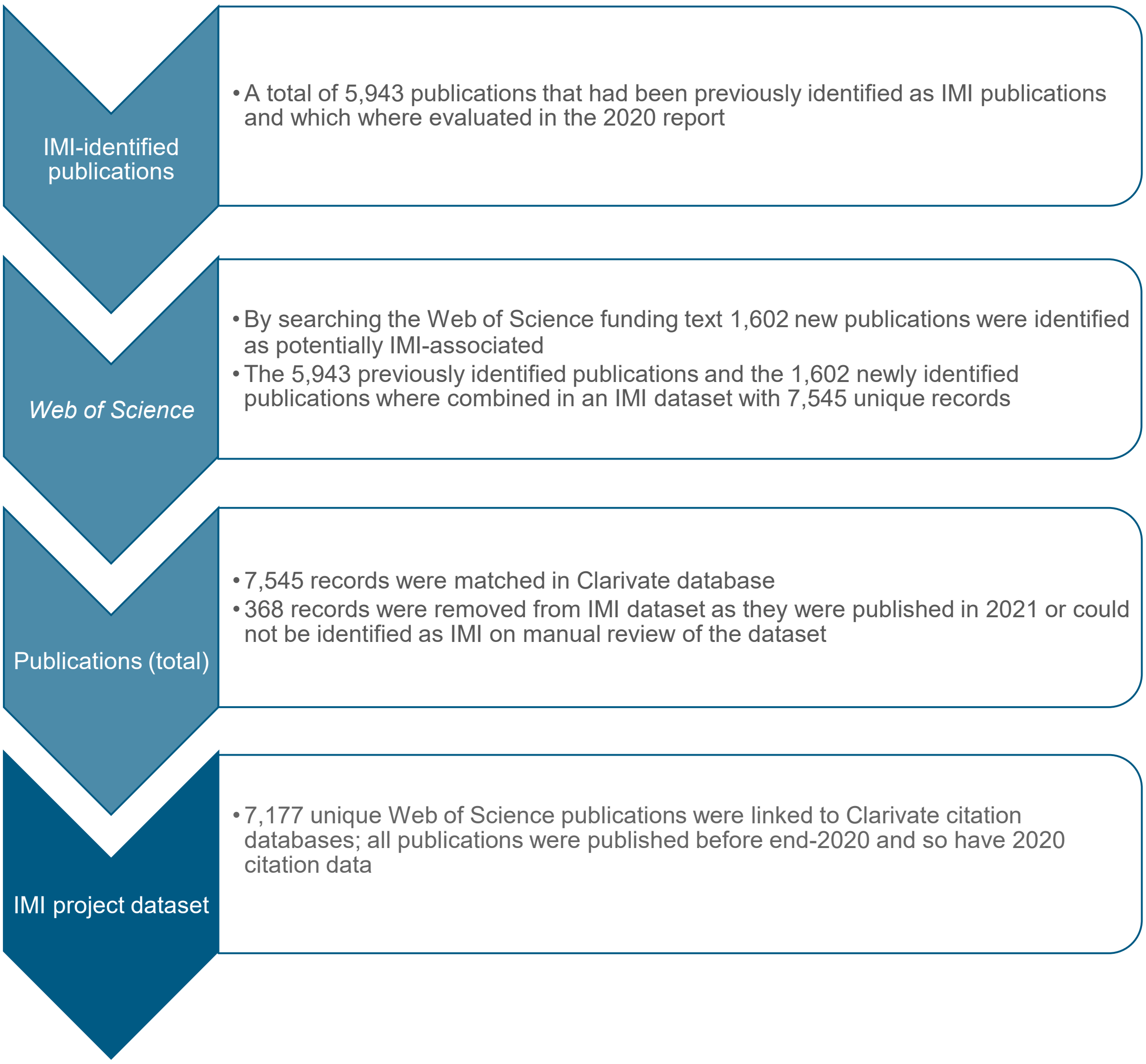


Table 4.1.1 NUMBER OF PUBLICATIONS FROM IMI PROJECTS, 2010-2020

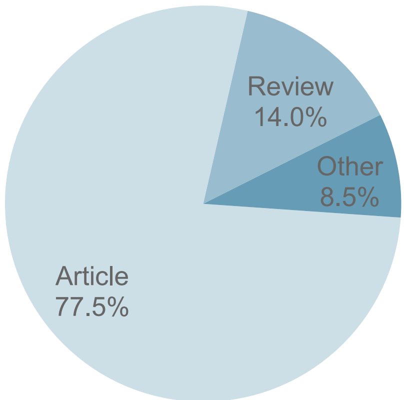
	Number of publications	Number of papers
All IMI	7,177	6,566
IMI 1	5,912	5,512
IMI 2	1,325	1,125

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 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, 2010-2020



Articles + Reviews = Papers, 91.5%

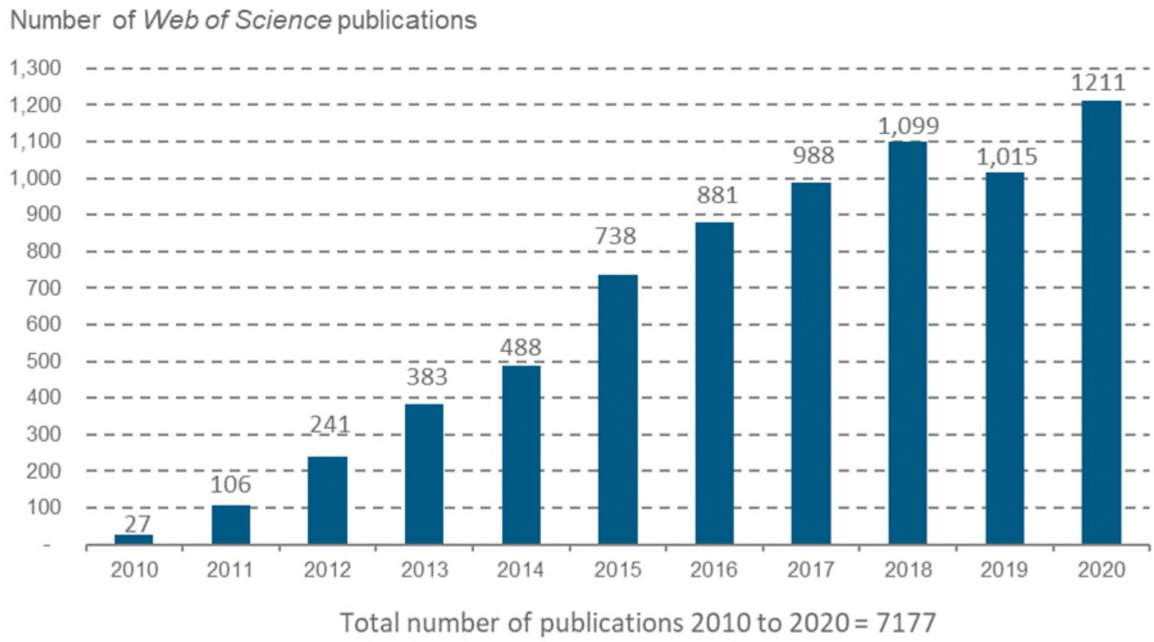
- IMI project research resulted in 7,177 unique Web of Science publications.
- Of these publications, 91.5% were articles (77.5%) and reviews (14%) which are collectively referred to as 'papers' in this report.
- A further 611 publications (8.5%) were not papers. These 'other' publications is composed of 140 editorials, 337 meeting abstracts, 59 proceeding papers, 57 letters, 11 corrections and three news items and four data papers.

TABLE 4.2.1 NUMBER AND PERCENTAGE OF IMI PROJECT PUBLICATIONS BY DOCUMENT TYPE, 2010-2020

Document type		Number of publications	% of IMI publications
Papers	Article	5,563	77.51%
	Review	1,003	13.98%
Other document types	Meeting Abstract	337	4.70%
	Editorial Material	140	1.95%
	Proceedings Paper	59	0.82%
	Letter	57	0.79%
	Correction	11	0.15%
	News Item	3	0.04%
	Data Paper	4	0.06%

4.3 TRENDS IN PUBLICATION OUTPUT

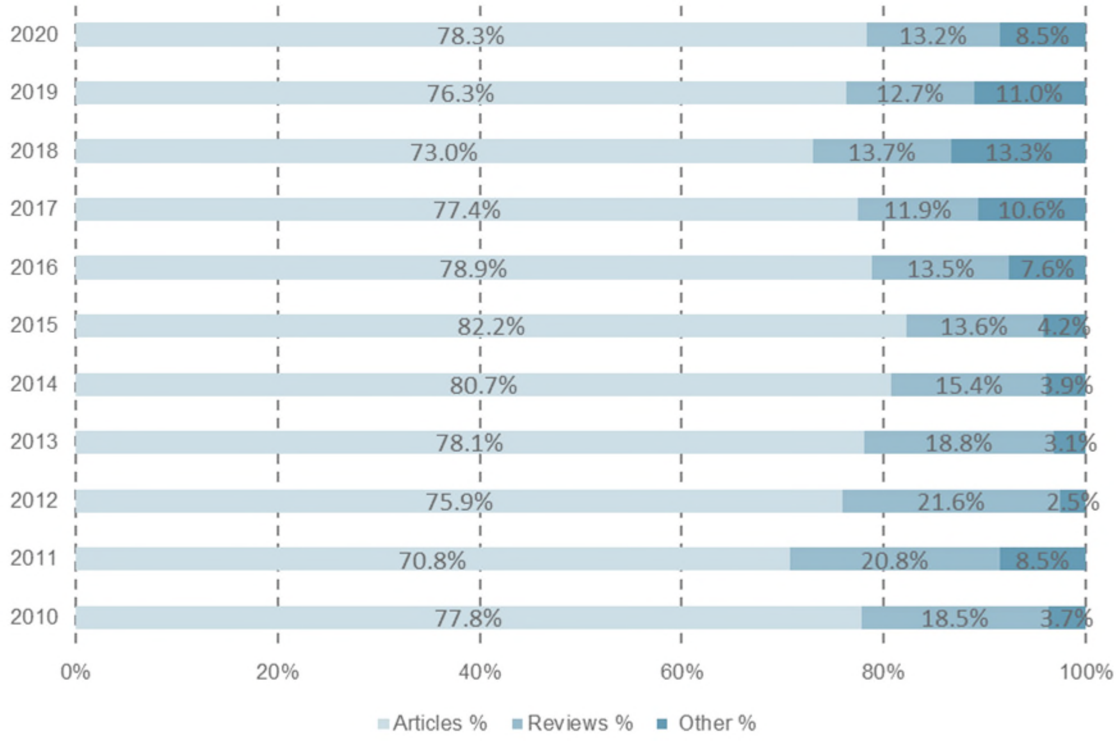
FIGURE 4.3.1 NUMBER OF WEB OF SCIENCE PUBLICATIONS FOR IMI PROJECTS BY YEAR, 2010-2020



- During 2020, IMI project research output has since recovered from a decrease in 2019. It is now continuing its growth trajectory with an increase of 19% from 2019.
- The recovery of publication output in 2020 from the 2019 decrease is likely driven by projects such as AIMS-2-TRIALS, RESCEU, RHAPSODY, and SPRINTT who published more than double the number of papers in 2020 compared to 2019. For example, AIMS-2-TRIALS, which is the project with the second most papers published in 2020, published 30 publications in 2019 and then in 2020 published 73.

Figure 4.3.2 shows the proportion of papers (articles and reviews) relative to other document types for IMI project research between 2010 and 2020.

FIGURE 4.3.2 PERCENTAGE OF IMI PROJECT PUBLICATIONS EACH YEAR BY DOCUMENT TYPE, 2010-2020



- IMI project research continued to generate a high proportion of papers relative to other document types. Articles accounted for around 78.3% of all publications in 2020, 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 2020. Figure 4.4.2 shows a map highlighting all countries with at least ten Web of Science publications from IMI projects between 2010 and 2020. 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 2020. 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, 2010-2020

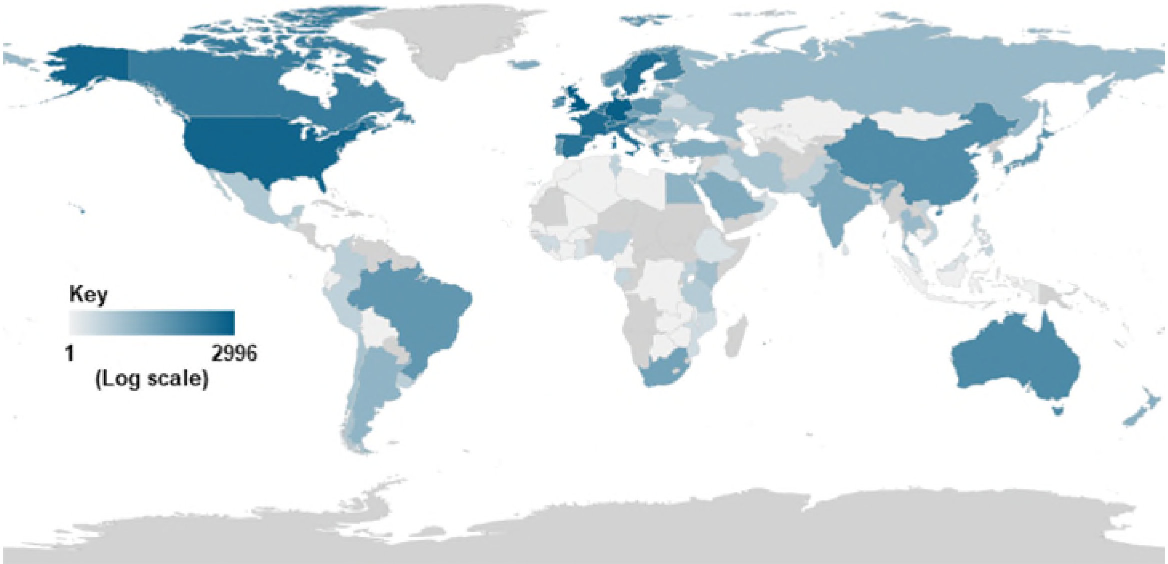
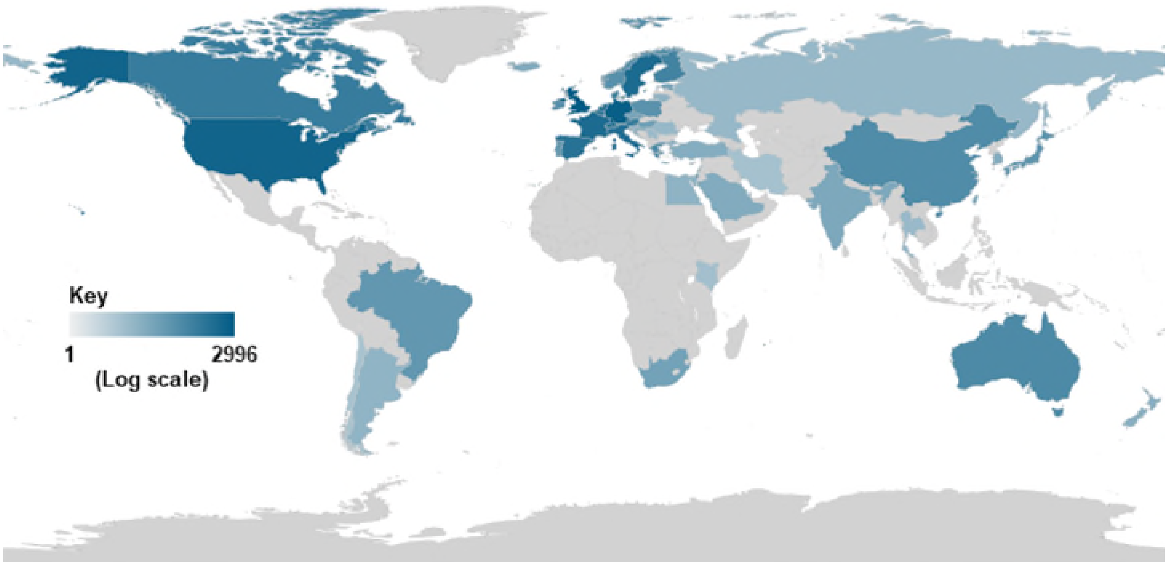


FIGURE 4.4.2 MAP OF COUNTRIES WHICH HAVE AT LEAST TEN WEB OF SCIENCE PUBLICATION FOR IMI PROJECTS, 2010-2020



- In total 117 countries have at least one IMI publications and 52 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, 2010-2020

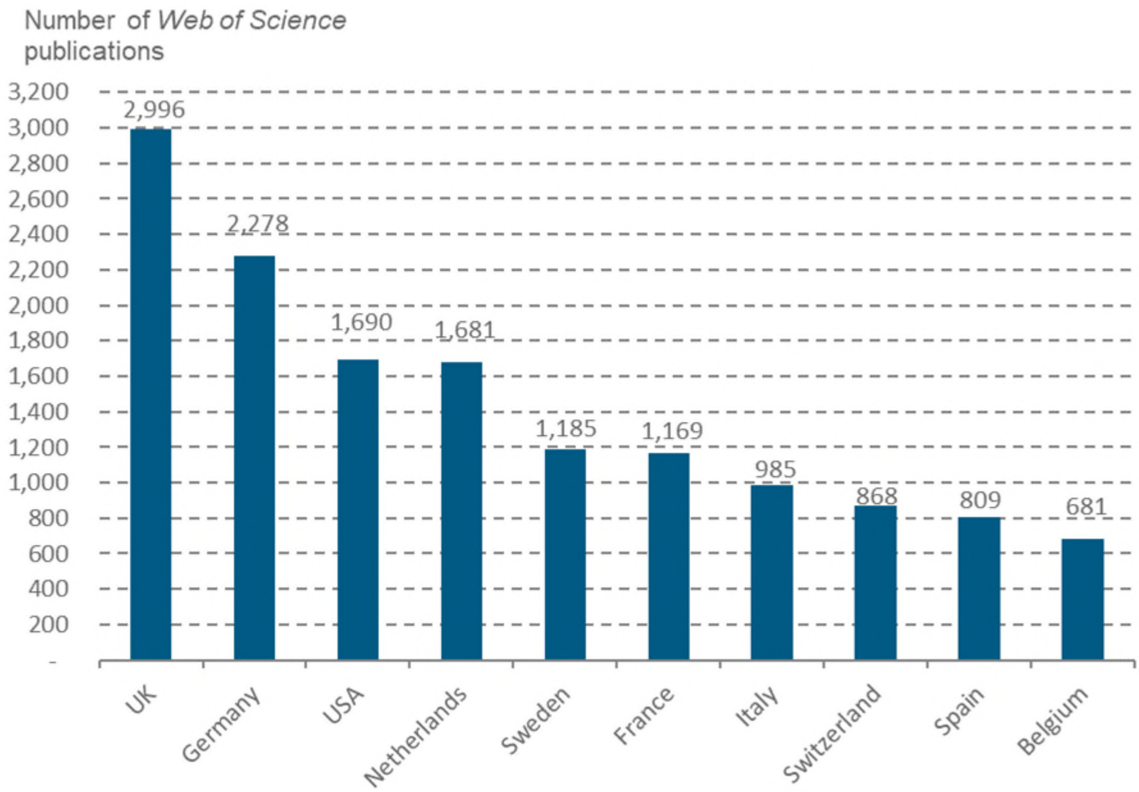


TABLE 4.4.1 TWENTY COUNTRIES WITH THE MOST IMI PROJECT PUBLICATIONS. ANNEX 3 LISTS ALL COUNTRIES WITH AT LEAST ONE IMI PROJECT PUBLICATION, 2010-2020

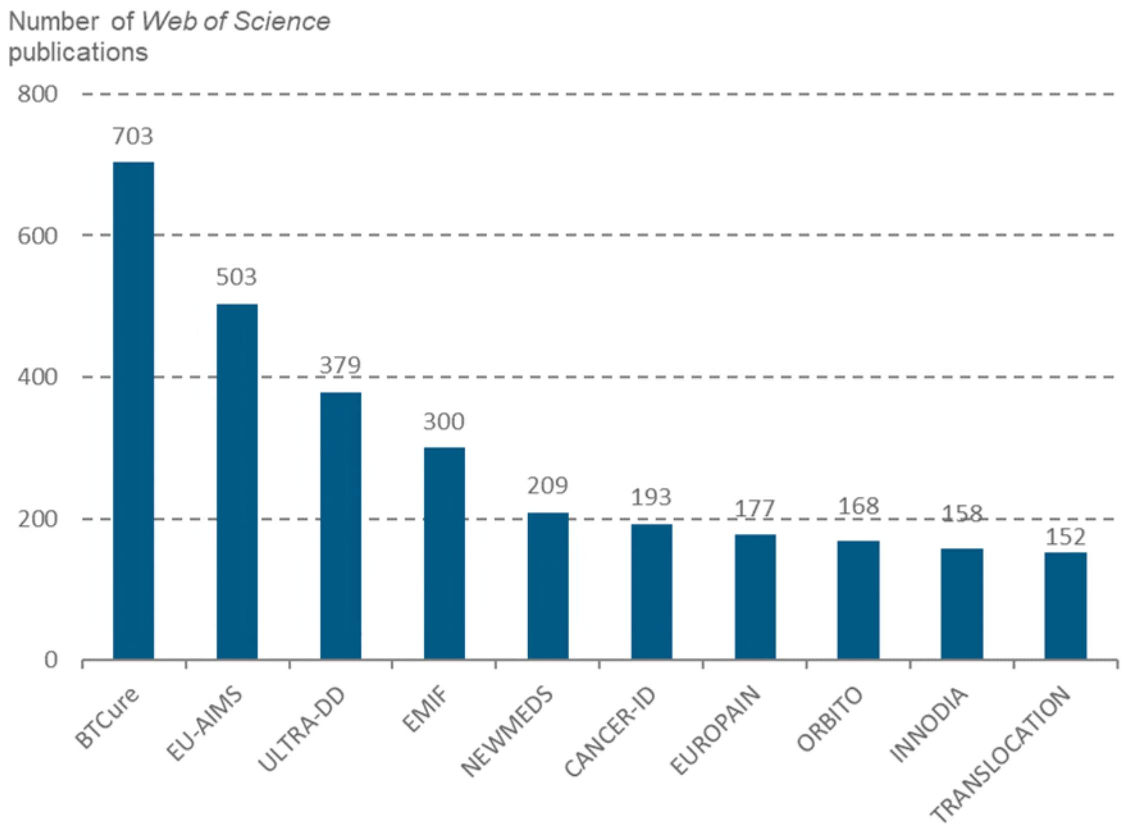
Country	Number of publications
UK	2,996
Germany	2,278
USA	1,690
Netherlands	1,681
Sweden	1,185
France	1,169
Italy	985
Switzerland	868
Spain	809
Belgium	681
Denmark	523
Canada	465
Austria	424
Finland	328
Australia	226
Greece	214
China	207
Ireland	171
Norway	161
Poland	146

- Researchers affiliated to the United Kingdom authored the most IMI project publications (2,996 publications).
- Other EU-28 countries where among the countries with the highest output. The most productive exceptions are the USA (1,690 publications) and Switzerland (868 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 2020. 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 2020. A full list of 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, 2010-2020



- BTCure remains the most productive IMI project in terms of number of publications (703 publications) and the second most productive project is still EU-AIMS (503 publications).
- INNODIA is new to the top 10 projects with highest output of publications (158 publications), displacing IMIDIA (149 publications)

TABLE 4.5.1 TWENTY IMI PROJECTS WITH THE MOST PUBLICATIONS, THE NUMBER OF PAPERS, NUMBER AND PERCENTAGE OF OPEN ACCESS PUBLICATIONS, 2010-2020.

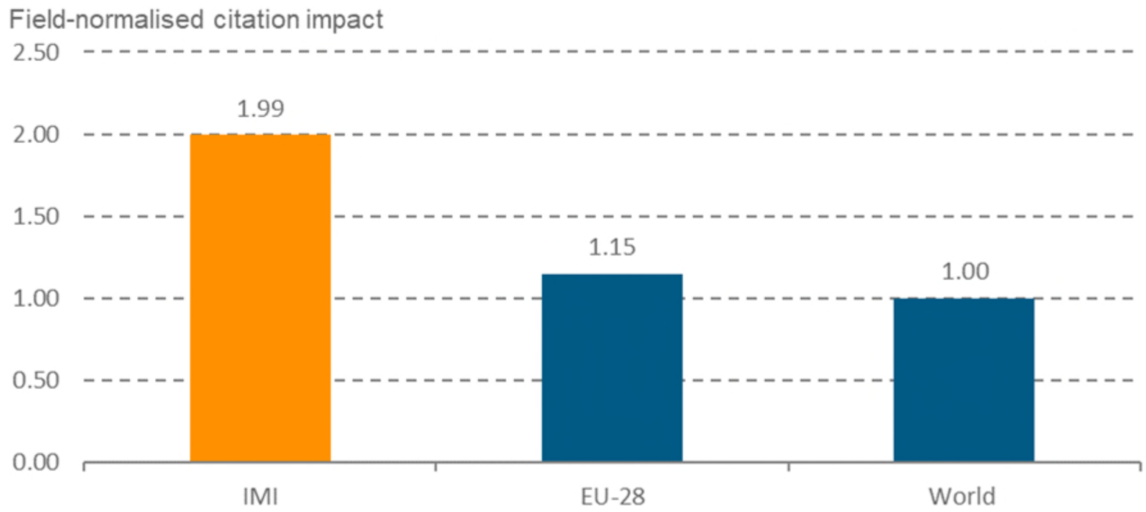
Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
BTCure	703	656	461	65.6%
EU-AIMS	503	488	378	75.1%
ULTRA-DD	379	371	295	77.8%
EMIF	300	279	229	76.3%
NEWMEDS	209	204	113	54.1%
CANCER-ID	193	167	136	70.5%
EUROPAIN	177	177	68	38.4%
ORBITO	168	165	47	28.0%
INNODIA	158	126	110	69.6%
TRANSLOCATION	152	152	90	59.2%
IMIDIA	149	139	120	80.5%
STEMBANCC	143	138	107	74.8%
U-BIOPRED	136	87	65	47.8%
SUMMIT	132	128	96	72.7%
CHEM21	130	127	61	46.9%
ELF	126	125	83	65.9%
PreDiCT-TB	118	112	101	85.6%
SPRINTT	113	106	63	55.8%
MIP-DILI	113	106	64	56.6%
AIMS-2-TRIALS	107	101	96	89.7%

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 is 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 2020. 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



- IMI's field normalised citation impact is lower than last year's report but is still 73% higher than the EU-28 and almost double the World average.

TABLE 4.6.1 SUMMARY CITATION ANALYSIS FOR IMI SUPPORTED RESEARCH PAPERS, 2010-2020

		Citation impact			
	Number of papers	**Normalised at field level**	**Normalised at journal level**	**Average percentile**	**% highly cited papers**
IMI projects	6,566	1.99	1.21	35.0	25.7%
IMI 1	5,512	1.98	1.22	33.1	26.0%
IMI 2	1,125	1.94	1.11	45.6	23.0%

TABLE 4.6.2 SUMMARY OF IMI SUPPORTED RESEARCH PUBLICATIONS, 2010-2020

	Number of publications	% of open access publications*	Number of papers	Citations	Raw citation impact
IMI Projects	7,177	67.4%	6,566	179,823	27.39
IMI 1	5,912	65.8%	5,512	167,967	30.47
IMI 2	1,325	77.2%	1,125	10,791	9.59

SUMMARY OF KEY FINDINGS

- The field-normalised citation impact of IMI project papers was 1.99 for the eleven-year period, 2010-2020, 3% lower than last year's report but is still almost double the World average.
- The field-normalised citation impact of IMI project papers was 73% higher than the EU's average citation impact (1.15)[5] between 2010 and 2020, in similar biomedical journal categories.
- More than a quarter (25.7%) 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 2020 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 2020, are listed in Table 4.7.1. Together, the 20 most frequently used journals account for 1,517 publications, 21.1% of IMI's publications

IMI project publications appeared most frequently in both *Annals of the Rheumatic Diseases* and *PLOS One* which IMI published 178 publications each. IMI published more papers in *PLOS One* (178 papers) than in *Annals of the Rheumatic Diseases* (119 papers). For most journals, papers (articles and reviews) were the most frequent publication type, however large collections of meeting abstracts were published in *Diabetologia* (60 meeting abstracts) and *European Respiratory Journal* (26 meeting abstracts).

IMI continued to have a strong focus on Rheumatology with three of the top ten most frequently used journals assigned to this journal subject category, as well as Pharmacology & Pharmacy with a quarter of the top 20 journals assigned to this journal subject category. Neurosciences was assigned to three journal titles, and multidisciplinary journals were assigned to four of the top 20 journals by publication count. A further two top-ten journals, *Diabetologia* and *Diabetes* are assigned to Endocrinology & Metabolism and the titles suggest a focus on diabetes.

Of the 20 most frequently used journals, just under three-quarters were in the top quartile (Q1) by Journal Impact Factor (JIF) while the rest were in the second quartile (Q2) ranked against other journals in the same category.

Overall IMI project publications were published in a total of 1,378 journals, of which 621 were ranked in the top quartile (by Journal Impact Factor) of journals in their relevant journal category. A total of 4,348 publications (60.6% of IMI project publications) were published in these well-regarded journals. The average Journal Impact Factor for all IMI project publications is 6.93, a slight increase of 0.55 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 *Nature Reviews Molecular Cell Biology*, with a Journal Impact Factor of 94.44 where IMI published 1 publication, followed by *Nature Reviews Drug Discovery* with an Impact Factor of 84.69 where IMI published 12 publications. Of the top 20 journals by Impact Factor, IMI published the most publications in *Nature* which has an Impact Factor of 49.96. IMI published a total of 131 publications in these top ranked journals by journal impact factor.

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 (19.10) and *PLOS One* published the most IMI publications (177 publications). 16 of these journals are ranked in the top quartile in their relevant journal categories.

TABLE 4.7.1 JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY NUMBER OF IMI PUBLICATIONS, 2010-2020

Journal	Number of IMI publications	Number of IMI papers	Journal Impact Factor (2020)	*Web of Science* journal categories	Quartile
Annals of the Rheumatic Diseases	178	119	19.10	Rheumatology	Q1
Plos One	178	177	3.24	Multidisciplinary Sciences	Q2
Scientific Reports	171	171	4.38	Multidisciplinary Sciences	Q1
Diabetologia	133	70	10.12	Endocrinology & Metabolism	Q1
Nature Communications	95	94	14.92	Multidisciplinary Sciences	Q1
Arthritis Research & Therapy	63	63	5.16	Rheumatology	Q2
Diabetes	62	44	9.46	Endocrinology & Metabolism	Q1
Frontiers in Immunology	62	61	7.56	Immunology	Q1
Journal of Alzheimers Disease	60	59	4.47	Neurosciences	Q2
Arthritis & Rheumatology	58	49	10.99	Rheumatology	Q1
Journal of Medicinal Chemistry	57	57	7.45	Chemistry, Medicinal	Q1
Pain	51	51	6.96	Anesthesiology; Clinical Neurology; Neurosciences	Q1
European Respiratory Journal	50	17	16.67	Respiratory System	Q1
European Journal of Pharmaceutics and Biopharmaceutics	48	48	5.57	Pharmacology & Pharmacy	Q1
European Journal of Pharmaceutical Sciences	47	45	4.38	Pharmacology & Pharmacy	Q2
Journal of Antimicrobial Chemotherapy	44	43	5.79	Infectious Diseases; Microbiology; Pharmacology & Pharmacy	Q1
Psychopharmacology	42	42	4.53	Neurosciences; Pharmacology & Pharmacy; Psychiatry	Q2
Proceedings of the National Academy of Sciences of the United States of America	41	41	11.21	Multidisciplinary Sciences	Q1
Translational Psychiatry	39	39	6.22	Psychiatry	Q1
Molecular Pharmaceutics	38	38	4.93	Research & Experimental Medicine; Pharmacology & Pharmacy	Q2

TABLE 4.7.2 JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY JOURNAL IMPACT FACTOR, 2010-2020

Journal	Number of IMI publications	Number of IMI papers	Journal Impact Factor (2020)	*Web of Science* journal categories	Quartile
Nature Reviews Molecular Cell Biology	1	1	94.44	Cell Biology	Q1
Nature Reviews Drug Discovery	12	6	84.69	Biotechnology & Applied Microbiology; Pharmacology & Pharmacy	Q1
Lancet	5	3	79.32	General & Internal Medicine	Q1
Nature Reviews Clinical Oncology	8	7	66.67	Oncology	Q1
Nature Reviews Cancer	2	2	60.72	Oncology	Q1
Nature Reviews Microbiology	1	1	60.63	Microbiology	Q1
Chemical Reviews	2	2	60.62	Chemistry, Multidisciplinary	Q1
Jama-Journal of the American Medical Association	9	7	56.27	General & Internal Medicine	Q1
Nature Biotechnology	3	1	54.91	Biotechnology & Applied Microbiology	Q1
Chemical Society Reviews	1	1	54.56	Chemistry, Multidisciplinary	Q1
Nature Medicine	13	12	53.44	Biochemistry & Molecular Biology; Cell Biology; Research & Experimental Medicine	Q1
Nature Reviews Genetics	4	4	53.24	Genetics & Heredity	Q1
Nature Reviews Immunology	4	2	53.11	Immunology	Q1
Nature Reviews Disease Primers	3	3	52.33	General & Internal Medicine	Q1
Nature	22	22	49.96	Multidisciplinary Sciences	Q1
Science	16	15	47.73	Multidisciplinary Sciences	Q1
Nature Reviews Gastroenterology & Hepatology	3	2	46.80	Gastroenterology & Hepatology	Q1
Journal of Clinical Oncology	1	0	44.54	Oncology	Q1
Lancet Neurology	18	16	44.18	Clinical Neurology	Q1
Nature Reviews Endocrinology	3	1	43.33	Endocrinology & Metabolism	Q1

TABLE 4.7.3 OPEN ACCESS JOURNALS IN WHICH IMI PROJECT PUBLICATIONS WERE PUBLISHED MOST FREQUENTLY, TOP 20 RANKED BY NUMBER OF OPEN ACCESS WEB OF SCIENCE PUBLICATIONS, 2010-2020

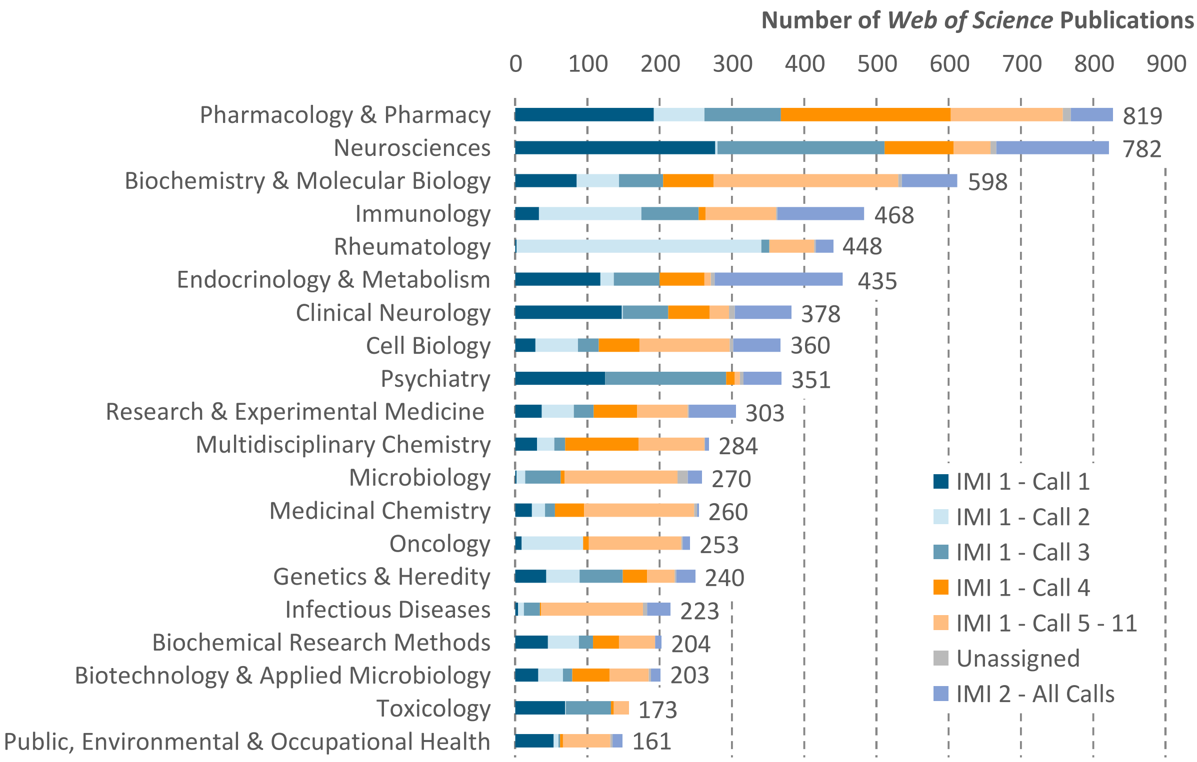
Journal	Number of IMI publications	Number of IMI papers	Journal Impact Factor (2020)	*Web of Science* journal categories	Quartile
Plos One	177	177	3.24	Multidisciplinary Sciences	Q2
Scientific Reports	171	171	4.38	Multidisciplinary Sciences	Q1
Nature Communications	95	94	14.92	Multidisciplinary Sciences	Q1
Annals of the Rheumatic Diseases	77	44	19.10	Rheumatology	Q1
Diabetologia	65	62	10.12	Endocrinology & Metabolism	Q1
Arthritis Research & Therapy	63	63	5.16	Rheumatology	Q2
Frontiers in Immunology	62	61	7.56	Immunology	Q1
Proceedings of the National Academy of Sciences of the United States of America	41	41	11.21	Multidisciplinary Sciences	Q1
Journal of Antimicrobial Chemotherapy	40	39	5.79	Infectious Diseases; Microbiology; Pharmacology & Pharmacy	Q1
Diabetes	40	40	9.46	Endocrinology & Metabolism	Q1
Translational Psychiatry	39	39	6.22	Psychiatry	Q1
Arthritis & Rheumatology	38	37	10.99	Rheumatology	Q1
Journal of Alzheimers Disease	36	35	4.47	Neurosciences	Q2
International Journal of Molecular Sciences	36	36	5.92	Biochemistry & Molecular Biology; Chemistry, Multidisciplinary	Q1
Nucleic Acids Research	36	36	16.97	Biochemistry & Molecular Biology	Q1
Bioinformatics	35	34	6.94	Biochemical Research Methods; Biotechnology & Applied Microbiology; Computer Science, Interdisciplinary Applications; Mathematical & Computational Biology; Statistics & Probability	Q1
Antimicrobial Agents and Chemotherapy	35	34	5.19	Microbiology; Pharmacology & Pharmacy	Q1
Molecular Autism	33	32	7.51	Genetics & Heredity; Neurosciences	Q1
Cell Reports	33	33	9.42	Cell Biology	Q1
Journal of Biological Chemistry	32	32	5.16	Biochemistry & Molecular Biology	Q2

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 2020. 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.

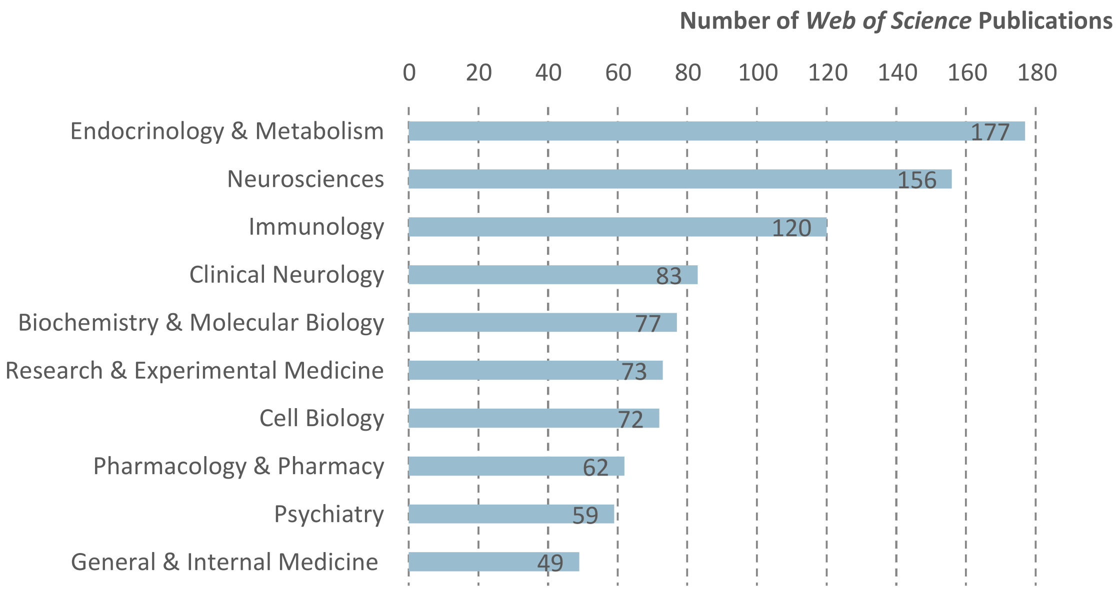
Table 4.8.1 shows the same data as Figure 4.8.1 and Figure 4.8.2 for the top twenty journal categories. It provides the number of publications assigned to each of the top twenty Web of Science journal categories in which IMI project research is published by IMI 1 calls and IMI 2 in total.

FIGURE 4.8.1 TOP TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS PUBLISHED MOST FREQUENTLY, 2010-2020. 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, 2010-2020. DATA LABELS SHOWS THE TOTAL NUMBER OF PUBLICATIONS PER JOURNAL CATEGORY



- IMI projects produced more publications in Pharmacology & Pharmacy (819 publications) than in other journal categories, followed by Neurosciences (782 publications) and Biochemistry & Molecular Biology (598 publications).
- Most publications in IMI 1 calls 5 to 11 belong to call 11.
- IMI 2 publications most frequently appeared in Endocrinology & Metabolism journals (177 publications), followed by Neurosciences (156 publications) and Immunology (120 publications).

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, 2010-2020. ORDERED BY TOTAL NUMBER OF PUBLICATIONS.

Journal Category	Number of publications by IMI 1 Call											IMI 2	Not assigned
	1	2	3	4	5	6	7	8	9	10	11		
Pharmacology & Pharmacy	192	70	106	235	12	35	8	15	45	0	57	62	11
Neurosciences	277	3	231	96	0	0	0	29	3	0	20	156	8
Biochemistry & Molecular Biology	85	59	61	70	28	40	0	33	16	0	142	77	5
Immunology	33	142	79	10	0	8	17	15	8	30	25	120	2
Rheumatology	2	339	11	0	0	0	1	33	0	0	28	38	2
Endocrinology & Metabolism	118	19	63	62	0	0	0	1	2	0	6	177	5
Clinical Neurology	148	1	63	57	0	0	0	10	0	0	18	83	8
Cell Biology	28	59	29	56	2	6	0	19	11	0	87	72	5
Psychiatry	125	0	167	12	0	0	1	1	1	0	4	59	5
Research & Experimental Medicine	37	44	28	60	0	3	19	3	1	14	30	73	2
Multidisciplinary Chemistry	30	24	15	102	35	13	0	5	5	0	33	22	1
Microbiology	2	12	49	5	1	73	1	10	48	6	55	34	14
Medicinal Chemistry	23	18	14	40	46	9	0	11	1	0	89	13	4
Oncology	9	85	0	8	1	0	2	1	0	0	124	22	2
Genetics & Heredity	43	46	60	34	0	2	0	10	1	0	28	40	2
Infectious Diseases	4	8	22	2	1	47	2	5	56	8	65	43	6
Biochemical Research Methods	45	43	20	36	2	7	0	13	1	1	28	23	0
Biotechnology & Applied Microbiology	32	34	13	52	2	3	0	20	2	6	21	29	3
Toxicology	69	1	63	4	0	1	1	0	13	0	9	13	1
Public, Environmental & Occupational Health	53	7	2	4	0	10	18	0	27	1	21	31	3

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, 2010-2020. 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	771	1.45	1.12	18.57
Neurosciences	733	1.95	1.36	28.65
Biochemistry & Molecular Biology	584	2.44	1.54	31.78
Immunology	443	1.83	1.36	21.34
Rheumatology	366	1.77	0.86	25.48
Endocrinology & Metabolism	341	1.64	1.06	17.11
Clinical Neurology	337	2.53	1.56	35.82
Cell Biology	345	2.25	1.38	29.15
Psychiatry	324	2.04	1.10	27.25
Research & Experimental Medicine	295	1.97	1.17	23.47
Chemistry, Multidisciplinary	279	1.45	1.15	30.86
Microbiology	262	1.48	1.02	18.07
Chemistry, Medicinal	257	1.44	1.16	13.86
Oncology	227	2.49	1.42	40.21
Genetics & Heredity	224	2.24	1.22	35.60
Infectious Diseases	206	2.20	1.39	16.54
Biochemical Research Methods	201	1.44	1.08	21.99
Biotechnology & Applied Microbiology	185	1.63	1.20	22.91
Toxicology	162	1.41	1.23	18.10
Public, Environmental & Occupational Health	142	1.50	1.07	12.91

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 2010-2020. ORDERED BY TOTAL NUMBER OF PUBLICATIONS.

Journal category	Number of publications	% of open access publications	Number of papers	% of highly cited papers
Pharmacology & Pharmacy	819	50.2%	771	19.8%
Neurosciences	782	61.9%	733	28.1%
Biochemistry & Molecular Biology	598	70.6%	584	27.7%
Immunology	468	74.4%	443	22.3%
Rheumatology	448	58.0%	366	27.3%
Endocrinology & Metabolism	435	64.1%	341	20.5%
Clinical Neurology	378	48.7%	337	38.0%
Cell Biology	360	79.4%	345	36.2%
Psychiatry	351	64.1%	324	28.1%
Research & Experimental Medicine	303	68.6%	295	27.1%
Multidisciplinary Chemistry	284	61.3%	279	21.9%
Microbiology	270	84.8%	262	25.6%
Medicinal Chemistry	260	54.2%	257	19.1%
Oncology	253	70.8%	227	35.2%
Genetics & Heredity	240	80.0%	224	26.3%
Infectious Diseases	223	81.2%	206	27.2%
Biochemical Research Methods	204	63.7%	201	22.4%
Biotechnology & Applied Microbiology	203	77.3%	185	25.9%
Toxicology	173	43.4%	162	20.4%
Public, Environmental & Occupational Health	161	57.8%	142	19.0%

- IMI project research was most frequently published in Pharmacology & Pharmacy journals. Of the 771 papers published in this category, around one fifth were highly cited.
- Clinical Neurology (337 papers) remains the category with the highest percentage of highly cited papers (38%), followed by Cell Biology with 345 papers of which 36.2% are highly cited.
- The percentage of open access publications is highest in Microbiology (84.8%), followed by Infectious Diseases (81.2%), it is worth noting that these categories share more than 50% (136 papers) of their papers which likely contributes to their similarity.

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 2020. 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, 2010-2020. ORDERED BY THE FIELD-NORMALISED CITATION IMPACT OF IMI RESEARCH.

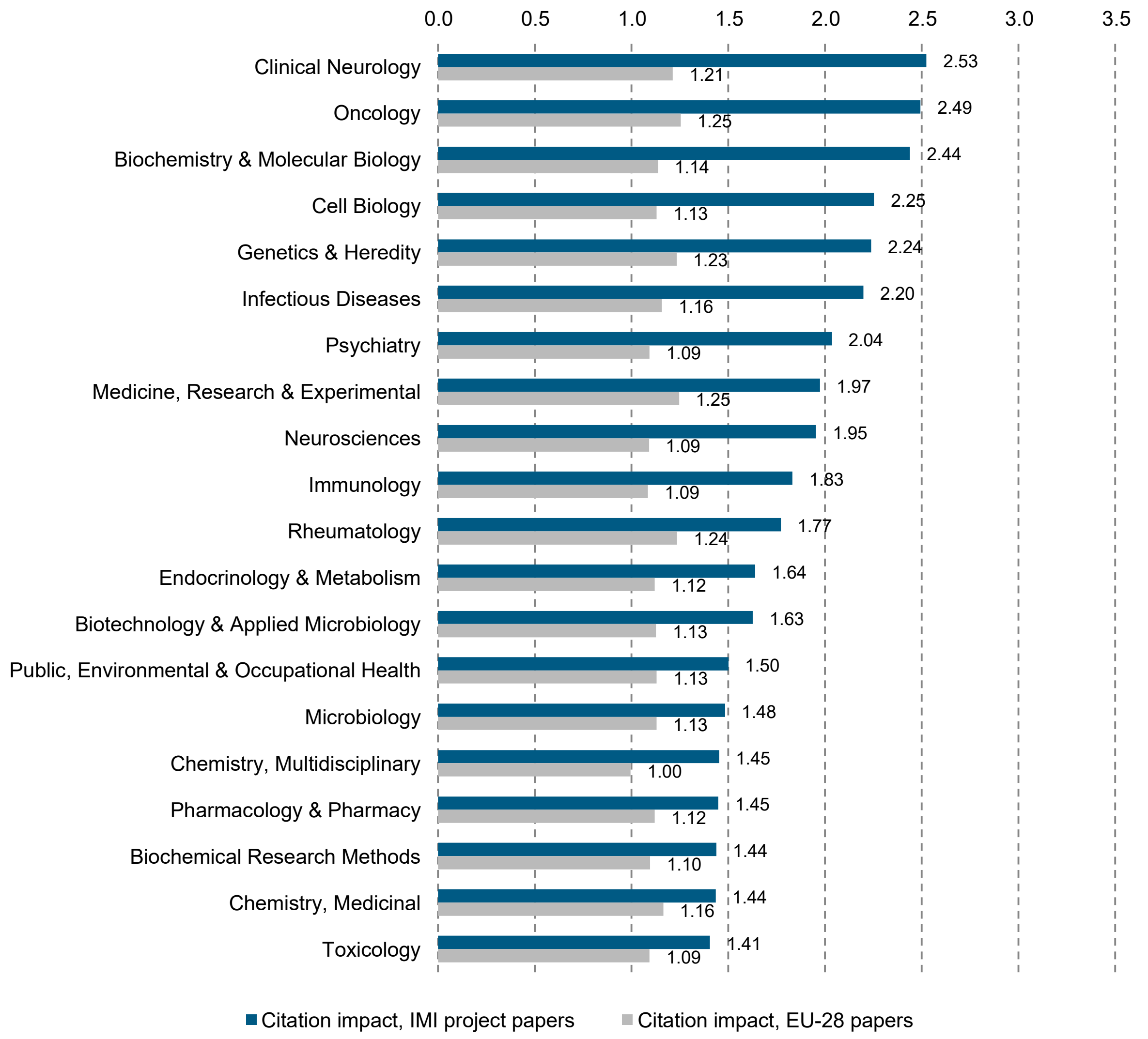


TABLE 4.9.1 CITATION IMPACT AND PERCENTAGE OF PAPERS IN TOP TWENTY WEB OF SCIENCE JOURNAL CATEGORIES IN WHICH IMI PROJECT RESEARCH WAS MOST FREQUENTLY PUBLISHED, BENCHMARKED AGAINST EU-28 PAPERS IN THE SAME JOURNAL CATEGORIES, 2010-2020

			Citation impact normalised at field level	
Journal category	**% of IMI papers**	**% of EU-28 papers**	**IMI papers**	**EU-28**
Clinical Neurology	5.76%	1.94%	2.53	1.21
Oncology	3.85%	2.36%	2.49	1.25
Biochemistry & Molecular Biology	9.11%	3.56%	2.44	1.14
Cell Biology	5.48%	1.74%	2.25	1.13
Genetics & Heredity	3.66%	1.34%	2.24	1.23
Infectious Diseases	3.40%	1.01%	2.20	1.16
Psychiatry	5.35%	1.46%	2.04	1.09
Research & Experimental Medicine	4.61%	1.13%	1.97	1.25
Neurosciences	11.91%	2.74%	1.95	1.09
Immunology	7.13%	1.52%	1.83	1.09
Rheumatology	6.82%	0.45%	1.77	1.24
Endocrinology & Metabolism	6.63%	1.36%	1.64	1.12
Biotechnology & Applied Microbiology	3.09%	1.35%	1.63	1.13
Public, Environmental & Occupational Health	2.45%	1.85%	1.50	1.13
Microbiology	4.11%	1.53%	1.48	1.13
Chemistry, Multidisciplinary	4.33%	3.02%	1.45	1.00
Pharmacology & Pharmacy	12.47%	2.20%	1.45	1.12
Biochemical Research Methods	3.11%	1.04%	1.44	1.10
Chemistry, Medicinal	3.96%	0.67%	1.44	1.16
Toxicology	2.63%	0.58%	1.41	1.09

- In all twenty journal categories listed, IMI project research had a higher field-normalised citation impact than EU-28 papers in the same field.
- Clinical Neurology (2.53) and Oncology (2.49) remained the top two journal categories in which IMI-supported research had the highest field-normalised citation impact. Although the field normalised citation impacts are 14% and 9% lower than that reported in the 2020 report, respectively.
- The average field-normalised citation impact of EU-28 papers was highest in Oncology (1.25) and Research & Experimental Medicine (1.25).

5 CITATION ANALYSIS – AT IMI PROJECT LEVEL

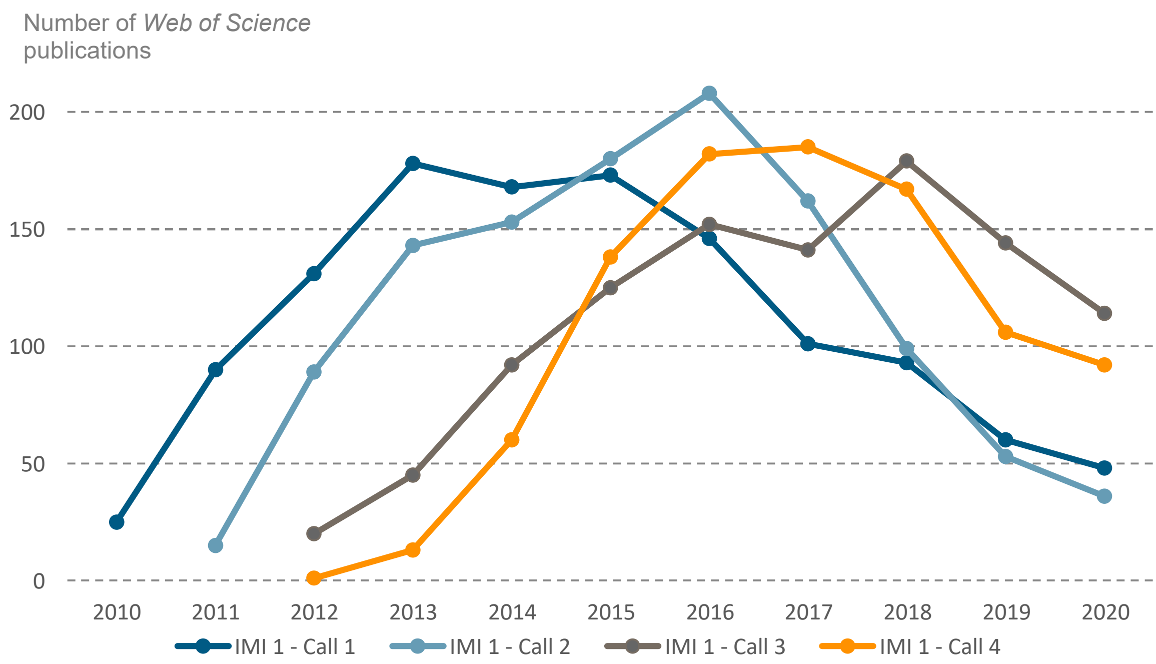
This section analyses the volume and citation impact of publications arising from different IMI-phases and calls.

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 2020 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.

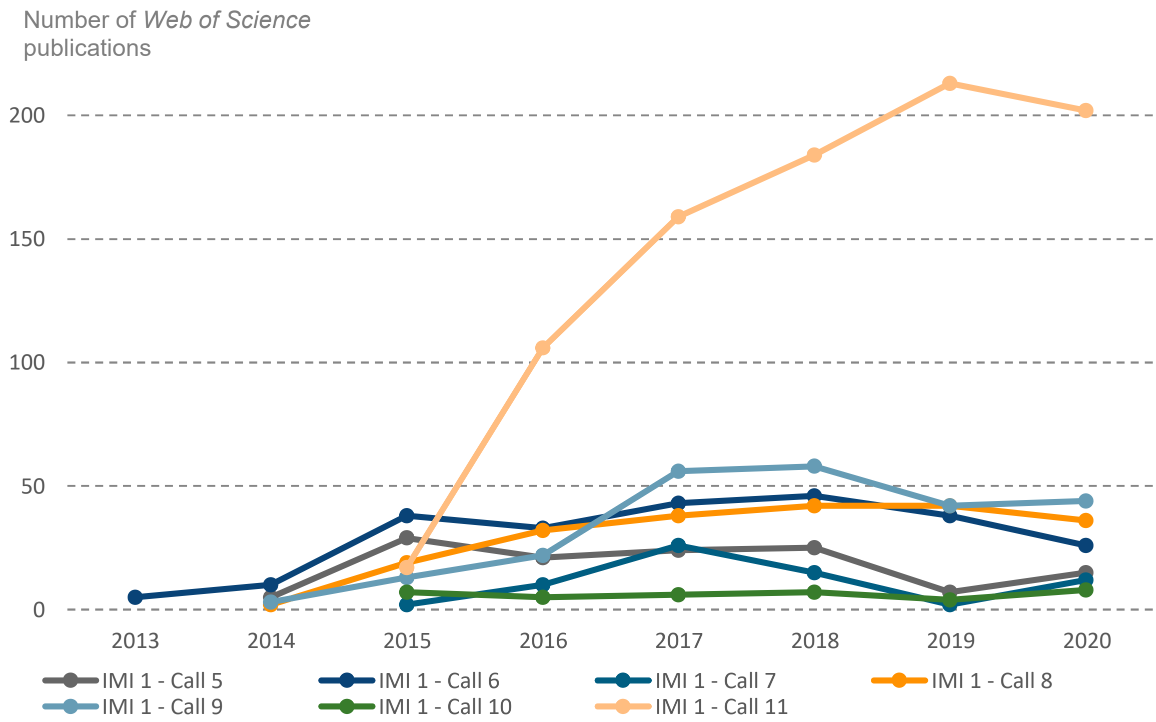
Table 5.1.1 presents summary bibliometric data for all IMI 1 and IMI 2 calls that have at least one publication, including the number of publications, numbers of papers, and citation impact indicators.

FIGURE 5.1.1 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2020



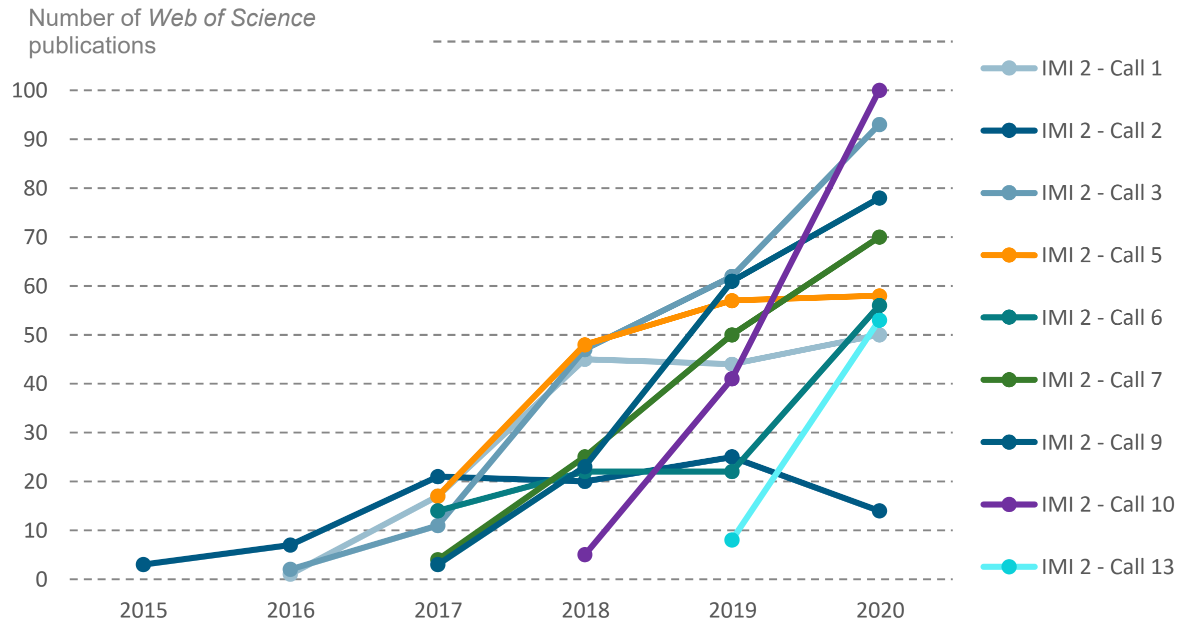
- Over the five years 2010 to 2014, IMI 1 call 1 had the highest output of publications, reaching a peak output of 178 publications in 2013.
- In 2015 and 2016, IMI 1 call 2 had the highest number of publications (180 and 208, respectively). In 2017 call 2's output fell (162 publications) and call 4 had the highest output of publications (185 publications).
- In 2020 all IMI 1 calls 1-4 are on a downward trend. Which is likely to continue since all the calls are now closed.
- Call 3 remains the call with the highest number of publications and appears to have a steeper decline then the other calls.

FIGURE 5.1.2 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2020



- 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 declined slightly (5%) in 2020.
- Many of the call 11 projects are due to close in 2021 so it is quite possible that we will start to see a plateau for call 11 publications.

FIGURE 5.1.3 NUMBER OF WEB OF SCIENCE PUBLICATIONS BY YEAR AND FUNDING CALL, 2010-2020. 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 after plateauing between 2017-2019 it now has begun declining.
- IMI 2 Calls 10 and 13 are newly included to this analysis as the number of publications within these calls has increased rapidly. Especially, Call 10 which published 100 papers in 2020, more than any other call and more than double the number of publications published in 2019.
- Call 10's rapid increase is largely driven by the AIMS-2-Trials which published 73 publications in 2020.
- Calls 3,6,7, and 9 have sustained their growth in the number of publications. While Calls 1 and 5 have begun to plateau.

TABLE 5.1.1 SUMMARY BIBLIOMETRIC ANALYSES OF IMI PROJECTS AGGREGATED BY FUNDING CALL, 2010-2020

					Citation Impact		
Phase	**Call**	**Number of Publications**[8]	**% Open Access Publications**	**Number of Papers**	**Raw citation impact**	**Normalised at field level**	**Normalised at journal level**
1	1	1,213	56.0%	1,122	39.29	1.83	1.12
1	2	1,138	68.0%	1,071	40.35	2.14	1.19
1	3	1,012	71.0%	933	26.46	1.87	1.06
1	4	944	61.0%	900	28.81	2.12	1.35
1	5	126	66.0%	125	14.75	1.15	0.99

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

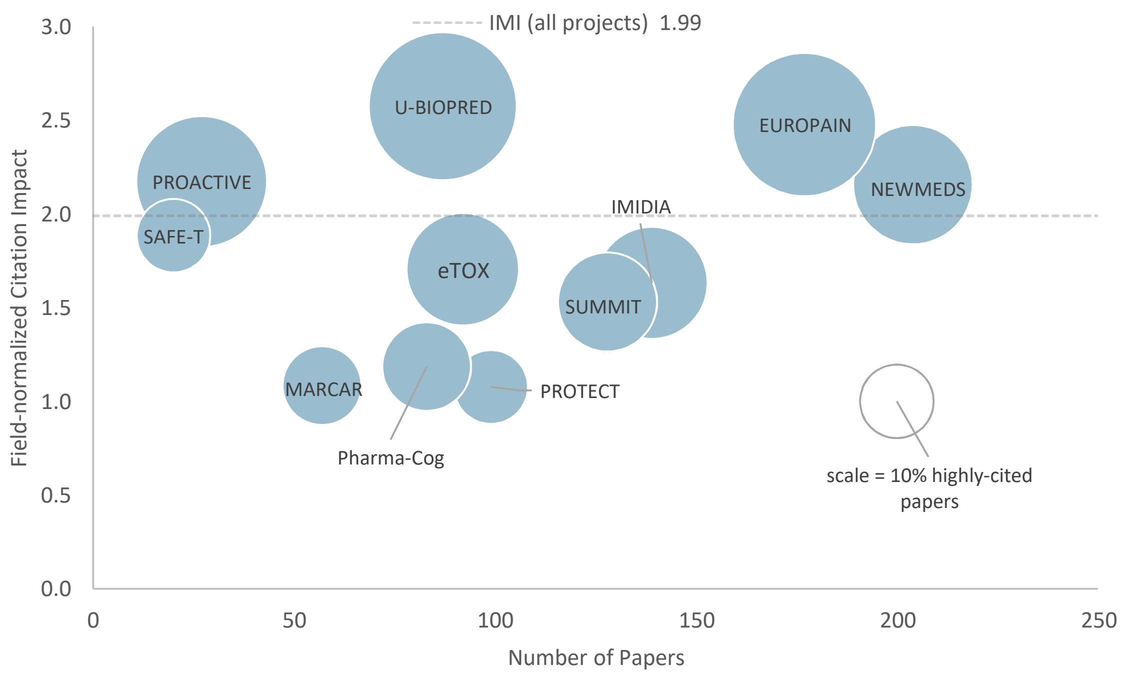
Phase	Call	Number of Publications[8]	% Open Access Publications	Number of Papers	Citation Impact: Raw citation impact	Citation Impact: Normalised at field level	Citation Impact: Normalised at journal level
1	6	239	66.0%	232	16.86	1.26	1.01
1	7	67	81.0%	60	14.35	1.84	1.74
1	8	211	74.0%	187	24.26	2.46	1.47
1	9	238	69.0%	220	20.62	1.90	1.75
1	10	37	78.0%	36	13.25	1.09	1.15
1	11	881	74.0%	805	20.49	2.18	1.28
2	1	158	70.0%	126	9.88	1.63	1.09
2	2	90	87.0%	85	13.59	1.73	1.26
2	3	215	70.0%	169	9.21	1.88	1.22
2	4	4	50.0%	4	6.25	0.61	0.33
2	5	180	84.0%	158	10.70	1.85	0.93
2	6	114	79.0%	92	7.11	1.96	1.25
2	7	149	84.0%	134	17.50	3.19	1.31
2	8	18	83.0%	16	6.56	0.68	0.72
2	9	165	80.0%	141	9.76	2.81	1.52
2	10	146	80.0%	126	4.14	1.69	0.85
2	12	28	64.0%	22	2.45	1.54	0.69
2	13	61	70.0%	53	3.72	1.87	1.42
2	14	15	60.0%	14	0.43	0.32	0.18
2	15	12	83.0%	9	1.67	1.46	2.02
2	17	24	71.0%	24	0.83	0.63	0.25
2	19	14	79.0%	11	1.27	0.93	0.82
2	21	12	100.0%	10	4.50	3.06	1.15

- IMI 1 call 1 remains the funding call that produced the highest number of publications (1,213), and papers (1,122). Although papers from IMI 1 call 2 had the highest raw citation impact (40.35), slightly higher than IMI 1 Call 1 (39.28).
- Papers assigned to IMI 2 call 7 had the highest average field-normalised citation impact (3.19), which is three times the world average. This is driven by six highly cited papers, mainly within the IMPRIND project, which were cited between 20 and 40 times the world average.
- IMI 2 call 21 which mainly consists of Coronavirus related topics is perhaps unsurprisingly the second highest average field-normalised citation impact (3.05). Although, due to the low paper counts (10) within this call it is difficult to make any firm conclusions.
- The highest percentage of open access publications belongs to IMI 2 call 21 where all the publications are open access.
- Generally, IMI 2 calls have a higher proportion of open access publications compared to IMI 1 calls.
- IMI 2 call 3 with 215 publications is IMI 2's highest output call while IMI 2 call 7 which has the highest field-normalised citation impact (3.19) overall, ranks 5th in terms of output (149) for IMI 2 calls.

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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020



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 or in line with the world average (10%) for all projects. This indicates excellent research performance.
- Research associated with NEWMEDS, EUROPAIN, PROACTIVE and U-BIOPRED was cited more than twice the world average. These four projects have an average citation impact greater than the average citation impact of all IMI project papers (1.99).

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
NEWMEDS	209	204	54.1%	10,613	52.02
EUROPAIN	177	177	38.4%	9,629	54.40
IMIDIA	149	139	80.5%	5,627	40.48
SUMMIT	132	128	72.7%	3,249	25.38
PROTECT	101	99	41.6%	2,070	20.91
eTOX	97	92	66.0%	3,536	38.43
U-BIOPRED	136	87	47.8%	3,563	40.95
Pharma-Cog	89	83	39.3%	2,656	32.00
MARCAR	58	57	75.9%	1,319	23.14
PROACTIVE	32	27	78.1%	1,241	45.96
SAFE-T	22	20	27.3%	503	25.15

TABLE 5.2.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 1, 2010-2020

		Citation impact			
Project	**Number of papers**	**Normalised at field level**	**Normalised at journal level**	**Average percentile**	**% highly cited papers**
NEWMEDS	204	2.16	1.15	30.80	26.0%
EUROPAIN	177	2.48	1.34	25.30	37.3%
IMIDIA	139	1.63	1.03	31.01	21.6%
SUMMIT	128	1.53	0.95	35.43	18.0%
PROTECT	99	1.08	0.93	39.37	10.1%
eTOX	92	1.71	1.28	30.20	21.7%
U-BIOPRED	87	2.57	1.30	22.78	37.9%
Pharma-Cog	83	1.19	0.90	42.31	14.5%
MARCAR	57	1.08	0.77	41.04	10.5%
PROACTIVE	27	2.17	1.60	27.65	29.6%
SAFE-T	20	1.88	1.16	30.18	10.0%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- Of the projects in call 1, NEWMEDS had the highest number of publications (209) 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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020

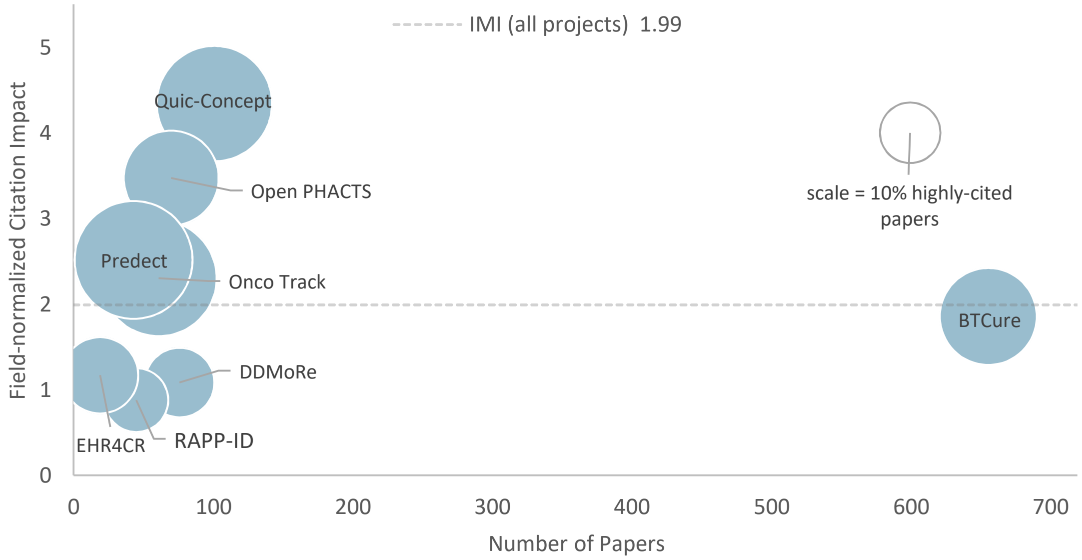
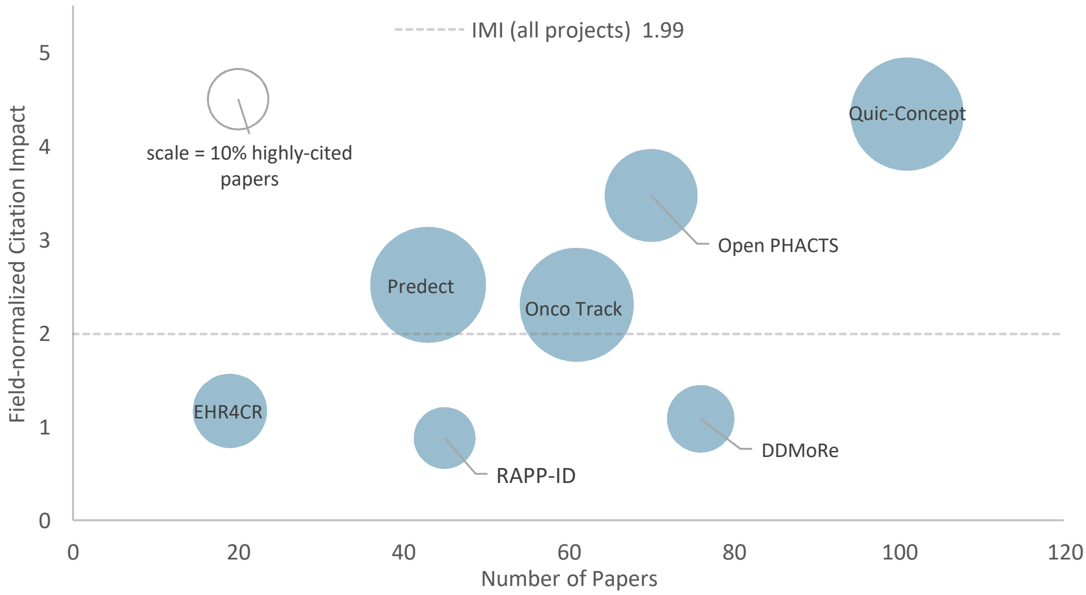


FIGURE 5.3.2 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 1 PROJECTS – CALL 2, 2010-2020 SAME GRAPH AS FIGURE 5.3.1 BUT WITH A SMALLER X-AXIS RANGE



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 (0.88).

- BTCURE remains the most prolific IMI 1 call 2 project with 656 papers and a citation impact of 1.85, which is 7.5% lower than the 2020 report and lower than the citation impact of all IMI project papers (1.99).
- QUIC-CONCEPT is the most highly cited project with a citation impact more than four times the world average (4.34).
- Open Phacts and Predect are also well cited with a citation impact of 3.47 and 2.52, respectively.
- Four of the eight projects in this call had an average citation impact greater than the average citation impact of all IMI project papers (1.99).

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
BTCure	703	656	65.6%	23,302	35.52
Quic-Concept	102	101	80.4%	7,620	75.45
DDMoRe	81	76	64.2%	1,196	15.74
Open PHACTS	73	70	86.3%	4,561	65.16
Onco Track	65	61	67.7%	3,649	59.82
RAPP-ID	46	45	52.2%	864	19.20
Predect	47	43	76.6%	2,122	49.35
EHR4CR	21	19	61.9%	353	18.58

TABLE 5.3.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 2, 2010-2020

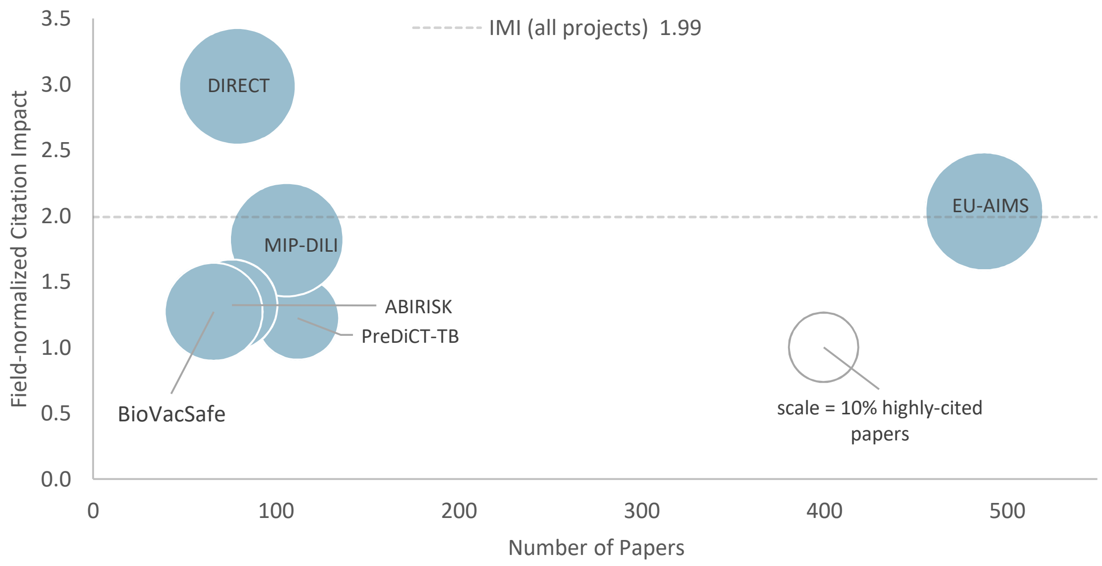
		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% highly cited papers
BTCure	656	1.85	1.01	30.55	25.3%
Quic-Concept	101	4.34	2.17	29.96	35.6%
DDMoRe	76	1.08	0.90	47.65	13.2%
Open PHACTS	70	3.47	1.83	36.29	24.3%
Onco Track	61	2.30	1.19	25.92	36.1%
RAPP-ID	45	0.88	0.79	41.62	11.1%
Predect	43	2.52	1.47	32.16	37.2%
EHR4CR	19	1.17	0.97	43.80	15.8%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- Among IMI 1 call 2 projects Open PHACTS has the highest percentage of open access publications (86.3%).
- Predect has the highest percentage of highly cited papers (37.2%)

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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020



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 the world average.
- EU-AIMS was by far the most prolific IMI 1, call 3 project with 488 papers. The field-normalised citation impact of this research was twice the world average (2.03) and above average for all IMI research (1.99).
- EU-AIMS also has the highest percentage of highly cited papers 28.5%
- Research associated with DIRECT was very well-cited with a field-normalised citation impact of almost three times (2.98) the world average.

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
EU-AIMS	503	488	75.1%	14,458	29.63
PreDiCT-TB	118	112	85.6%	1,989	17.76
MIP-DILI	113	106	56.6%	2,544	24.00
DIRECT	105	79	62.9%	2,311	29.25
ABIRISK	97	76	49.5%	1,680	22.11
BioVacSafe	69	66	73.9%	1,777	26.92

TABLE 5.4.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 3, 2010-2020

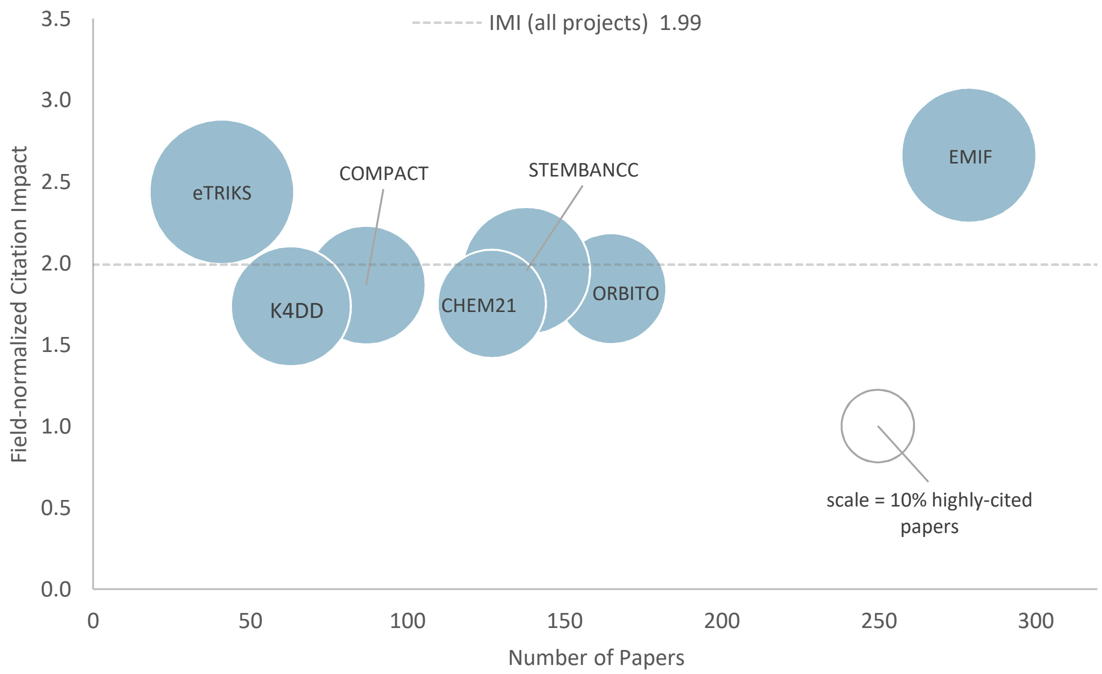
		Citation impact			
Project	**Number of papers**	**Normalised at field level**	**Normalised at journal level**	**Average percentile**	**% highly cited papers**
EU-AIMS	488	2.03	1.11	31.15	28.5%
PreDiCT-TB	112	1.22	0.82	42.90	14.3%
MIP-DILI	106	1.82	1.33	34.12	26.4%
DIRECT	79	2.98	0.90	38.15	27.8%
ABIRISK	76	1.32	0.93	44.48	17.1%
BioVacSafe	66	1.27	0.99	32.27	19.7%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- PreDiCT-TB had the highest percentage of open access publications (85.6%).

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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020



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 279 papers published by the end of 2020 and has a field-normalised citation impact more than two and half times the world average (2.66).
- eTRICKS has the highest percentage of highly cited papers (39.0%)
- Two-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 (1.99), which is two less than last years (2020) report.

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
EMIF	300	279	76.3%	9,136	32.75
ORBITO	168	165	28.0%	3,468	21.02
STEMBANCC	143	138	74.8%	3,489	25.28
CHEM21	130	127	46.9%	4,305	33.90
COMPACT	87	87	48.3%	3,038	34.92
K4DD	65	63	67.7%	1,382	21.94
eTRIKS	51	41	82.4%	1,279	31.20

TABLE 5.5.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 4, 2010-2020

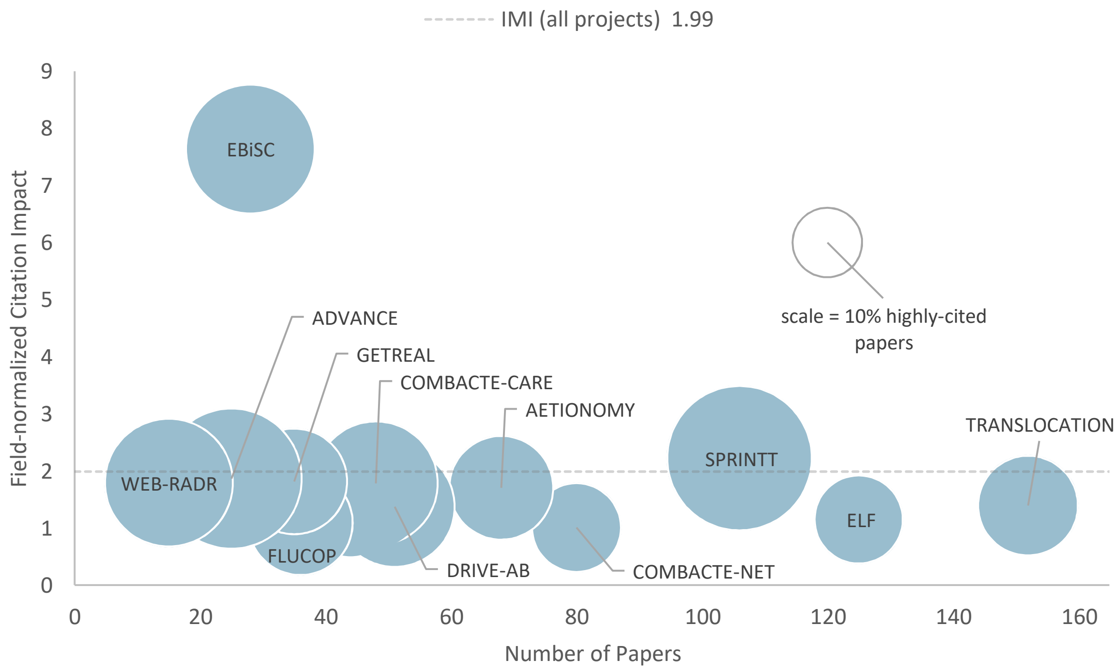
		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% highly cited papers
EMIF	279	2.66	1.36	28.56	34.1%
ORBITO	165	1.84	1.40	30.26	23.0%
STEMBANCC	138	1.95	1.30	34.47	30.4%
CHEM21	127	1.75	1.29	37.29	22.0%
COMPACT	87	1.86	1.39	29.73	26.4%
K4DD	63	1.74	1.36	29.02	27.0%
eTRIKS	41	2.44	1.48	22.27	39.0%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- eTRIKS has the highest percentage of open access publications (82.4%).

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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020



The data in Figure 5.6.1 shows that:

- Research associated with EBiSC was very well cited with an astounding field-normalised citation impact of more than seven times the world average (7.64). However, the total number of EBiSC papers is relativity low (28 papers) so citation indicators are easily inflated by one or a few very highly cited papers.
- SPRINTT has the highest percentage of highly cited papers (42.5%).
- TRANSLOCATION produced the most papers (152) likely due to it being one of the longest running projects from IMI 1 calls 5-10.
- All of the projects in calls 5-10 have a field-normalised citation impact greater than the world average but below average for all IMI project research (1.99), with the exception of EBiSC and SPRINTT.

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
TRANSLOCATION	152	152	59.2%	3,018	19.86
ELF	126	125	65.9%	1,845	14.76
SPRINTT	113	106	55.8%	2,515	23.73
COMBACTE-NET	87	80	78.2%	915	11.44
AETIONOMY	69	68	78.3%	1,206	17.74
DRIVE-AB	57	51	80.7%	908	17.80
COMBACTE-CARE	52	48	84.6%	971	20.23
ENABLE	47	47	85.1%	735	15.64
PRECISESADS	64	44	56.3%	742	16.86
FLUCOP	37	36	78.4%	486	13.50
GETREAL	41	35	75.6%	633	18.09
EBiSC	31	28	87.1%	1,884	67.29
ADVANCE	26	25	88.5%	270	10.80
WEB-RADR	16	15	75.0%	231	15.40

TABLE 5.6.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALLS 5-10, 2010-2020

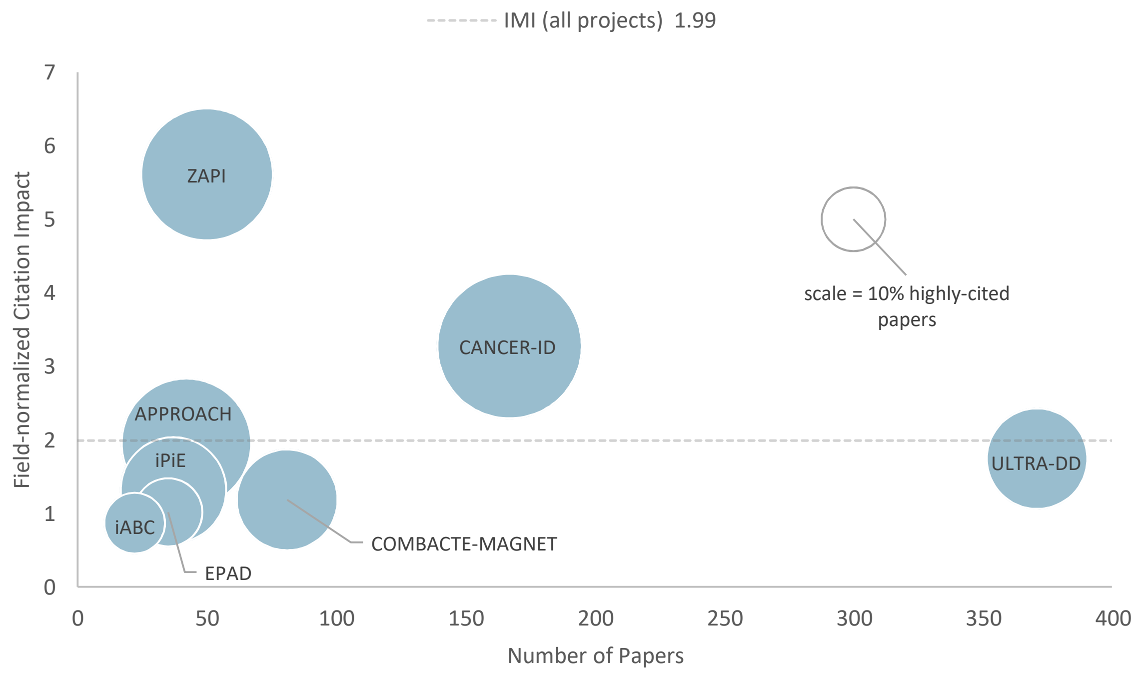
		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% highly cited papers
TRANSLOCATION	152	1.39	1.04	36.94	20.4%
ELF	125	1.15	0.99	41.68	16.0%
SPRINTT	106	2.22	2.29	26.98	42.5%
COMBACTE-NET	80	1.01	0.96	39.99	16.3%
AETIONOMY	68	1.71	1.20	40.16	22.1%
DRIVE-AB	51	1.37	1.13	31.23	29.4%
COMBACTE-CARE	48	1.78	1.21	37.88	31.3%
ENABLE	47	1.61	1.14	33.87	25.5%
PRECISESADS	44	1.23	0.89	40.91	13.6%
FLUCOP	36	1.09	1.15	39.24	22.2%
GETREAL	35	1.82	1.23	32.93	22.9%
EBiSC	28	7.64	3.59	29.52	32.1%
ADVANCE	25	1.87	2.45	24.57	40.0%
WEB-RADR	15	1.80	1.65	28.59	33.3%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- ADVANCE has the highest percentage (88.5%) of open access publications.

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 (2010-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted 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, 2010-2020



The data in Figure 5.7.1 shows that:

- ULTRA-DD produced by far the most papers (371).
- All of the projects (except for iABC) perform above world average for percentage of highly cited papers and field-normalised citation impact.
- Research papers associated with CANCER-ID and ZAPI were very well-cited with a field-normalised citation impact nearly three (3.27) and (5.61) five times the world average, respectively. They are also the only two projects in this call that are higher than the average for all IMI projects (1.99).
- Over half of CANCER-ID papers are highly cited (50.3%).

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, 2010-2020

Project	Number of publications	Number of papers	% open access publications	Citations	Raw citation impact
ULTRA-DD	379	371	77.8%	5,690	15.34
CANCER-ID	193	167	70.5%	6,429	38.50
COMBACTE-MAGNET	91	81	74.7%	928	11.46
ZAPI	53	50	98.1%	1,494	29.88
APPROACH	52	42	69.2%	1,179	28.07
iPiE	38	37	63.2%	487	13.16
EPAD	39	35	64.1%	463	13.23
iABC	36	22	50.0%	224	10.18

TABLE 5.7.2 SUMMARY CITATION INDICATORS FOR IMI 1 PROJECTS IN CALL 11, 2010-2020

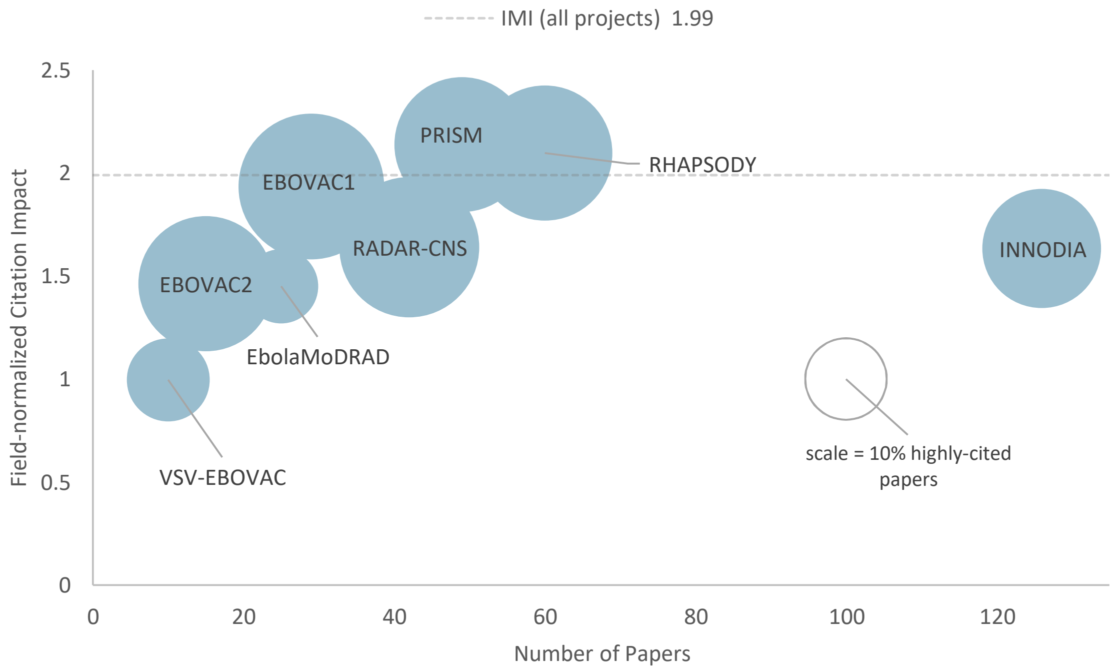
Project	Number of papers	Citation impact Normalised at field level	Citation impact Normalised at journal level	Average percentile	% highly cited papers
ULTRA-DD	371	1.74	1.01	35.76	24.5%
CANCER-ID	167	3.27	1.63	17.83	50.3%
COMBACTE-MAGNET	81	1.18	1.00	42.49	24.7%
ZAPI	50	5.61	3.05	27.23	42.0%
APPROACH	42	1.95	1.65	27.55	40.5%
iPiE	37	1.32	1.08	35.83	27.0%
EPAD	35	1.01	0.74	48.53	11.4%
iABC	22	0.87	0.90	60.99	9.1%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

- ZAPI has the highest percentage (98.1%) of open access publications.

5.8 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 2 CALLS 1-4 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 calls 1-4. Only projects with at least 10 papers and one highly cited paper over the time period (2015-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.8.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – CALLS 1-4, 2015-2020



The data in Figure 5.8.1 shows that:

- INNODIA was the most productive project, publishing 126 papers.
- With the exception of EbolaMoDRAD, all of the projects meet or exceed the world average for highly cited papers.
- RHAPSODY and PRISM are the most impactful projects with a field-normalized citation impact of more than two times the world average, 2.10 and 2.14 respectively.
- Besides RHAPSODY and PRISM, the other projects fall short of the average field-normalized citation impact for all IMI projects (1.99)

Table 5.8.1 shows raw citation impact and percentage of open access publications by project for IMI 2 calls 1-4 publications and Table 5.8.2 shows indicators for IMI 2 calls 1-4 project research where citation impact has been normalised against world average values.

TABLE 5.8.1 BIBLIOMETRIC INDICATORS FOR IMI 2 CALLS 1-4 PROJECTS, 2015-2020

Project	Number of publications	Number of papers	% open access publications[9]	Citations	Raw citation impact
INNODIA	158	126	69.6%	1,306	10.37
RHAPSODY	75	60	78.7%	754	12.57
PRISM	58	49	75.9%	513	10.47
RADAR-CNS	64	42	48.4%	393	9.36
EBOVAC1	31	29	100.0%	529	18.24
EbolaMoDRAD	26	25	69.2%	227	9.08
EBOVAC2	15	15	100.0%	192	12.80
VSV-EBOVAC	11	10	63.6%	149	14.90

- All the EBOVAC1 & EBOVAC2 project papers are open access.
  RADAR-CNS has less than 50% of its publications as open access.[9]

TABLE 5.8.2 SUMMARY CITATION INDICATORS FOR IMI 2 CALLS 1-4 PROJECTS, 2015-2020

		Citation impact			
Project	Number of papers	Normalised at field level	Normalised at journal level	Average percentile	% highly cited papers
INNODIA	126	1.63	1.09	40.38	20.6%
RHAPSODY	60	2.10	1.01	41.44	26.7%
PRISM	49	2.14	1.05	43.16	26.5%
RADAR-CNS	42	1.64	1.76	42.66	28.6%
EBOVAC1	29	1.93	1.29	38.90	31.0%
EbolaMoDRAD	25	1.45	1.09	40.15	8.0%
EBOVAC2	15	1.46	1.27	42.24	26.7%
VSV-EBOVAC	10	1.00	0.69	26.23	10.0%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

[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/

5.9 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 2 CALLS 5-10 PROJECTS

Figure 5.9.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers from IMI 2 projects from calls 5-10. Only projects with at least 10 papers and one highly cited paper over the time period (2017-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted horizontal line indicates the average field-normalised citation impact for all IMI project papers. The same data is shown in Figure 5.9.1 and Figure 5.9.2, however Figure 5.9.2 has a smaller x-axis range in order to get a better view of the clustered projects in the bottom left corner of Figure 5.9.1.

FIGURE 5.9.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – CALLS 5-10, 2017-2020

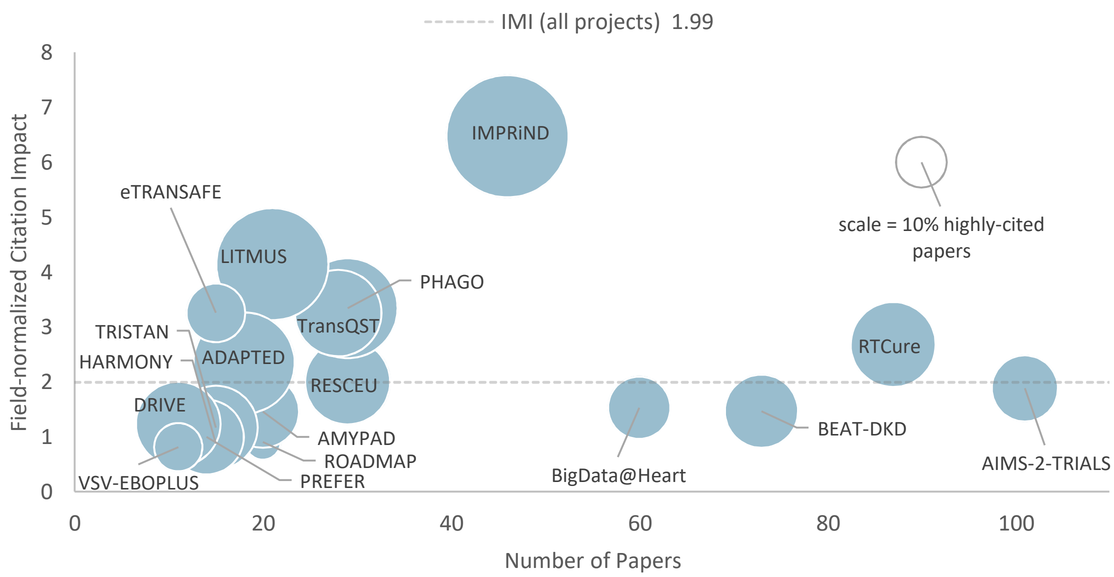
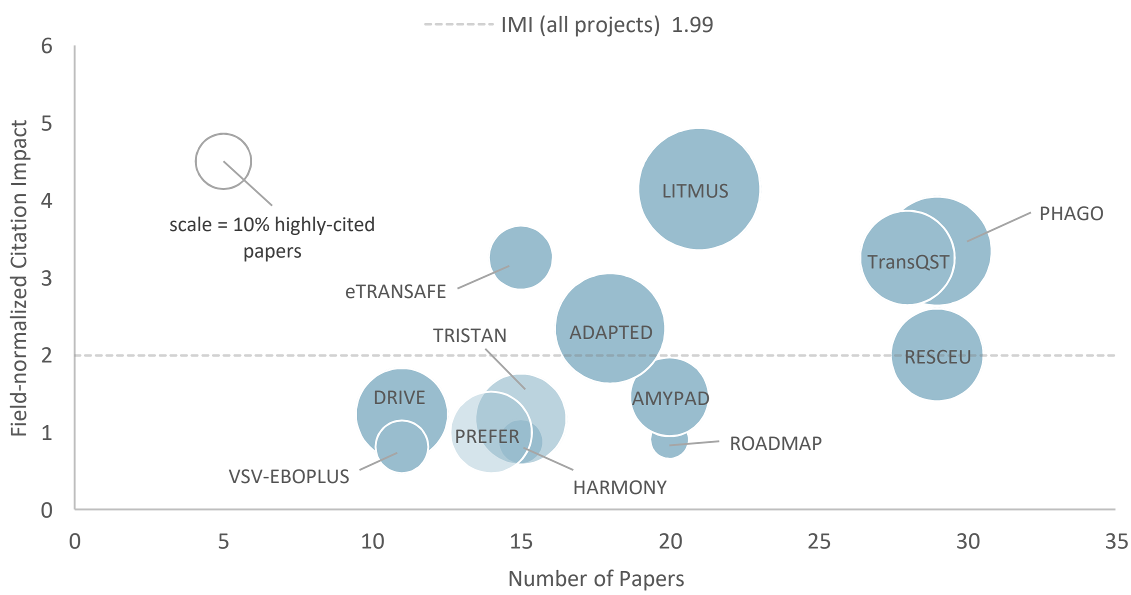


FIGURE 5.9.2 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – CALLS 5-10, 2017-2020. SMALLER AXIS RANGE.



The data in Figure 5.9.1 and Figure 5.9.2 shows that:

- The AIMS-2-Trials publishes the most papers, 101 papers. Although, the field-normalized citation impact remains low compared to many of the other projects. This is likely because 69 out of 101 papers were published in 2020 and therefore have not had much time to accumulate citations.
- IMPRIND project is very well cited and has exceeded the world average field-normalized citation impact by more than six times (6.47). It has more than half (56.5%) of its papers that are highly cited.

Table 5.9.1 shows raw citation impact and percentage of open access publications by project for IMI 2 calls 5-10 publications and Table 5.9.2 shows indicators for IMI 2 calls 5-10 project research where citation impact has been normalised against world average values.

TABLE 5.9.1 BIBLIOMETRIC INDICATORS FOR IMI 2 CALLS 5-10 PROJECTS, 2017-2020

Project	Number of publications	Number of papers	% open access publications[10]	Citations	Raw citation impact
AIMS-2-TRIALS	107	101	89.7%	522	5.17
RTCure	94	87	84.0%	1,142	13.13
BEAT-DKD	78	73	83.3%	659	9.03
BigData@Heart	69	60	78.3%	363	6.05
IMPRiND	48	46	85.4%	1,798	39.09
RESCEU	31	29	87.1%	204	7.03
PHAGO	29	29	96.6%	474	16.34
TransQST	30	28	83.3%	273	9.75
LITMUS	26	21	65.4%	178	8.48
ROADMAP	26	20	80.8%	102	5.10
AMYPAD	26	20	69.2%	211	10.55
ADAPTED	20	18	90.0%	274	15.22
TRISTAN	15	15	93.3%	142	9.47
eTRANSAFE	20	15	75.0%	104	6.93
HARMONY	27	15	63.0%	161	10.73
PREFER	23	14	78.3%	115	8.21
DRIVE	12	11	83.3%	50	4.55
VSV-EBOPLUS	12	11	75.0%	97	8.82

[10] 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/

- 96.6% of PHAGO project papers are open access.

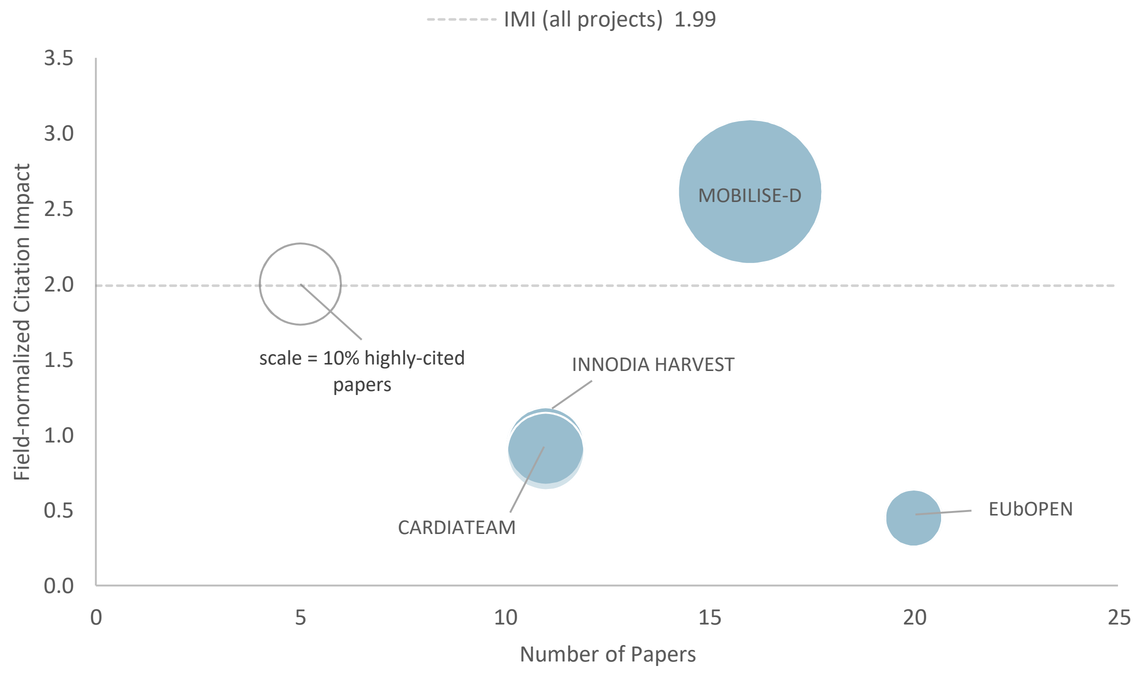
TABLE 5.9.2 SUMMARY CITATION INDICATORS FOR IMI 2 CALLS 5-10 PROJECTS, 2017-2020

		Citation impact			
Project	**Number of papers**	**Normalised at field level**	**Normalised at journal level**	**Average percentile**	**% highly cited papers**
AIMS-2-TRIALS	101	1.88	0.89	57.06	16.8%
RTCure	87	2.68	1.49	37.33	27.6%
BEAT-DKD	73	1.46	0.81	40.90	20.5%
BigData@Heart	60	1.53	0.85	51.39	15.0%
IMPRiND	46	6.47	2.18	15.90	56.5%
RESCEU	29	2.00	1.26	34.56	27.6%
PHAGO	29	3.34	1.53	31.59	37.9%
TransQST	28	3.25	2.09	38.36	28.6%
LITMUS	21	4.14	1.40	37.46	47.6%
ROADMAP	20	0.90	0.61	52.97	5.0%
AMYPAD	20	1.45	0.84	40.78	20.0%
ADAPTED	18	2.34	0.78	45.77	38.9%
HARMONY	15	0.87	0.52	52.90	6.7%
TRISTAN	15	1.17	0.91	51.77	26.7%
eTRANSAFE	15	3.25	1.83	44.09	13.3%
PREFER	14	0.99	0.86	54.30	21.4%
DRIVE	11	1.23	1.79	53.91	27.3%
VSV-EBOPLUS	11	0.81	0.94	32.51	9.1%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

5.10 SUMMARY BIBLIOMETRIC ANALYSES FOR IMI 2 CALLS 11-21 PROJECTS

Figure 5.10.1 compares the number of papers, average field-normalised citation impact and share of highly cited papers from IMI 2 projects from calls 11-21. Only projects with at least 10 papers and one highly cited paper over the time period (2019-2020) are shown. The area of the 'bubble' is proportional to the share of highly cited papers. The dotted horizontal line indicates the average field-normalised citation impact for all IMI project papers.

FIGURE 5.10.1 PAPER NUMBERS, AVERAGE FIELD-NORMALISED CITATION IMPACT AND SHARE OF HIGHLY CITED RESEARCH FOR SELECTED IMI 2 PROJECTS – CALLS 11-21, 2019-2020



The data in Figure 5.10.1 and Figure shows that:

- Publication rates in these calls are still quite low, with EUbOPEN being the most prolific with 20 papers. This is because these projects are quite new, and the oldest publication was published in 2019.
- As these publications are so new their percentage of highly cited papers and field-normalized citation impact is also low. Except for MOBILISE-D.
- MOBILISE-D is the most well-cited in this group with an average field-normalised citation impact (2.61) of more than two times the world average.
- Almost a third (31.3%) of MOBILISE-D project papers are highly cited.

Table 5.10.1 shows raw citation impact and percentage of open access publications by project for IMI 2 calls 11-21 publications and Table 5.9.2 shows indicators for IMI 2 calls 11-21 project research where citation impact has been normalised against world average values.

TABLE 5.10.1 BIBLIOMETRIC INDICATORS FOR IMI 2 CALLS 11-21 PROJECTS, 2019-2020

Project	Number of publications	Number of papers	% open access publications[11]	Citations	Raw citation impact
EUbOPEN	20	20	65.0%	13	0.65
MOBILISE-D	18	16	55.6%	40	2.50
INNODIA HARVEST	14	11	78.6%	16	1.45
CARDIATEAM	13	11	69.2%	19	1.73

- INNODIA HARVEST has the highest percentage of open access publications, 78.6%.

TABLE 5.10.2 SUMMARY CITATION INDICATORS FOR IMI 2 CALLS 11-21 PROJECTS, 2019-2020

Project	Number of papers	Citation impact Normalised at field level	Normalised at journal level	Average percentile	% highly cited papers
EUbOPEN	20	0.45	0.19	81.85	5.0%
MOBILISE-D	16	2.61	1.61	51.37	31.3%
INNODIA HARVEST	11	0.93	0.82	53.00	9.1%
CARDIATEAM	11	0.89	1.00	57.38	9.1%
Overall (IMI projects)	**6,566**	**1.99**	**1.21**	**35.00**	**25.7%**

[10] 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.

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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 36 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 (1,454 publications), Amsterdam (1,221 publications), Stockholm (685 publications), Paris (630 publications) and Oxford (587) which replaced Copenhagen (502) since last year's report. The largest clusters in North America are Toronto (310 publications), Boston (296 publications), Bethesda (172 publications), New York (131 publications), and Montreal (119 publications).

IMI research performs well above the national averages for citation impact for all the European and North American clusters. The highest European clusters for citation impact are Maastricht (3.69) and Cambridge (3.43) both more than two times their national averages of 1.70 and 1.52, respectively.

A relatively high percentage of IMI research is open access, with the Seattle cluster being among the highest with 90.4% of its IMI project research as open access publications and Rome being the lowest with over half (57.7%) of its publications being open access. The European cluster with the highest percentage of IMI research was Oxford with 86.2 % of its publication being open access.

Around 40% of all EU-28 biomedical research involves international co-authorship while in comparison rates of international collaboration for IMI project research are very high for most clusters, especially in North America where most clusters have around 90% international collaboration which is expected as IMI is European funding organisation that primarily funds researchers working in EU-28. The European cluster with the highest rate of internationally collaborative papers was Dresden with 95.5% of its research involving international co-authorship. While the European cluster, Uppsala, remained the lowest at 70% international collaboration.

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 areas of lowest 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.[12] 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.

[12] 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, 2010-2020

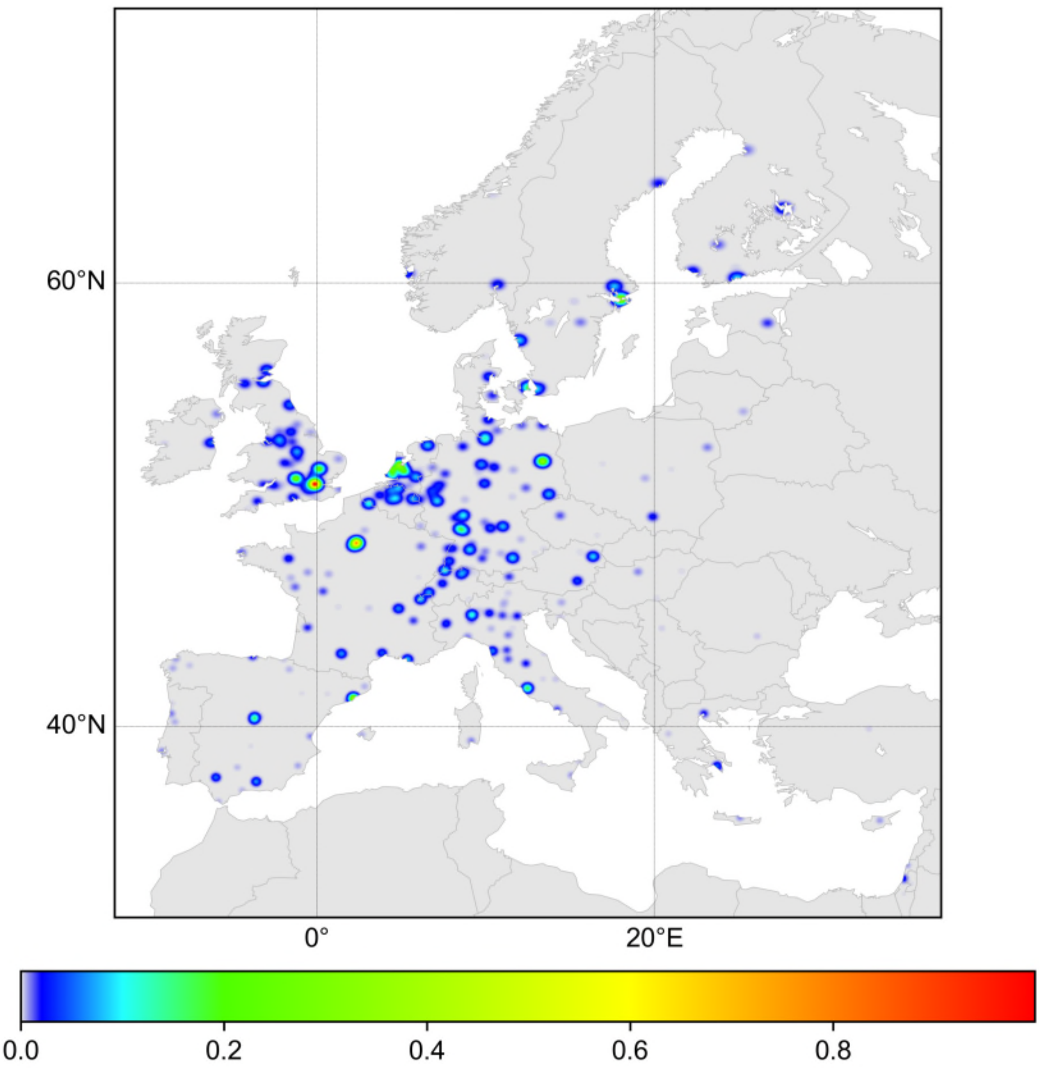

FIGURE 6.1.2 MAP SHOWING NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2020

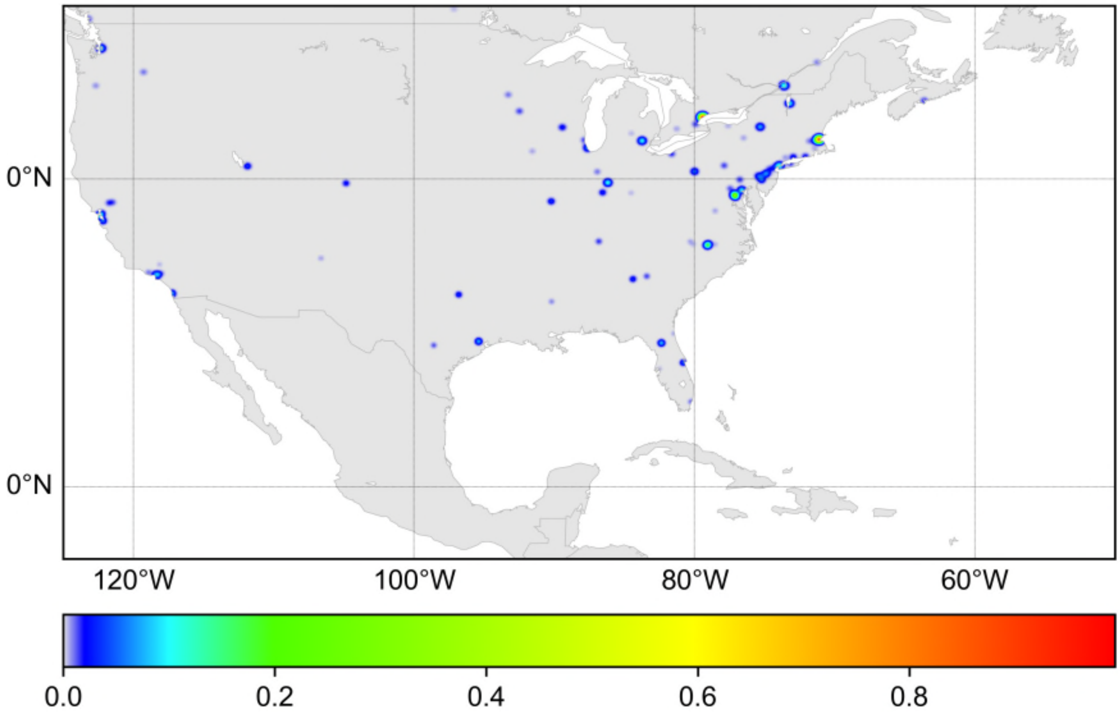

TABLE 6.1.1 OUTPUT AND RESEARCH PERFORMANCE OF EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2020

Cluster	Number of publications	Number of papers	% open access publications	Raw citation impact	% internationally collaborative publications
London (UK)	1,454	1,322	75.2%	30.77	83.1%
Amsterdam (Netherlands)	1,221	1,102	69.3%	32.57	80.9%
Stockholm (Sweden)	685	636	70.4%	33.71	77.8%
Paris (France)	630	590	70.6%	32.75	84.1%
Oxford (UK)	587	561	86.2%	27.82	82.2%
Cambridge (UK)	516	477	81.0%	40.57	82.4%
Copenhagen (Denmark)	502	464	63.9%	26.22	81.5%
Barcelona (Spain)	406	366	70.2%	28.43	77.9%
Berlin (Germany)	355	330	74.1%	31.04	80.9%
Mannheim (Germany)	353	342	70.8%	38.10	85.7%
Basel (Switzerland)	312	283	67.3%	27.25	94.0%
Uppsala (Sweden)	269	253	72.5%	23.20	70.0%
Rome (Italy)	260	235	57.7%	32.58	74.9%
Madrid (Spain)	257	238	75.5%	25.23	76.5%
Groningen (Netherlands)	255	240	80.8%	28.58	82.1%
Milan (Italy)	249	212	63.1%	33.90	83.5%
Vienna (Austria)	246	227	72.8%	20.45	81.5%
Frankfurt (Germany)	245	227	60.8%	20.52	87.2%
Nijmegen (Netherlands)	243	230	74.9%	34.51	83.5%
Gothenburg (Sweden)	243	227	68.7%	33.44	89.0%
Geneva (Switzerland)	236	213	78.0%	37.48	85.4%
Hamburg (Germany)	232	218	77.2%	29.03	80.3%
Munich (Germany)	214	191	64.5%	31.73	82.7%
Manchester (UK)	213	188	71.4%	41.28	86.2%
Erlangen (Germany)	212	201	64.2%	40.63	72.1%
Maastricht (Netherlands)	201	193	80.1%	61.05	92.2%
Leuven (Belgium)	199	172	68.3%	32.38	85.5%
Nottingham (UK)	190	176	77.9%	26.15	88.6%
Helsinki (Finland)	161	155	84.5%	36.14	86.5%
Dresden (Germany)	146	132	76.7%	24.27	95.5%
Bonn (Germany)	143	137	83.9%	28.58	78.1%
Tubingen (Germany)	137	129	72.3%	19.20	75.2%
Beerse (Belgium)	125	118	62.4%	23.14	89.8%
Marseille (France)	117	105	64.1%	30.30	82.9%
Zurich (Switzerland)	99	89	83.8%	40.56	84.3%
Lille (France)	75	70	64.0%	25.74	90.0%

TABLE 6.1.2 RESEARCH PERFORMANCE OF EUROPEAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH COMPARED TO NATIONAL BENCHMARKS, 2010-2020

	Field-normalised citation impact		Journal-normalised citation impact		% highly cited papers	
Cluster	**Cluster**	**National**	**Cluster**	**National**	**Cluster**	**National**
London (UK)	2.39	1.52	1.30	1.08	31.4%	17.2%
Amsterdam (Netherlands)	2.50	1.70	1.36	1.13	30.1%	19.5%
Stockholm (Sweden)	2.33	1.61	1.28	1.12	29.2%	17.9%
Paris (France)	2.87	1.45	1.40	1.05	32.4%	15.5%
Oxford (UK)	2.44	1.52	1.31	1.08	32.6%	17.2%
Cambridge (UK)	3.43	1.52	1.47	1.08	34.2%	17.2%
Copenhagen (Denmark)	2.27	1.70	1.25	1.15	26.7%	18.6%
Barcelona (Spain)	2.74	1.35	1.43	1.06	31.7%	14.2%
Mannheim (Germany)	2.73	1.33	1.27	1.06	30.1%	14.9%
Berlin (Germany)	2.81	1.33	1.45	1.06	27.9%	14.9%
Basel (Switzerland)	2.10	1.71	1.49	1.16	30.7%	19.2%
Uppsala (Sweden)	2.04	1.61	1.11	1.12	23.3%	17.9%
Groningen (Netherlands)	2.58	1.70	1.17	1.13	27.1%	19.5%
Madrid (Spain)	2.55	1.35	1.46	1.06	29.0%	14.2%
Rome (Italy)	2.38	1.40	1.81	1.16	37.4%	15.1%
Nijmegen (Netherlands)	2.57	1.70	1.29	1.13	34.3%	19.5%
Gothenburg (Sweden)	3.01	1.61	1.68	1.12	36.6%	17.9%
Vienna (Austria)	1.77	1.57	1.17	1.13	20.3%	17.3%
Frankfurt (Germany)	1.90	1.33	1.23	1.06	27.3%	14.9%
Hamburg (Germany)	2.56	1.33	1.23	1.06	31.2%	14.9%
Geneva (Switzerland)	2.32	1.71	1.01	1.16	29.6%	19.2%
Milan (Italy)	2.73	1.40	1.48	1.16	36.8%	15.1%
Erlangen (Germany)	2.71	1.33	1.45	1.06	32.8%	14.9%
Maastricht (Netherlands)	3.69	1.70	1.93	1.13	37.3%	19.5%
Munich (Germany)	2.81	1.33	1.42	1.06	31.4%	14.9%
Manchester (UK)	2.75	1.52	1.52	1.08	38.8%	17.2%
Nottingham (UK)	2.28	1.52	1.25	1.08	32.4%	17.2%
Leuven (Belgium)	2.57	1.77	1.54	1.20	33.7%	19.8%
Helsinki (Finland)	3.08	1.62	1.48	1.09	39.4%	17.0%
Bonn (Germany)	2.22	1.33	1.35	1.06	24.1%	14.9%
Dresden (Germany)	2.45	1.33	0.86	1.06	21.2%	14.9%
Tubingen (Germany)	1.96	1.33	1.15	1.06	30.2%	14.9%
Beerse (Belgium)	2.03	1.77	1.41	1.20	24.6%	19.8%
Marseille (France)	2.74	1.45	1.52	1.05	31.4%	15.5%
Zurich (Switzerland)	3.28	1.71	1.71	1.16	36.0%	19.2%
Lille (France)	1.79	1.45	0.94	1.05	28.6%	15.5%
London (UK)	2.39	1.52	1.30	1.08	31.4%	17.2%
Amsterdam (Netherlands)	2.50	1.70	1.36	1.13	30.1%	19.5%
Stockholm (Sweden)	2.33	1.61	1.28	1.12	29.2%	17.9%

TABLE 6.1.3 OUTPUT AND RESEARCH PERFORMANCE OF NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2020

Cluster	Number of publications	Number of papers	% open access publications	Raw citation impact	% internationally collaborative publications
Toronto (Canada)	310	302	81.0%	36.61	91.4%
Boston (USA)	296	286	86.1%	58.51	98.6%
Bethesda (USA)	172	164	80.2%	45.16	98.2%
New York (USA)	131	129	72.5%	46.97	99.2%
Montreal (Canada)	119	118	80.7%	40.28	98.3%
Chapel Hill (USA)	111	108	87.4%	30.59	88.9%
Indianapolis (USA)	100	95	69.0%	39.82	97.9%
Burlington (USA)	87	85	78.2%	23.01	100.0%
San Francisco (USA)	83	80	85.5%	81.89	100.0%
New York (USA)	79	78	84.8%	45.44	100.0%
Baltimore (USA)	68	66	88.2%	66.47	100.0%
Ann Arbor (USA)	56	54	85.7%	51.69	98.1%
Seattle (USA)	52	51	90.4%	65.20	98.0%
Gainesville (USA)	42	40	66.7%	31.00	97.5%
Los Angeles (USA)	34	34	76.5%	88.15	97.1%
Houston (USA)	31	30	90.3%	54.23	100.0%

TABLE 6.1.4 RESEARCH PERFORMANCE OF NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH COMPARED TO NATIONAL BENCHMARKS, 2010-2020

	Field-normalised citation impact		Journal-normalised citation impact		% highly cited papers	
Cluster	Cluster	National	Cluster	National	Cluster	National
Toronto (Canada)	2.81	1.49	1.34	1.07	33.4%	16.2%
Boston (USA)	3.92	1.33	1.51	1.01	39.2%	15.5%
New York (USA)	4.29	1.33	1.63	1.01	35.3%	15.5%
Bethesda (USA)	3.50	1.33	1.57	1.01	48.2%	15.5%
Montreal (Canada)	3.24	1.49	1.09	1.07	28.8%	16.2%
Chapel Hill (USA)	3.21	1.33	1.44	1.01	34.3%	15.5%
Indianapolis (USA)	3.82	1.33	1.34	1.01	32.6%	15.5%
Burlington (USA)	1.79	1.33	0.79	1.01	18.8%	15.5%
San Francisco (USA)	6.14	1.33	2.17	1.01	53.7%	15.5%
Baltimore (USA)	6.50	1.33	1.67	1.01	60.6%	15.5%
Ann Arbor (USA)	5.12	1.33	2.20	1.01	55.6%	15.5%
Seattle (USA)	5.68	1.33	2.29	1.01	52.9%	15.5%
Gainesville (USA)	2.33	1.33	1.74	1.01	50.0%	15.5%
Los Angeles (USA)	5.76	1.33	1.53	1.01	52.9%	15.5%
Houston (USA)	4.93	1.33	2.46	1.01	53.3%	15.5%
Toronto (Canada)	2.81	1.49	1.34	1.07	33.4%	16.2%
Boston (USA)	3.92	1.33	1.51	1.01	39.2%	15.5%
New York (USA)	4.29	1.33	1.63	1.01	35.3%	15.5%

Table 6.1.5 Institutions constituting top-five, by number of publications, European geographic clusters of IMI PROJECT RESEARCH, 2010-2020

Cluster	Country	Institutions	Number of publications
London	**UK**	Kings College London	590
		Imperial College London	391
		University College London	354
		GlaxoSmithKline	108
		London School of Hygiene & Tropical Medicine	67
		South London & Maudsley NHS Trust	61
		Birkbeck University London	61
		Guy's & St Thomas' NHS Foundation Trust	58
		Queen Mary University London	46
		St Georges University London	35
		Royal Brompton Harefield NHS Foundation Trust	34
		Royal Brompton Hosp	33
		University of London	31
		University College London Hospitals NHS Foundation Trust	26
		Med & Healthcare Prod Regulatory Agency	26
		Francis Crick Institute	22
		European Med Agency	18
		UCB Pharma SA	18
		Institute Cancer Research UK	17
		Medical Research Council	16
		London School Economics & Political Science	14
		Natl Inst Health Care Excellence	13
		South London & Maudsley NHS Foundation	13
		University of Westminster	11
		Royal Marsden NHS Foundation Trust	11
		EMA	10
		Public Health England	9
		Kings College Hospital	9
		Royal Coll Gen Practitioners	8
		MRC Social Genet & Dev Psychiat SGDP Ctr	8
		Alan Turing Inst	7
		Amgen	7
		AMGEN LTD	7
		Health Data Res UK	7
		Natl Inst Biol Stand Control	7
		Royal Brompton NIHR Biomed Res Unit	7
		Kings Coll Hosp NHS Foundation Trust	6
		South London & Maudsley Foundation NHS Trust	6
		UCL Medical School	6
		UK Dementia Res Inst	6
		South London & Maudsley NHS Foundation Trust SLaM	6
		Moorfields Eye Hospital NHS Foundation Trust	6
		Genet Alliance UK	5
		Heptares Therapeut	5
		UKRI	4

Cluster	Country	Institutions	Number of publications
Amsterdam	**Netherlands**	Utrecht University	349
		Vrije Universiteit Amsterdam	342
		Leiden University	339
		University of Amsterdam	325
		Leiden University Med Center	269
		Erasmus University Rotterdam	234
		Acad Med Center University Amsterdam	224
		Erasmus MC	213
		VU UNIV MED CTR	85
		Utrecht University Med Center	40
		Netherlands National Institute for Public Health & the Environment	39
		Netherlands Cancer Inst	12
		Delft University of Technology	12
		Med Evaluation Board	8
		ICIN Netherlands Heart Inst	8
		Netherlands Inst Health Serv Res	8
		ReSViNET Foundation	7
		Lygature	6
		Jan van Breemen Res Inst Reade	6
		Janssen Vaccines & Prevent BV	6
		Netherlands Heart Inst	6
		Amsterdam University Med Center	5
		Weibel Consulting	5
		Emma Childrens Hospital	4
Stockholm	**Sweden**	Karolinska Institutet	622
		Karolinska University Hosp	247
		Royal Institute of Technology	56
		Stockholm City Council	53
		Stockholm University	48
		Danderyds Hosp	10
		AstraZeneca	8
		Sci Life Lab	6
Paris	**France**	Institut National de la Sante et de la Recherche Medicale (Inserm)	350
		University Paris	285
		Universite Paris Saclay (ComUE)	220
		University Paris Saclay	186
		Centre National de la Recherche Scientifique (CNRS)	165
		Sorbonne University	159
		CEA	132
		CNRS INSB	85
		Hopital Universitaire Pitie-Salpetriere - APHP	83
		Hopital Universitaire Cochin - APHP	70
		Le Reseau International des Instituts Pasteur (RIIP)	59
		Inst Pasteur Paris	52
		Sanofi-Aventis	46

Cluster	Country	Institutions	Number of publications
		Sanofi France	44
		Assistance Publique Hopitaux Paris (APHP)	35
		Institut de Recherches Internationales Servier	33
		Hopital Universitaire Bichat-Claude Bernard - APHP	24
		UNICANCER	22
		Inst Curie	21
		Orsay Hosp	20
		Hopital Universitaire Saint-Louis - APHP	16
		Hopital Universitaire Europeen Georges-Pompidou - APHP	16
		Hopital Universitaire Necker-Enfants Malades - APHP	16
		PSL Res Univ Paris ComUE	15
		Universite Grenoble Alpes (UGA)	14
		Communaute University Grenoble Alpes	14
		Gustave Roussy	13
		CNRS Inst Chem	12
		Hopital Universitaire Paul-Brousse - APHP	11
		Hopital Universitaire Saint-Antoine - APHP	9
		Hopital Universitaire Robert-Debre - APHP	9
		Hopital Universitaire Bicetre - APHP	9
		Inst Ecol Environment	9
		Hopital Universitaire Beaujon - APHP	7
		Servier	7
		Hop Univ Ambroise-Pare APHP	6
		SOLEIL Synchrotron	6
		Museum Natl Histoire Nat	3
		University Paris XIII	1
Oxford	**UK**	University of Oxford	580
		Wellcome Center Human Genetics	82
		Oxford University Hosp NHS Foundation Trust	22
		Diamond Light Source	14
		Ludwig Institute for Cancer Research	12
		P1vital Ltd	5

TABLE 6.1.6 INSTITUTIONS CONSTITUTING TOP-FIVE, BY NUMBER OF PUBLICATIONS, NORTH AMERICAN GEOGRAPHIC CLUSTERS OF IMI PROJECT RESEARCH, 2010-2020

Cluster	Country	Institutions	Number of publications
Toronto	**Canada**	University of Toronto	309
		Struct Genom Consortium	129
		Hospital for Sick Children (SickKids)	71
		Princess Margaret Cancer Center	61
		Baycrest	54
		University Toronto Affiliates	38
		Centre for Addiction & Mental Health - Canada	25
		Ontario Institute for Cancer Research	21
		University Health Network Toronto	21
		Holland Bloorview Kids Rehab Hosp	14
		Lunenfeld Tanenbaum Res Inst	12
		Toronto General Hosp	6
		Mt Sinai Hosp Toronto	2
Boston	**USA**	Harvard University	219
		Harvard University Medical Affiliates	73
		Harvard Med School	66
		Brigham & Womens Hospital	58
		Harvard T.H. Chan School Public Health	57
		Broad Institute	53
		Pfizer	37
		Boston Child Hosp	27
		Boston University	25
		Dana-Farber Cancer Institute	17
		Massachusetts Gen Hosp	15
		Beth Israel Deaconess Medical Center	14
		Biogen	13
		Massachusetts Institute of Technology (MIT)	12
		Framingham Heart Study	11
		NIH National Heart Lung & Blood Institute (NHLBI)	8
		Merck & Company	6
		Tufts University	6
		CARB X	5
		Natl Inst Health USA	2
		US Dept Health Human Services	2
Bethesda	**USA**	Natl Inst Health USA	108
		NIH National Heart Lung & Blood Institute (NHLBI)	21
		AstraZeneca	20
		US Dept Health Human Services	19
		NIH National Institute of Mental Health (NIMH)	16
		NIH National Human Genome Research Institute (NHGRI)	10
		NIH National Institute on Aging (NIA)	10
		Medimmune	9
		US Food & Drug Administration (FDA)	9
		NIH Natl Cancer Inst	8

Cluster	Country	Institutions	Number of publications
		Natl Inst Allergy Infectious Dis (NIAID)	8
		NIH National Institute of Arthritis & Musculoskeletal & Skin Diseases (NIAMS)	7
		NIH National Institute of Diabetes & Digestive & Kidney Diseases (NIDDK)	7
		George Washington University	6
		GlaxoSmithKline	5
		Naval Research Laboratory	5
		Natl Inst Neuro Disorders Stroke	2
New York	**USA**	Columbia University	47
		Pfizer	39
		New York University	27
		Albert Einstein College of Medicine	14
		Memorial Sloan Kettering Cancer Center	12
		NewYork–Presbyterian Hosp	7
Montreal	**Canada**	University of Montreal	82
		McGill University	70

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, 2010-2020

Cluster	Country	Journal subject category	Number of publications
London	**UK**	Neurosciences	301
		Psychiatry	179
		Clinical Neurology	151
		Pharmacology & Pharmacy	139
		Immunology	118
Amsterdam	**Netherlands**	Rheumatology	159
		Pharmacology & Pharmacy	156
		Neurosciences	142
		Immunology	135
		Clinical Neurology	89
Stockholm	**Sweden**	Rheumatology	121
		Immunology	91
		Neurosciences	75
		Clinical Neurology	64
		Biochemistry & Molecular Biology	55
Paris	**France**	Neurosciences	130
		Psychiatry	65
		Pharmacology & Pharmacy	56
		Endocrinology & Metabolism	50
		Biochemistry & Molecular Biology	46
Oxford	**UK**	Biochemistry & Molecular Biology	109
		Neurosciences	81
		Cell Biology	55
		Endocrinology & Metabolism	55
		Medicinal Chemistry	53

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, 2010-2020

Cluster	Country	Journal subject category	Number of publications
Toronto	**Canada**	Biochemistry & Molecular Biology	82
		Neurosciences	66
		Psychiatry	59
		Cell Biology	34
		Medicinal Chemistry	32
Boston	**USA**	Neurosciences	45
		Genetics & Heredity	39
		Endocrinology & Metabolism	34
		Clinical Neurology	27
		Pharmacology & Pharmacy	25
Bethesda	**USA**	Pharmacology & Pharmacy	29
		Immunology	24
		Neurosciences	23

		Psychiatry	21
		Public, Environmental & Occupational Health	21
New York	**USA**	Pharmacology & Pharmacy	35
		Neurosciences	23
		Psychiatry	20
		Public, Environmental & Occupational Health	17
		Clinical Neurology	14
Montreal	**Canada**	Neurosciences	45
		Psychiatry	40
		Biochemistry & Molecular Biology	15
		Psychology, Developmental	12
		Genetics & Heredity	11

7 COLLABORATION ANALYSIS FOR IMI RESEARCH

7.1 COLLABORATION ANALYSIS FOR IMI RESEARCH

International research collaboration is increasing[13] 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.[14] 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[15] 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

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

[14] 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.

[15] 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.

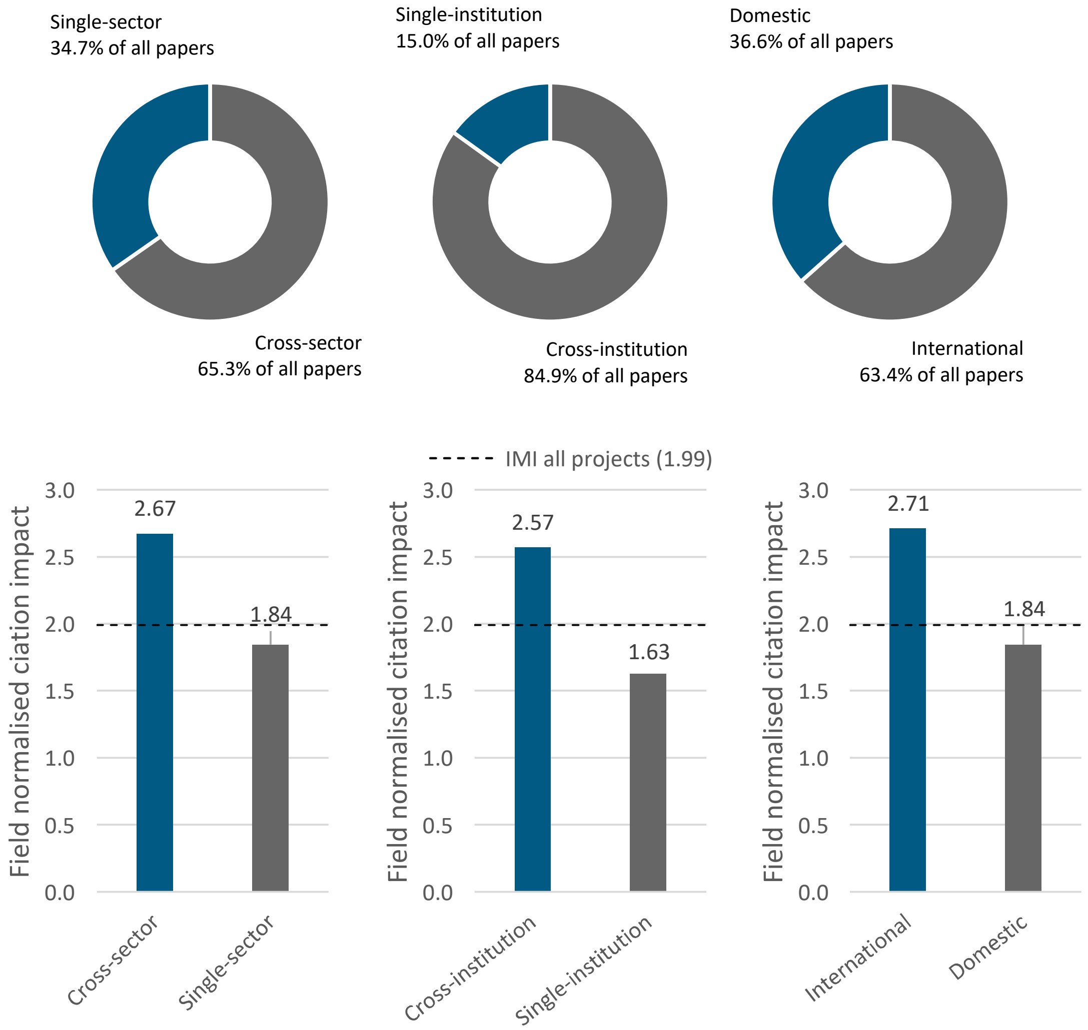
in the addresses. A paper is defined as international if more than one country is listed in the addresses, or domestic if only a single country is listed.

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, 2010-2020

	Number of papers	% of papers	Citation impact (normalised at field level)
Cross-sector	4,286	65%	2.67
Single-sector	2,276	35%	1.84
Cross-institution	5,576	85%	2.57
Single-institution	986	15%	1.63
International	4,161	63%	2.71
Domestic	2,401	37%	1.84

FIGURE 7.1.1 FIELD-NORMALISED CITATION IMPACT OF AND PERCENTAGE OF CROSS-SECTOR, CROSS-INSTITUTION AND INTERNATIONALLY COLLABORATIVE PAPERS FROM IMI PROJECT RESEARCH, 2010-2020



- Nearly two-thirds of (65.3%) of all IMI project papers were published by co-authors working in different sectors.
- The majority (84.9%) of IMI project papers involved collaboration between different institutions.
- More than half (63.4%) 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 an average field-normalised citation impact that is almost 50% higher than IMI's non-collaborative research and the non-collaborative research field-normalised citation impact was below average for IMI project research (1.99).

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, ULTRA-DD, EMIF, and NEWMEDS. The countries with the most frequent collaboration are the darkest shade of blue and gradually gets lighter the less collaboration there is.

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). Again, this also may be due to EU-AIMS having the second highest overall number of papers
- For those projects with at least 100 papers, AIMS-2-TRIALS has the highest percentage of its papers that are co-authors from more than one country (76.2%) and institution (96%). While INNODIA has the highest percentage of its papers (82.5%) that are co-authors from more than one sector.
- The majority of collaborative papers from the top five projects were co-authored with researchers from the United States (USA), Germany and the UK (Figure 7.2.1 to Figure 7.2.5).
- In general, there is a high level of collaboration within Europe for all of the top five projects. The most frequently collaborating European countries were the UK, Sweden, Netherlands, France and Germany.
- EU-AIMS, NEWMEDS and ULTRA-DD had substantial input from Canadian researchers and ULTRA-DD had a noteworthy amount of collaboration from Chinese researchers (Figure 7.2.2-Figure 7.2.5).

TABLE 7.2.1 NUMBER, PERCENTAGE AND CITATION IMPACT[16] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE COUNTRY, 2010-2020

Project	Number of papers	Number of internationally collaborative papers	% internationally collaborative papers	Citation impact (normalised at field level)
BTCure	656	387	59.0%	2.19
EU-AIMS	488	348	71.3%	2.47
ULTRA-DD	371	279	75.2%	2.20
EMIF	279	206	73.8%	3.18
NEWMEDS	204	129	63.2%	2.56
EUROPAIN	177	74	41.8%	3.19
CANCER-ID	167	84	50.3%	4.36
ORBITO	165	91	55.2%	1.94
TRANSLOCATION	152	87	57.2%	1.72
IMIDIA	139	80	57.6%	1.92
STEMBANCC	138	75	54.3%	2.37
SUMMIT	128	86	67.2%	1.80
CHEM21	127	46	36.2%	2.44
INNODIA	126	95	75.4%	2.22
ELF	125	72	57.6%	1.20
PreDiCT-TB	112	63	56.3%	1.58
MIP-DILI	106	56	52.8%	2.32
SPRINTT	106	67	63.2%	2.41
Quic-Concept	101	68	67.3%	5.94
AIMS-2-TRIALS	101	77	76.2%	3.86
PROTECT	99	71	71.7%	1.24
eTOX	92	38	41.3%	1.70
COMPACT	87	47	54.0%	2.42
U-BIOPRED	87	64	73.6%	3.25
RTCure	87	52	59.8%	4.32
Pharma-Cog	83	67	80.7%	1.42
COMBACTE-MAGNET	81	53	65.4%	1.30
COMBACTE-NET	80	45	56.3%	1.06
DIRECT	79	61	77.2%	3.73
ABIRISK	76	39	51.3%	1.51
DDMoRe	76	50	65.8%	1.18
BEAT-DKD	73	58	79.5%	1.48
Open PHACTS	70	43	61.4%	3.49
AETIONOMY	68	34	50.0%	2.54
BioVacSafe	66	36	54.5%	1.45
K4DD	63	37	58.7%	2.24
Onco Track	61	30	49.2%	3.10
BigData@Heart	60	45	75.0%	1.88
RHAPSODY	60	43	71.7%	3.23

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

Project	Number of papers	Number of internationally collaborative papers	% internationally collaborative papers	Citation impact (normalised at field level)
MARCAR	57	28	49.1%	1.25
DRIVE-AB	51	35	68.6%	1.51
ZAPI	50	37	74.0%	7.33
None	50	40	80.0%	4.71
PRISM	49	35	71.4%	3.10
COMBACTE-CARE	48	33	68.8%	2.04
ENABLE	47	21	44.7%	1.50
IMPRiND	46	28	60.9%	8.85
RAPP-ID	45	24	53.3%	0.97
PRECISESADS	44	38	86.4%	1.54
Predect	43	31	72.1%	1.93
APPROACH	42	34	81.0%	2.31
RADAR-CNS	42	36	85.7%	2.16
eTRIKS	41	38	92.7%	2.65
iPiE	37	12	32.4%	1.54
FLUCOP	36	22	61.1%	1.13
EPAD	35	23	65.7%	1.49
GETREAL	35	29	82.9%	1.74
RESCEU	29	24	82.8%	2.78
EBOVAC1	29	19	65.5%	2.57
PHAGO	29	20	69.0%	4.35
TransQST	28	21	75.0%	2.63
EBiSC	28	21	75.0%	2.13
PROACTIVE	27	23	85.2%	2.47
EbolaMoDRAD	25	15	60.0%	1.63
ADVANCE	25	22	88.0%	1.79
iABC	22	16	72.7%	1.61
LITMUS	21	15	71.4%	4.89
AMYPAD	20	17	85.0%	1.56
EUbOPEN	20	12	60.0%	1.49
SAFE-T	20	11	55.0%	2.48
ROADMAP	20	15	75.0%	0.65
EHR4CR	19	13	68.4%	1.47
ADAPTED	18	13	72.2%	3.75
MOBILISE-D	16	12	75.0%	4.17
eTRANSAFE	15	6	40.0%	0.64
TRISTAN	15	10	66.7%	1.53
HARMONY	15	7	46.7%	1.29
WEB-RADR	15	12	80.0%	2.05
EBOVAC2	15	7	46.7%	2.61
COMBACTE	14	2	14.3%	9.77
PREFER	14	12	85.7%	1.51
INNODIA HARVEST	11	11	100.0%	1.26

Project	Number of papers	Number of internationally collaborative papers	% internationally collaborative papers	Citation impact (normalised at field level)
VSV-EBOPLUS	11	9	81.8%	0.89
DRIVE	11	3	27.3%	1.84
CARDIATEAM	11	11	100.0%	1.38
3TR	11	5	45.5%	0.75
VSV-EBOVAC	10	7	70.0%	1.15
PERISCOPE	9	4	44.4%	1.78
IMI-PainCare	9	4	44.4%	0.63
VAC2VAC	9	6	66.7%	0.71
Hypo-RESOLVE	8	7	87.5%	1.64
EHDEN	8	7	87.5%	3.01
PD-MitoQUANT	8	4	50.0%	2.16
ITCC-P4	6	5	83.3%	2.12
BIOMAP	6	6	100.0%	3.62
EUPATI	6	6	100.0%	0.97
RADAR-AD	5	2	40.0%	0.50
DRAGON	5	5	100.0%	3.49
ERA4TB	5	3	60.0%	1.35
EQIPD	5	4	80.0%	3.40
ADAPT-SMART	4	2	50.0%	1.17
MOPEAD	4	3	75.0%	0.17
EBODAC	4	3	75.0%	3.81
ReSOLUTE	4	1	25.0%	0.00
SafeSciMET	4	4	100.0%	0.97
SOPHIA	4	3	75.0%	2.05
TransBioLine	4	1	25.0%	0.00
FAIRplus	3	1	33.3%	13.59
DO->IT	3	3	100.0%	1.32
VITAL	3	2	66.7%	0.20
MACUSTAR	3	2	66.7%	2.28
Eu2P	3	2	66.7%	0.11
MAD-CoV 2	2	2	100.0%	0.29
c4c	2	2	100.0%	0.00
NECESSITY	2	2	100.0%	1.40
ND4BB	2	2	100.0%	1.85
VHFMoDRAD	2	1	50.0%	0.00
PEVIA	2	2	100.0%	0.92
EBOMAN	2	2	100.0%	5.40
IMMUCAN	2	1	50.0%	0.65
ConcePTION	2	1	50.0%	0.00
EU-PEARL	2	1	50.0%	8.33
COMBACTE-CDI	2	2	100.0%	0.25
Immune-Image	2	2	100.0%	0.97
EBiSC2	2	2	100.0%	1.60

Project	Number of papers	Number of internationally collaborative papers	% internationally collaborative papers	Citation impact (normalised at field level)
PIONEER	1	1	100.0%	4.49
EMTRAIN	1	1	100.0%	0.12
NGN-PET	1	0	0.0%	0.00
EBOVAC3	1	1	100.0%	0.20
EBOVAC	1	1	100.0%	3.53
NeuroDeRisk	1	1	100.0%	0.00
IM2PACT	1	0	0.0%	0.00
COVID-RED	1	1	100.0%	0.00
COMBINE	1	0	0.0%	0.00
MELLODDY	1	0	0.0%	0.00
CARE	1	0	0.0%	0.00
IDEA-FAST	1	1	100.0%	0.79
KRONO	1	1	100.0%	0.00
VALUE-Dx	1	1	100.0%	0.67
PARADIGM	1	1	100.0%	0.40
Pharmatrain	1	1	100.0%	0.09
FILODIAG	0	0	0.0%	0.00
imSAVAR	0	0	0.0%	0.00

TABLE 7.2.2 NUMBER, PERCENTAGE AND CITATION IMPACT[17] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE INSTITUTION, 2010-2020

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	656	537	81.9%	2.07
EU-AIMS	488	454	93.0%	2.32
ULTRA-DD	371	331	89.2%	2.15
EMIF	279	261	93.5%	2.99
NEWMEDS	204	168	82.4%	2.39
EUROPAIN	177	121	68.4%	2.88
CANCER-ID	167	143	85.6%	3.70
ORBITO	165	129	78.2%	2.09
TRANSLOCATION	152	109	71.7%	1.67
IMIDIA	139	116	83.5%	1.74
STEMBANCC	138	109	79.0%	2.35
SUMMIT	128	113	88.3%	1.63
CHEM21	127	68	53.5%	2.16
INNODIA	126	120	95.2%	2.03
ELF	125	92	73.6%	1.27
PreDiCT-TB	112	93	83.0%	1.35
MIP-DILI	106	79	74.5%	2.08
SPRINTT	106	90	84.9%	2.50
Quic-Concept	101	96	95.0%	4.76
AIMS-2-TRIALS	101	97	96.0%	3.65
PROTECT	99	97	98.0%	1.10
eTOX	92	52	56.5%	1.59
COMPACT	87	67	77.0%	2.04
U-BIOPRED	87	77	88.5%	2.85
RTCure	87	81	93.1%	3.59
Pharma-Cog	83	77	92.8%	1.33
COMBACTE-MAGNET	81	68	84.0%	1.45
COMBACTE-NET	80	70	87.5%	1.10
DIRECT	79	76	96.2%	3.41
ABIRISK	76	65	85.5%	1.55
DDMoRe	76	63	82.9%	1.12
BEAT-DKD	73	67	91.8%	1.60
Open PHACTS	70	57	81.4%	3.52
AETIONOMY	68	68	100.0%	1.90
BioVacSafe	66	40	60.6%	1.39
K4DD	63	51	81.0%	2.03
Onco Track	61	50	82.0%	2.45
BigData@Heart	60	59	98.3%	2.39
RHAPSODY	60	53	88.3%	2.94

[17] 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)
MARCAR	57	41	71.9%	1.22
DRIVE-AB	51	45	88.2%	1.54
ZAPI	50	42	84.0%	6.59
None	50	47	94.0%	4.43
PRISM	49	44	89.8%	2.96
COMBACTE-CARE	48	47	97.9%	2.08
ENABLE	47	42	89.4%	1.74
IMPRiND	46	40	87.0%	6.98
RAPP-ID	45	36	80.0%	0.95
PRECISESADS	44	42	95.5%	1.46
Predect	43	34	79.1%	1.89
APPROACH	42	38	90.5%	2.21
RADAR-CNS	42	39	92.9%	2.27
eTRIKS	41	40	97.6%	2.56
iPiE	37	32	86.5%	1.43
FLUCOP	36	34	94.4%	1.19
EPAD	35	28	80.0%	1.50
GETREAL	35	34	97.1%	1.88
RESCEU	29	28	96.6%	2.68
EBOVAC1	29	22	75.9%	2.48
PHAGO	29	24	82.8%	4.26
TransQST	28	24	85.7%	2.47
EBiSC	28	25	89.3%	7.14
PROACTIVE	27	27	100.0%	2.17
EbolaMoDRAD	25	23	92.0%	1.53
ADVANCE	25	24	96.0%	1.93
iABC	22	19	86.4%	1.51
LITMUS	21	18	85.7%	5.69
AMYPAD	20	19	95.0%	1.68
EUbOPEN	20	19	95.0%	1.49
SAFE-T	20	19	95.0%	1.95
ROADMAP	20	18	90.0%	1.10
EHR4CR	19	18	94.7%	1.19
ADAPTED	18	18	100.0%	3.24
MOBILISE-D	16	16	100.0%	4.18
eTRANSAFE	15	8	53.3%	0.66
TRISTAN	15	14	93.3%	1.75
HARMONY	15	12	80.0%	1.23
WEB-RADR	15	13	86.7%	1.96
EBOVAC2	15	14	93.3%	1.69
COMBACTE	14	12	85.7%	2.70
PREFER	14	13	92.9%	1.54
INNODIA HARVEST	11	11	100.0%	1.26

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)
VSV-EBOPLUS	11	10	90.9%	0.83
DRIVE	11	10	90.9%	1.69
CARDIATEAM	11	11	100.0%	1.38
3TR	11	11	100.0%	0.85
VSV-EBOVAC	10	8	80.0%	1.04
PERISCOPE	9	6	66.7%	1.23
IMI-PainCare	9	7	77.8%	0.65
VAC2VAC	9	8	88.9%	0.97
Hypo-RESOLVE	8	7	87.5%	1.64
EHDEN	8	7	87.5%	3.01
PD-MitoQUANT	8	7	87.5%	2.53
ITCC-P4	6	6	100.0%	2.08
BIOMAP	6	6	100.0%	3.62
EUPATI	6	6	100.0%	0.97
RADAR-AD	5	4	80.0%	0.33
DRAGON	5	5	100.0%	3.49
ERA4TB	5	4	80.0%	1.35
EQIPD	5	4	80.0%	3.40
ADAPT-SMART	4	3	75.0%	0.81
MOPEAD	4	4	100.0%	1.19
EBODAC	4	4	100.0%	3.04
ReSOLUTE	4	2	50.0%	0.95
SafeSciMET	4	4	100.0%	0.97
SOPHIA	4	4	100.0%	2.05
TransBioLine	4	4	100.0%	0.35
FAIRplus	3	1	33.3%	13.59
DO->IT	3	3	100.0%	1.32
VITAL	3	3	100.0%	0.76
MACUSTAR	3	2	66.7%	2.28
Eu2P	3	3	100.0%	1.95
MAD-CoV 2	2	2	100.0%	0.29
c4c	2	2	100.0%	0.00
NECESSITY	2	2	100.0%	1.40
ND4BB	2	2	100.0%	1.85
VHFMoDRAD	2	2	100.0%	0.00
PEVIA	2	2	100.0%	0.92
EBOMAN	2	2	100.0%	5.40
IMMUCAN	2	2	100.0%	1.24
ConcePTION	2	2	100.0%	0.00
EU-PEARL	2	2	100.0%	4.17
COMBACTE-CDI	2	2	100.0%	0.25

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)
Immune-Image	2	2	100.0%	0.97
EBiSC2	2	2	100.0%	1.60
PIONEER	1	1	100.0%	4.49
EMTRAIN	1	1	100.0%	0.12
NGN-PET	1	0	0.0%	0.00
EBOVAC3	1	1	100.0%	0.20
EBOVAC	1	1	100.0%	3.53
NeuroDeRisk	1	1	100.0%	0.00
IM2PACT	1	0	0.0%	0.00
COVID-RED	1	1	100.0%	0.00
COMBINE	1	1	100.0%	0.00
MELLODDY	1	0	0.0%	0.00
CARE	1	1	100.0%	23.03
IDEA-FAST	1	1	100.0%	0.79
KRONO	1	1	100.0%	0.00
VALUE-Dx	1	1	100.0%	0.67
PARADIGM	1	1	100.0%	0.40
Pharmatrain	1	1	100.0%	0.09
FILODIAG	0	0	0.0%	0.00
imSAVAR	0	0	0.0%	0.00

TABLE 7.2.3 NUMBER, PERCENTAGE AND CITATION IMPACT[18] OF IMI-SUPPORTED RESEARCH PAPERS WITH AUTHORS FROM MORE THAN ONE SECTOR, 2010-2020

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
BTCure	656	422	64.3%	2.17
EU-AIMS	488	354	72.5%	2.44
ULTRA-DD	371	226	60.9%	2.37
EMIF	279	225	80.6%	2.85
NEWMEDS	204	128	62.7%	2.48
EUROPAIN	177	96	54.2%	3.02
CANCER-ID	167	124	74.3%	3.90
ORBITO	165	103	62.4%	2.24
TRANSLOCATION	152	56	36.8%	1.82
IMIDIA	139	73	52.5%	1.96
STEMBANCC	138	68	49.3%	2.31
SUMMIT	128	97	75.8%	1.61
CHEM21	127	30	23.6%	2.18
INNODIA	126	104	82.5%	2.14
ELF	125	41	32.8%	1.18
PreDiCT-TB	112	61	54.5%	1.34
MIP-DILI	106	71	67.0%	2.04
SPRINTT	106	76	71.7%	2.62
Quic-Concept	101	72	71.3%	3.61
AIMS-2-TRIALS	101	76	75.2%	3.93
PROTECT	99	96	97.0%	1.10
eTOX	92	28	30.4%	1.85
COMPACT	87	19	21.8%	3.49
U-BIOPRED	87	71	81.6%	3.00
RTCure	87	67	77.0%	4.13
Pharma-Cog	83	70	84.3%	1.36
COMBACTE-MAGNET	81	54	66.7%	1.41
COMBACTE-NET	80	60	75.0%	1.18
DIRECT	79	59	74.7%	3.85
ABIRISK	76	58	76.3%	1.60
DDMoRe	76	49	64.5%	1.19
BEAT-DKD	73	52	71.2%	1.73
Open PHACTS	70	42	60.0%	4.40
AETIONOMY	68	44	64.7%	2.37
BioVacSafe	66	29	43.9%	1.41
K4DD	63	34	54.0%	1.94
Onco Track	61	39	63.9%	2.52
BigData@Heart	60	55	91.7%	2.50
RHAPSODY	60	32	53.3%	2.19

[18] 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)
MARCAR	57	25	43.9%	1.30
DRIVE-AB	51	38	74.5%	1.55
ZAPI	50	34	68.0%	7.37
None	50	38	76.0%	4.62
PRISM	49	36	73.5%	3.29
COMBACTE-CARE	48	44	91.7%	2.14
ENABLE	47	28	59.6%	1.70
IMPRiND	46	29	63.0%	4.77
RAPP-ID	45	15	33.3%	1.08
PRECISESADS	44	34	77.3%	1.61
Predect	43	29	67.4%	1.79
APPROACH	42	32	76.2%	1.81
RADAR-CNS	42	25	59.5%	2.82
eTRIKS	41	35	85.4%	2.76
iPiE	37	20	54.1%	1.12
FLUCOP	36	32	88.9%	1.21
EPAD	35	25	71.4%	1.55
GETREAL	35	31	88.6%	2.01
RESCEU	29	26	89.7%	2.80
EBOVAC1	29	20	69.0%	2.48
PHAGO	29	19	65.5%	4.80
TransQST	28	16	57.1%	2.89
EBiSC	28	20	71.4%	8.14
PROACTIVE	27	27	100.0%	2.17
EbolaMoDRAD	25	17	68.0%	1.69
ADVANCE	25	22	88.0%	1.99
iABC	22	18	81.8%	1.58
LITMUS	21	17	81.0%	5.69
AMYPAD	20	18	90.0%	1.72
EUbOPEN	20	13	65.0%	1.64
SAFE-T	20	19	95.0%	1.95
ROADMAP	20	18	90.0%	1.10
EHR4CR	19	17	89.5%	1.26
ADAPTED	18	17	94.4%	3.47
MOBILISE-D	16	14	87.5%	4.18
eTRANSAFE	15	5	33.3%	0.56
TRISTAN	15	12	80.0%	1.61
HARMONY	15	12	80.0%	1.23
WEB-RADR	15	11	73.3%	1.86
EBOVAC2	15	6	40.0%	2.51
COMBACTE	14	7	50.0%	3.62
PREFER	14	12	85.7%	1.54
INNODIA HARVEST	11	10	90.9%	1.28

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
VSV-EBOPLUS	11	7	63.6%	0.82
DRIVE	11	9	81.8%	1.69
CARDIATEAM	11	11	100.0%	1.38
3TR	11	11	100.0%	0.85
VSV-EBOVAC	10	5	50.0%	0.99
PERISCOPE	9	4	44.4%	1.78
IMI-PainCare	9	5	55.6%	0.57
VAC2VAC	9	5	55.6%	0.90
Hypo-RESOLVE	8	4	50.0%	2.02
EHDEN	8	6	75.0%	3.01
PD-MitoQUANT	8	7	87.5%	2.53
ITCC-P4	6	6	100.0%	2.08
BIOMAP	6	6	100.0%	3.62
EUPATI	6	6	100.0%	0.97
RADAR-AD	5	4	80.0%	0.33
DRAGON	5	5	100.0%	3.49
ERA4TB	5	3	60.0%	1.35
EQIPD	5	3	60.0%	4.18
ADAPT-SMART	4	3	75.0%	0.81
MOPEAD	4	4	100.0%	1.19
EBODAC	4	3	75.0%	3.85
ReSOLUTE	4	1	25.0%	0.00
SafeSciMET	4	4	100.0%	0.97
SOPHIA	4	3	75.0%	2.05
TransBioLine	4	3	75.0%	0.00
FAIRplus	3	1	33.3%	13.59
DO->IT	3	3	100.0%	1.32
VITAL	3	1	33.3%	0.40
MACUSTAR	3	2	66.7%	2.28
Eu2P	3	1	33.3%	0.00
MAD-CoV 2	2	1	50.0%	0.00
c4c	2	2	100.0%	0.00
NECESSITY	2	2	100.0%	1.40
ND4BB	2	1	50.0%	2.07
VHFMoDRAD	2	2	100.0%	0.00
PEVIA	2	2	100.0%	0.92
EBOMAN	2	2	100.0%	5.40
IMMUCAN	2	1	50.0%	0.65
ConcePTION	2	2	100.0%	0.00
EU-PEARL	2	2	100.0%	4.17
COMBACTE-CDI	2	2	100.0%	0.25

Project	Number of papers	Number of cross sector papers	% of cross sector papers	Citation impact (normalised at field level)
Immune-Image	2	2	100.0%	0.97
EBiSC2	2	2	100.0%	1.60
PIONEER	1	1	100.0%	4.49
EMTRAIN	1	1	100.0%	0.12
NGN-PET	1	0	0.0%	0.00
EBOVAC3	1	0	0.0%	0.00
EBOVAC	1	1	100.0%	3.53
NeuroDeRisk	1	1	100.0%	0.00
IM2PACT	1	0	0.0%	0.00
COVID-RED	1	1	100.0%	0.00
COMBINE	1	1	100.0%	0.00
MELLODDY	1	0	0.0%	0.00
CARE	1	1	100.0%	23.03
IDEA-FAST	1	0	0.0%	0.00
KRONO	1	1	100.0%	0.00
VALUE-Dx	1	1	100.0%	0.67
PARADIGM	1	1	100.0%	0.40
Pharmatrain	1	1	100.0%	0.09
FILODIAG	0	0	0.0%	0.00
imSAVAR	0	0	0.0%	0.00

FIGURE 7.2.1 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: BTCURE, 2010-2020

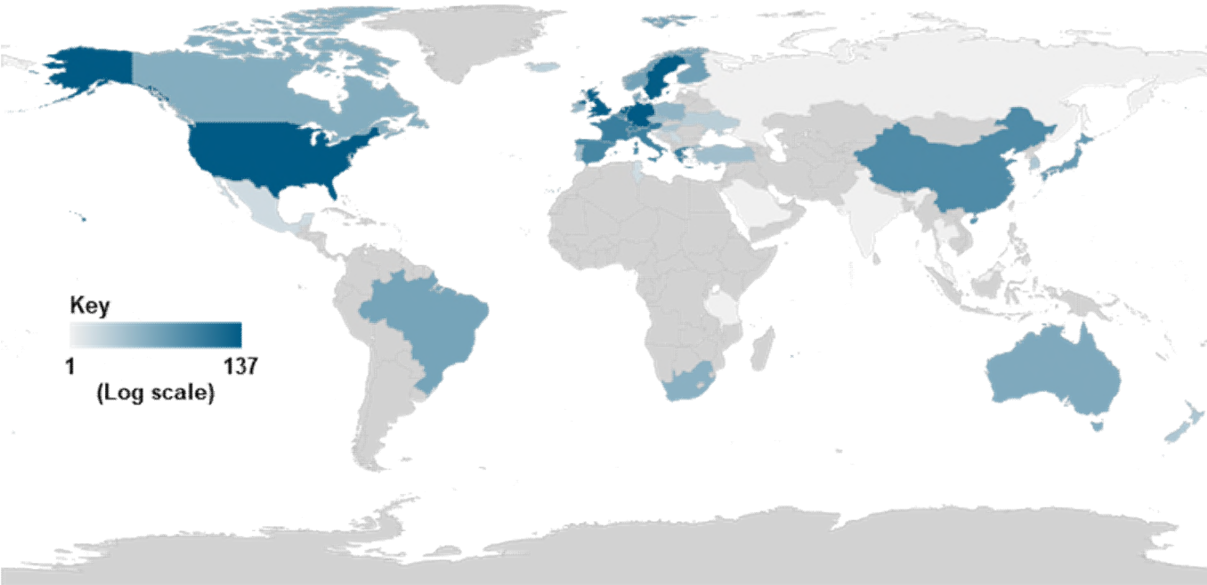


FIGURE 7.2.2 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: EMIF, 2010-2020

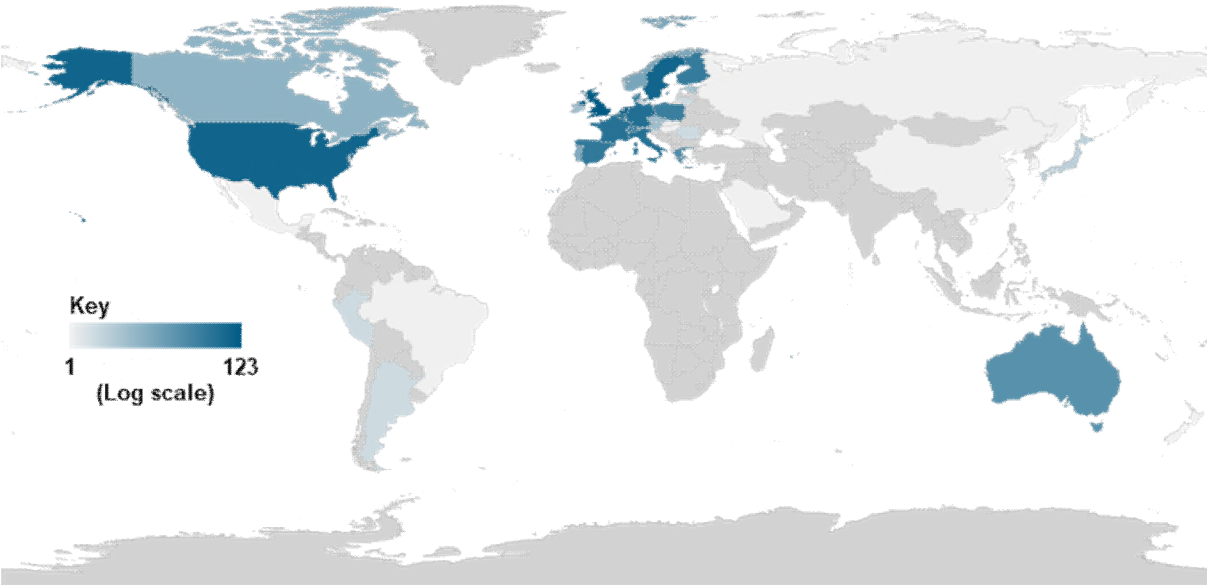


FIGURE 7.2.3 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: EU-AIMS, 2010-2020

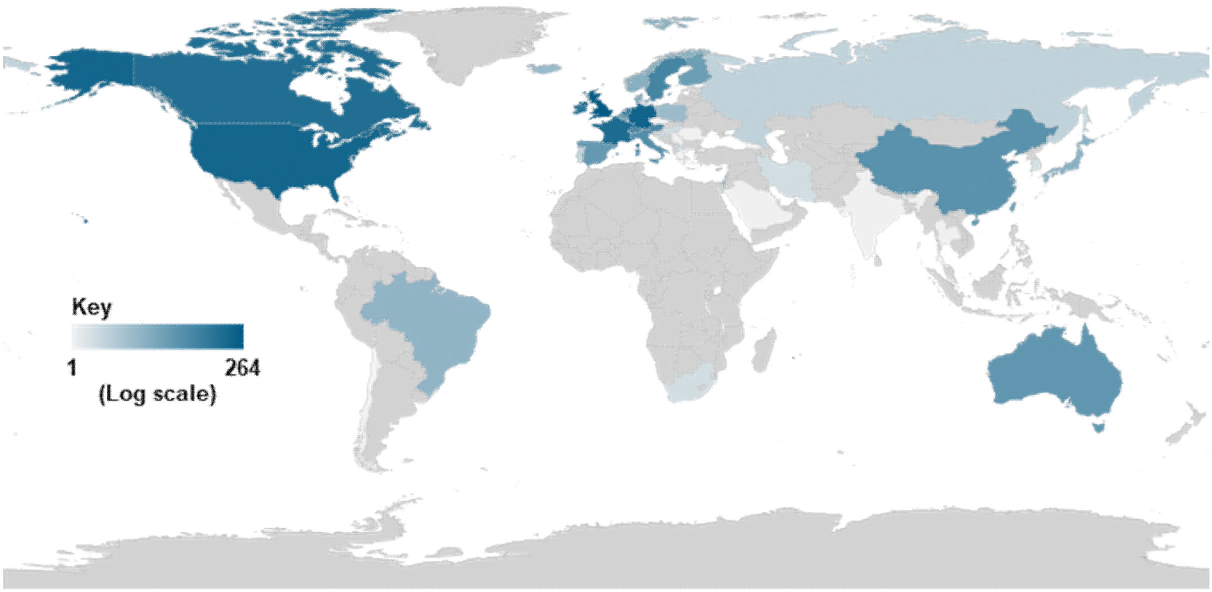


FIGURE 7.2.4 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: NEWMEDS, 2010-2020

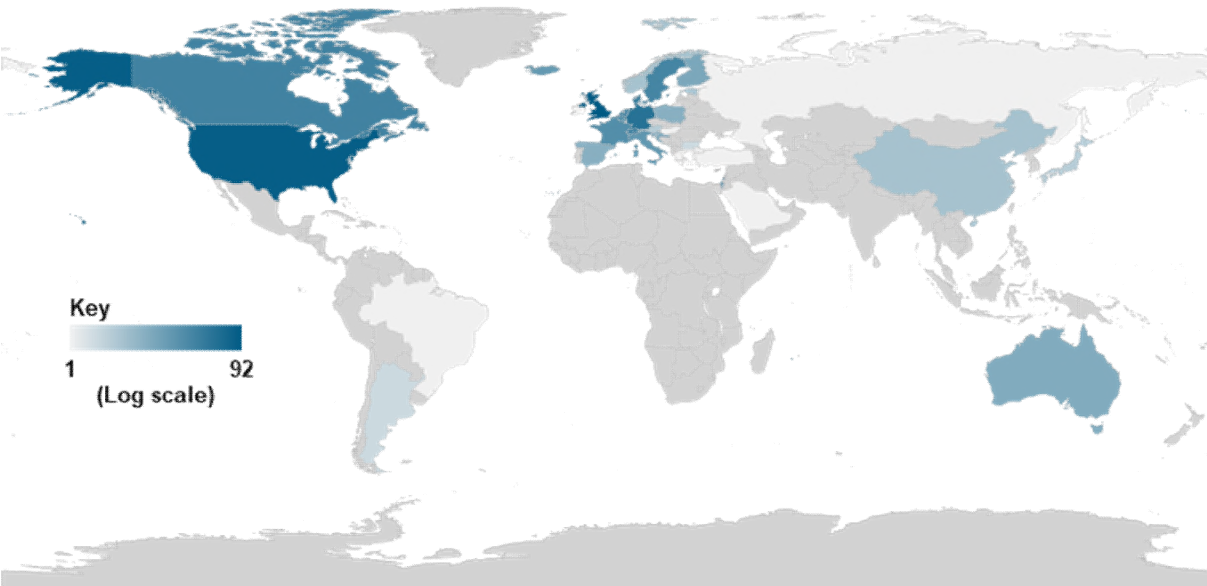
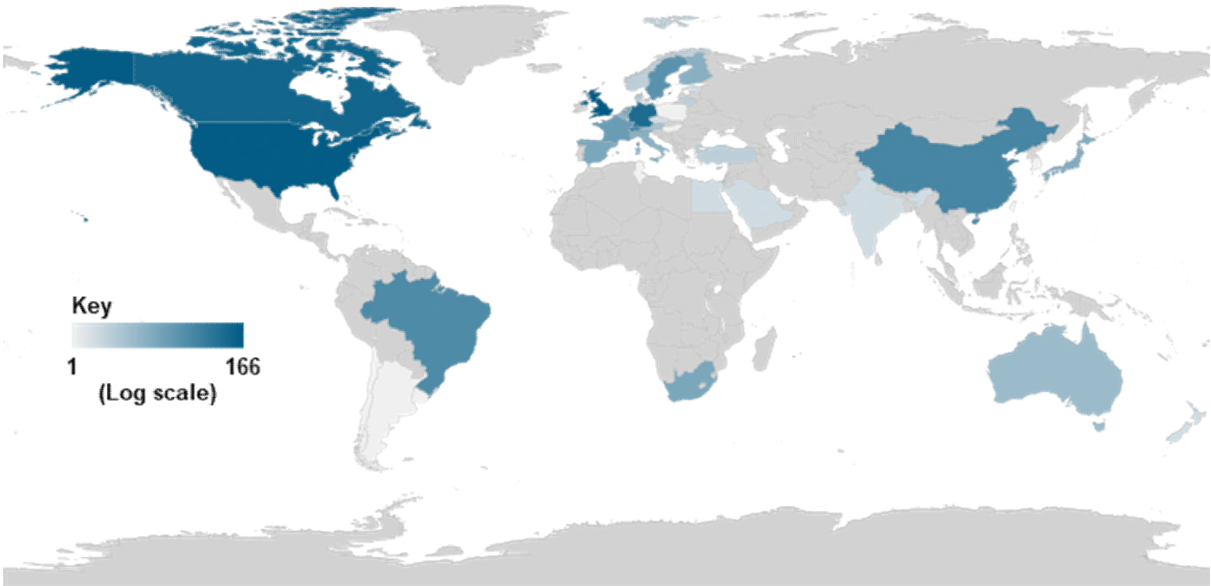


FIGURE 7.2.5 INTERNATIONAL COLLABORATION BY COUNTRY, FOR IMI PROJECT: ULTRA-DD, 2010-2020



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 2020.

In the ninth (2018) and earlier versions of this report metric 3 indicated the intensity of international collaboration, in 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 an IMI project paper 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.[19] 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 institutional 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.

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

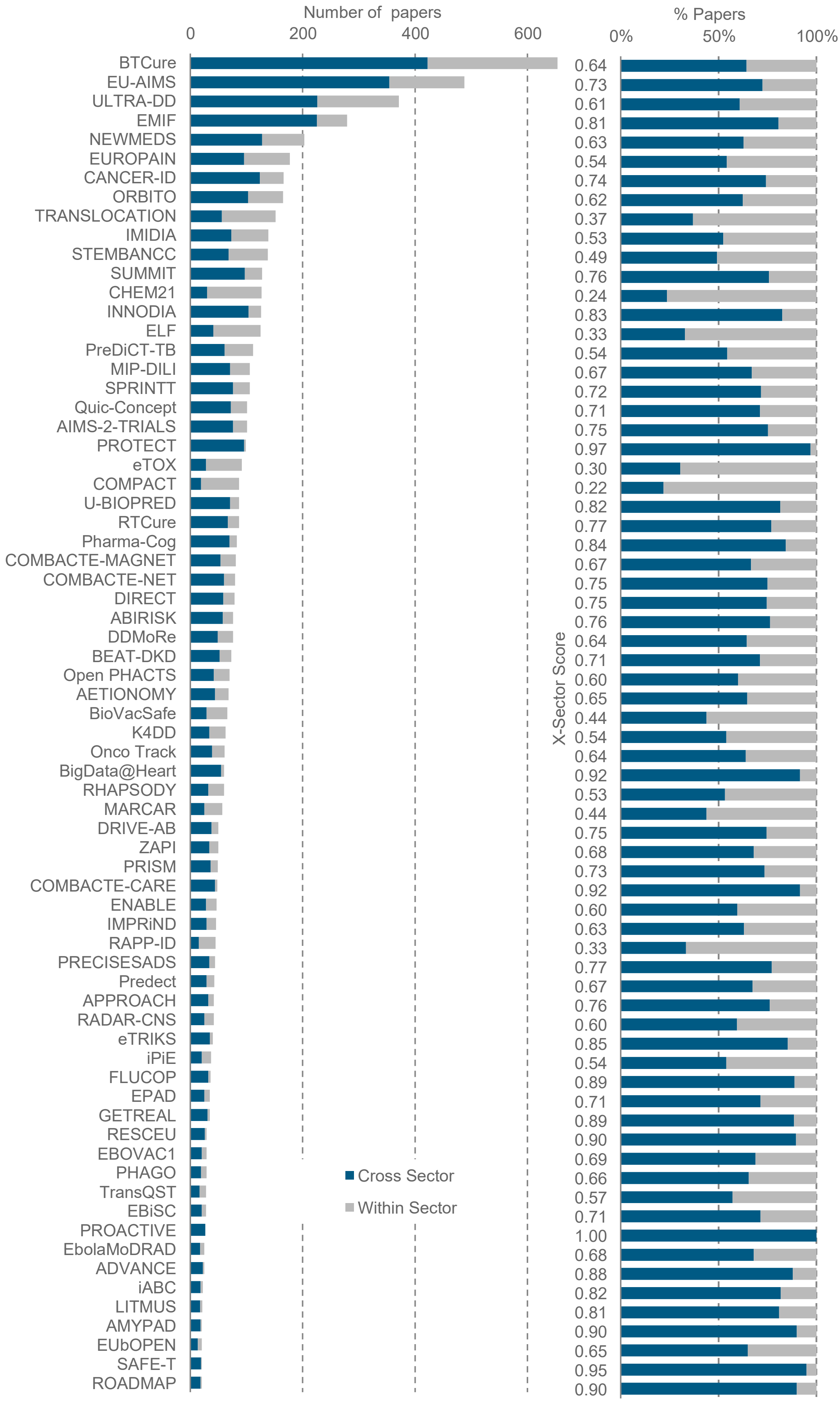
7.3.1 METRIC 1 (CROSS-SECTOR SCORE): FRACTION OF CROSS SECTOR COLLABORATIVE PAPERS

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, 422 out of a total of 656. PRO-active, PROTECT and SAFE-T had the highest percentage of cross-sector collaborative papers (100%, 96.9% and 95.0% respectively).

FIGURE 7.3.1.1 NUMBER AND FRACTION OF CROSS-SECTOR COLLABORATIVE PAPERS BY PROJECT, 2010-2020. ORDERED BY NUMBER OF CROSS-SECTOR PAPERS



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

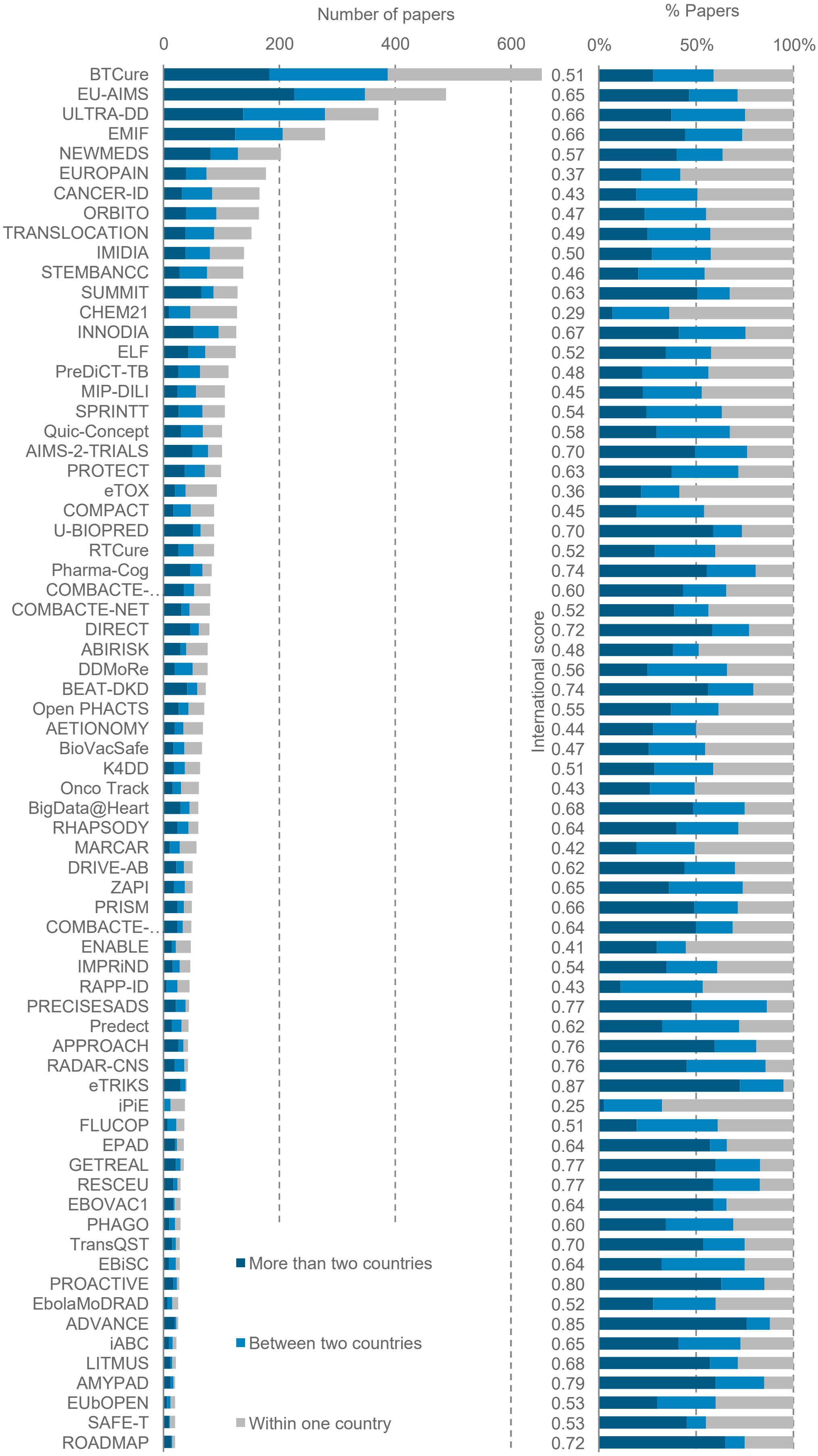
Author names and affiliations were extracted for all IMI project papers. The number of countries in the author affiliations for each paper was counted and used to classify the papers as “more than two countries”, “two countries” or “within one country” (same as domestic in the Section 7.1).

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 (387 out of 656), with an International Score of 0.51.
- EU-AIMS had the most internationally collaborative papers involving more than two countries. (226 out of 488), with an international Score of 0.65.
- eTRICKS, ADVANCE, and PROACTIVE had the highest International Scores (0.87, 0.85 and 0.80 respectively).

FIGURE 7.3.2.1 NUMBER AND FRACTION OF INTERNATIONALLY COLLABORATIVE PAPERS BY PROJECT, 2010-2020

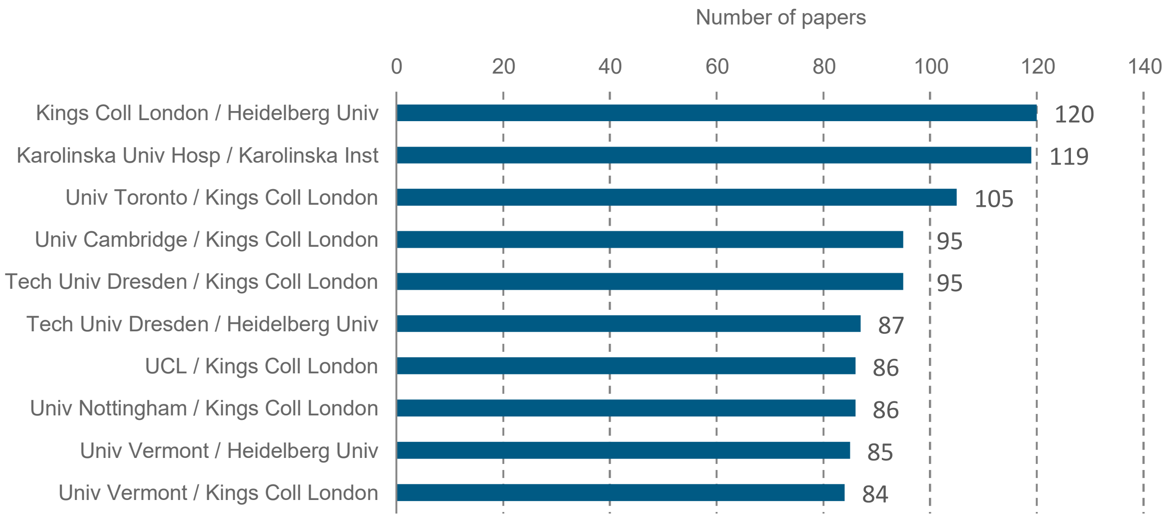


7.3.3 METRIC 3 (STABILITY SCORE): STABILITY OF INSTITUTIONAL COLLABORATION

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.

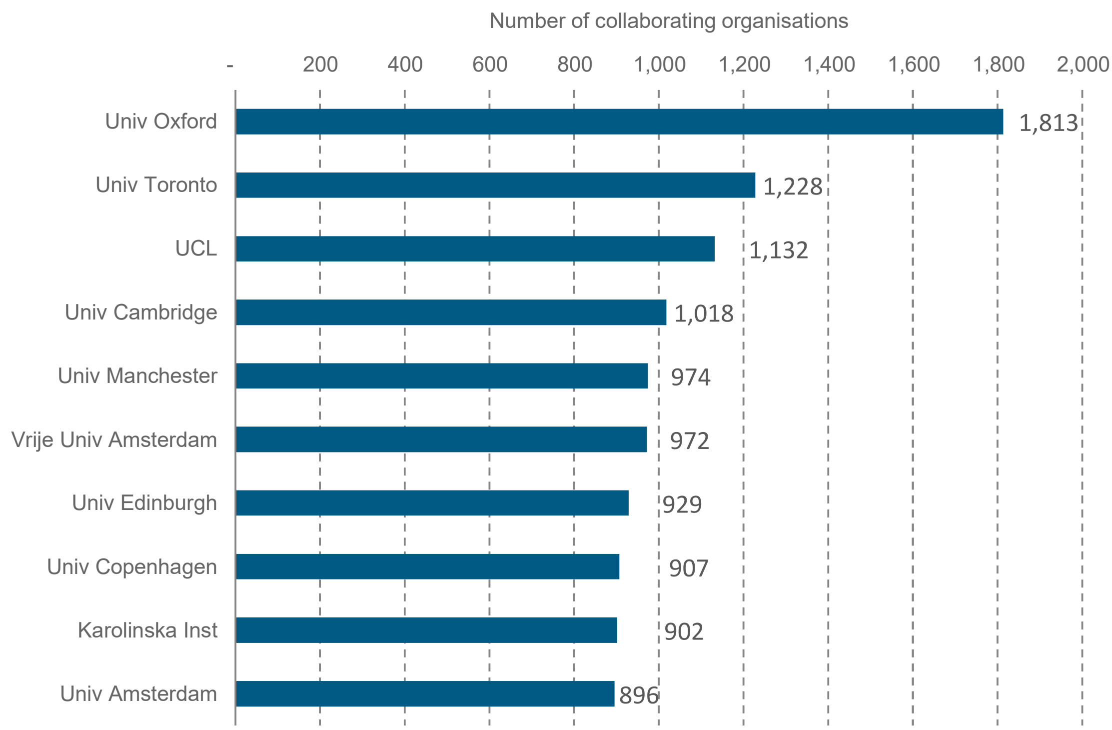
A project's Metric 3 is the mean average stability of collaborations between pairs of institutions that have co-authored papers that belong to that project. Pairs of institutions must have published two or more papers together as part of the same IMI project to be considered. A second requirement is that the IMI projects must have started in, or before, 2018. If a project started after 2018, 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, 2010-2020



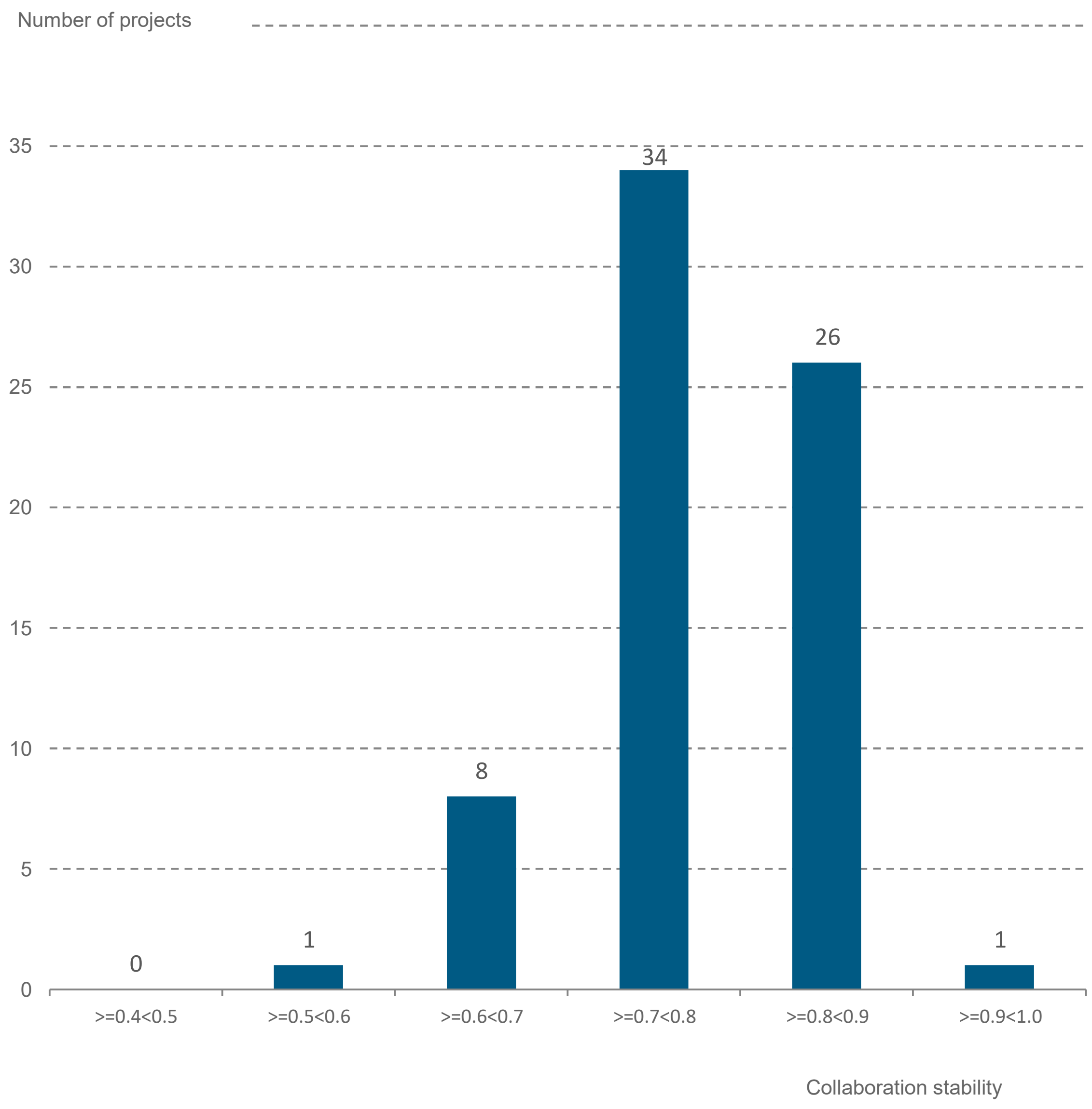
- The institutions that collaborated most frequently on IMI project papers were Kings College London and Heidelberg University, researchers at these institutions together, co-authored 120 publications.
- Kings College London is part of seven out of ten pairs of the most productive pairs of collaborating institutions.

FIGURE 7.3.3.2 THE TEN INSTITUTIONS THAT HAVE COLLABORATED WITH THE GREATEST NUMBER OF OTHER INSTITUTIONS, 2010-2020



- The University of Oxford has collaborated with 1,813 other institutions on IMI project papers, the most of any of the other institutions.
- Half of the ten most collaborative institutions are located in the United Kingdom.

FIGURE 7.3.3.3 METRIC 3: STABILITY SCORE DISTRIBUTION, 2010-2020



- Most IMI projects have a 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 2018, 2010-2020

Project	Stability score (Metric 3)	Number of collaborating institution pairs	Number of papers	Project start year
BTCure	0.83	1,074	656	2011
EU-AIMS	0.80	3,196	488	2012
ULTRA-DD	0.75	332	371	2015
EMIF	0.84	2,438	279	2012
NEWMEDS	0.81	644	204	2010
EUROPAIN	0.84	326	177	2010
CANCER-ID	0.75	177	167	2015
ORBITO	0.76	350	165	2013
TRANSLOCATION	0.80	75	152	2013
IMIDIA	0.83	156	139	2010
STEMBANCC	0.80	54	138	2013
SUMMIT	0.82	6,978	128	2011
CHEM21	0.79	22	127	2013
INNODIA	0.88	385	126	2010
ELF	0.73	43	125	2014
PreDiCT-TB	0.79	62	112	2013
MIP-DILI	0.81	144	106	2012
SPRINTT	0.80	234	106	2014
AIMS-2-TRIALS	0.68	563	101	2018
Quic-Concept	0.80	131	101	2012
PROTECT	0.86	300	99	2010
eTOX	0.86	126	92	2010
COMPACT	0.71	26	87	2014
RTCure	0.71	129	87	2017
U-BIOPRED	0.86	917	87	2010
Pharma-Cog	0.85	1,007	83	2010
COMBACTE-MAGNET	0.73	106	81	2015
COMBACTE-NET	0.78	102	80	2013
DIRECT	0.88	1,218	79	2012
ABIRISK	0.86	489	76	2012
DDMoRe	0.81	56	76	2012
BEAT-DKD	0.61	284	73	2017
Open PHACTS	0.76	63	70	2011
AETIONOMY	0.78	79	68	2014
BioVacSafe	0.81	21	66	2012
K4DD	0.79	31	63	2013
Onco Track	0.83	79	61	2011
BigData@Heart	0.56	3,099	60	2017
RHAPSODY	0.83	223	60	2016
MARCAR	0.82	38	57	2011

Project	Stability score (Metric 3)	Number of collaborating institution pairs	Number of papers	Project start year
DRIVE-AB	0.71	60	51	2015
ZAPI	0.71	44	50	2015
PRISM	0.66	64	49	2017
COMBACTE-CARE	0.73	552	48	2015
ENABLE	0.80	25	47	2015
IMPRiND	0.76	26	46	2017
RAPP-ID	0.89	13	45	2011
PRECISESADS	0.69	158	44	2015
Predect	0.74	25	43	2012
APPROACH	0.73	61	42	2015
RADAR-CNS	0.76	68	42	2016
eTRIKS	0.72	708	41	2014
iPiE	0.71	21	37	2016
FLUCOP	0.69	28	36	2015
EPAD	0.73	86	35	2015
GETREAL	0.74	36	35	2015
EBOVAC1	0.72	23	29	2015
PHAGO	0.71	36	29	2017
RESCEU	0.71	219	29	2018
EBiSC	0.75	14	28	2015
TransQST	0.74	6	28	2017
PROACTIVE	0.82	164	27	2011
ADVANCE	0.85	290	25	2015
EbolaMoDRAD	0.65	33	25	2016
iABC	0.81	31	22	2015
LITMUS	0.69	78	21	2018
AMYPAD	0.77	78	20	2017
ROADMAP	0.68	62	20	2017
SAFE-T	0.85	21	20	2011

- RAPP-ID has the highest stability score (0.89) while BigData@Heart has the lowest (0.56).
- 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 (656), only has 1,074 institution pairs compared with SUMMIT that started in the same year, has only produced 128 papers but has 6,978 institution pairs. This suggests that SUMMIT publishes papers with many authors from multiple institutions. In fact, one of SUMMIT's papers has 267 affiliations.

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 (2.62) followed by ADVANCE (2.58).

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, 2010-2020

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	0.83	1.98	656	1.85
EU-AIMS	0.73	0.65	0.80	2.18	488	2.03
ULTRA-DD	0.61	0.66	0.75	2.02	371	1.74
EMIF	0.81	0.66	0.84	2.31	279	2.66
NEWMEDS	0.63	0.57	0.81	2.01	204	2.16
EUROPAIN	0.54	0.37	0.84	1.75	177	2.48
CANCER-ID	0.74	0.43	0.75	1.92	167	3.27
ORBITO	0.62	0.47	0.76	1.85	165	1.84
TRANSLOCATION	0.37	0.49	0.80	1.66	152	1.39
IMIDIA	0.53	0.50	0.83	1.85	139	1.63
STEMBANCC	0.49	0.46	0.80	1.75	138	1.95
SUMMIT	0.76	0.63	0.82	2.21	128	1.53
CHEM21	0.24	0.29	0.79	1.31	127	1.75
INNODIA	0.83	0.67	0.88	2.38	126	1.63
ELF	0.33	0.52	0.73	1.58	125	1.15
PreDiCT-TB	0.54	0.48	0.79	1.81	112	1.22
SPRINTT	0.72	0.54	0.80	2.05	106	2.22
MIP-DILI	0.67	0.45	0.81	1.94	106	1.82
AIMS-2-TRIALS	0.75	0.70	0.68	2.13	101	1.88
Quic-Concept	0.71	0.58	0.80	2.09	101	4.34
PROTECT	0.97	0.63	0.86	2.46	99	1.08
eTOX	0.30	0.36	0.86	1.53	92	1.71
U-BIOPRED	0.82	0.70	0.86	2.38	87	2.57
RTCure	0.77	0.52	0.71	2.00	87	2.68

Project	Cross-sector Score (Metric 1)	International Score (Metric 2)	Stability score (Metric 3)	Collaboration index	Number of papers	Citation impact (field-normalised)
COMPACT	0.22	0.45	0.71	1.39	87	1.86
Pharma-Cog	0.84	0.74	0.85	2.44	83	1.19
COMBACTE-MAGNET	0.67	0.60	0.73	1.99	81	1.18
COMBACTE-NET	0.75	0.52	0.78	2.05	80	1.01
DIRECT	0.75	0.72	0.88	2.35	79	2.98
ABIRISK	0.76	0.48	0.86	2.10	76	1.32
DDMoRe	0.64	0.56	0.81	2.01	76	1.08
BEAT-DKD	0.71	0.74	0.61	2.05	73	1.46
Open PHACTS	0.60	0.55	0.76	1.92	70	3.47
AETIONOMY	0.65	0.44	0.78	1.87	68	1.71
BioVacSafe	0.44	0.47	0.81	1.72	66	1.27
K4DD	0.54	0.51	0.79	1.84	63	1.74
Onco Track	0.64	0.43	0.83	1.90	61	2.30
BigData@Heart	0.92	0.68	0.56	2.16	60	1.53
RHAPSODY	0.53	0.64	0.83	2.00	60	2.10
MARCAR	0.44	0.42	0.82	1.68	57	1.08
DRIVE-AB	0.75	0.62	0.71	2.08	51	1.37
None	0.76	0.72	0.92	2.40	50	3.41
ZAPI	0.68	0.65	0.71	2.03	50	5.61
PRISM	0.73	0.66	0.66	2.05	49	2.14
COMBACTE-CARE	0.92	0.64	0.73	2.29	48	1.78
ENABLE	0.60	0.41	0.80	1.80	47	1.61
IMPRiND	0.63	0.54	0.76	1.93	46	6.47
RAPP-ID	0.33	0.43	0.89	1.65	45	0.88
PRECISESADS	0.77	0.77	0.69	2.23	44	1.23
Predect	0.67	0.62	0.74	2.04	43	2.52
RADAR-CNS	0.60	0.76	0.76	2.11	42	1.64
APPROACH	0.76	0.76	0.73	2.24	42	1.95
eTRIKS	0.85	0.87	0.72	2.45	41	2.44
iPiE	0.54	0.25	0.71	1.50	37	1.32
FLUCOP	0.89	0.51	0.69	2.08	36	1.09
EPAD	0.71	0.64	0.73	2.08	35	1.01
GETREAL	0.89	0.77	0.74	2.39	35	1.82
RESCEU	0.90	0.77	0.71	2.38	29	2.00
PHAGO	0.66	0.60	0.71	1.97	29	3.34
EBOVAC1	0.69	0.64	0.72	2.04	29	1.93
EbiSC	0.71	0.64	0.75	2.11	28	7.64
TransQST	0.57	0.70	0.74	2.01	28	3.25
PROACTIVE	1.00	0.80	0.82	2.62	27	2.17
ADVANCE	0.88	0.85	0.85	2.58	25	1.87
EbolaMoDRAD	0.68	0.52	0.65	1.85	25	1.45
iABC	0.82	0.65	0.81	2.27	22	0.87
LITMUS	0.81	0.68	0.69	2.18	21	4.14

Project	Cross-sector Score (Metric 1)	International Score (Metric 2)	Stability score (Metric 3)	Collaboration index	Number of papers	Citation impact (field-normalised)
AMYPAD	0.90	0.79	0.77	2.46	20	1.45
ROADMAP	0.90	0.72	0.68	2.30	20	0.90
SAFE-T	0.95	0.53	0.85	2.32	20	1.88

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 eleventh report produced in 2020. Each comparator had sufficient publications to allow a meaningful analysis.

TABLE 8.1.1 SUMMARY OF INFORMATION OF IMI-SELECTED COMPARATORS, 2010-2020

Comparator	Number of publications (2010-2020)	Number of papers (2010-2020)	Country	Region
Critical Path (C-Path)	526	490	USA	North America
Commonwealth Scientific and Industrial Research Organisation (CSIRO)[20]	920	889	Australia	Australia
Foundation for the National Institutes of Health (FNIH)	4,329	4,102	USA	North America
Grand Challenges in Global Health (GCGH)	882	881	USA	North America
Indian Council of Medical Research (ICMR)	15,158	14,743	India	Asia
Medical Research Council (MRC)	119,662	107,203	UK	Europe
Wellcome Trust (WT)	84,927	78,962	UK	Europe

[20] 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.

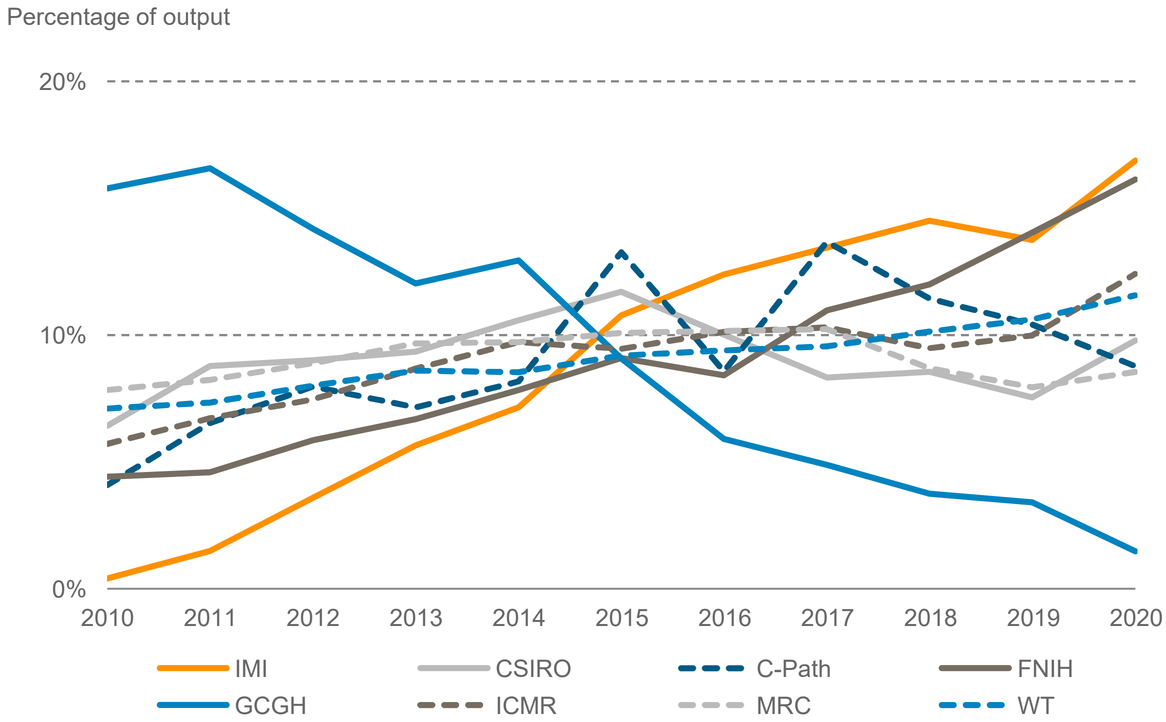
8.2 TRENDS IN OUTPUT: IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS

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

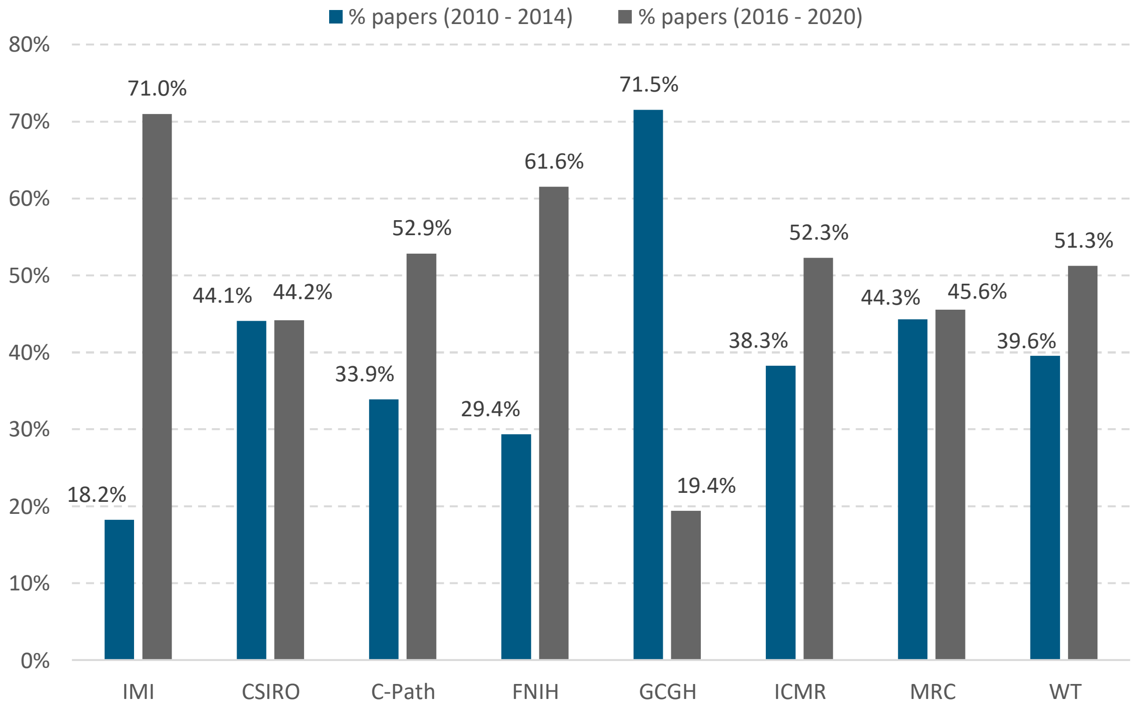
The output of IMI and the comparators varies widely (some produced many papers and some relatively few), therefore a visual comparison of absolute paper counts would not provide an understanding of their growth relative to one another. To provide a more easily interpretable comparison, Figure 8.2.1.1 shows the percentage of each organisation's total paper count between 2010 and 2020 published in each year. 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, 2010-2020



- Most of IMI's research output was published in the last four years 2017-2020, accounting for more than half of its paper output.
- 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 2011, with a brief recovery in 2014.
- After peaking 2015, CSIRO was on a steady decrease in percentage of output but in 2020, has increased by 2.3% since 2019.

FIGURE 8.2.1.2 COMPARING PERCENTAGE OUTPUT IN THE FIRST FIVE YEARS (2010–2014) TO MOST RECENT FIVE YEARS (2016-2020) – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020[21]



[21] note 2015 is excluded

TABLE 8.2.1.1 Share of output – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	0.4%	6.4%	4.1%	4.4%	15.8%	5.7%	7.8%	7.1%
2011	1.5%	8.8%	6.5%	4.6%	16.6%	6.7%	8.2%	7.3%
2012	3.6%	9.0%	8.0%	5.9%	14.2%	7.5%	8.9%	8.0%
2013	5.7%	9.3%	7.1%	6.7%	12.0%	8.7%	9.7%	8.6%
2014	7.1%	10.6%	8.2%	7.8%	12.9%	9.7%	9.7%	8.5%
2015	10.8%	11.7%	13.3%	9.1%	9.1%	9.4%	10.1%	9.2%
2016	12.4%	10.0%	8.6%	8.4%	5.9%	10.1%	10.2%	9.4%
2017	13.4%	8.3%	13.7%	11.0%	4.9%	10.3%	10.2%	9.6%
2018	14.5%	8.5%	11.4%	12.0%	3.7%	9.5%	8.7%	10.1%
2019	13.8%	7.5%	10.4%	14.0%	3.4%	10.0%	7.9%	10.6%
2020	16.9%	9.8%	8.8%	16.1%	1.5%	12.4%	8.6%	11.6%

TABLE 8.2.1.2 NUMBER OF PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

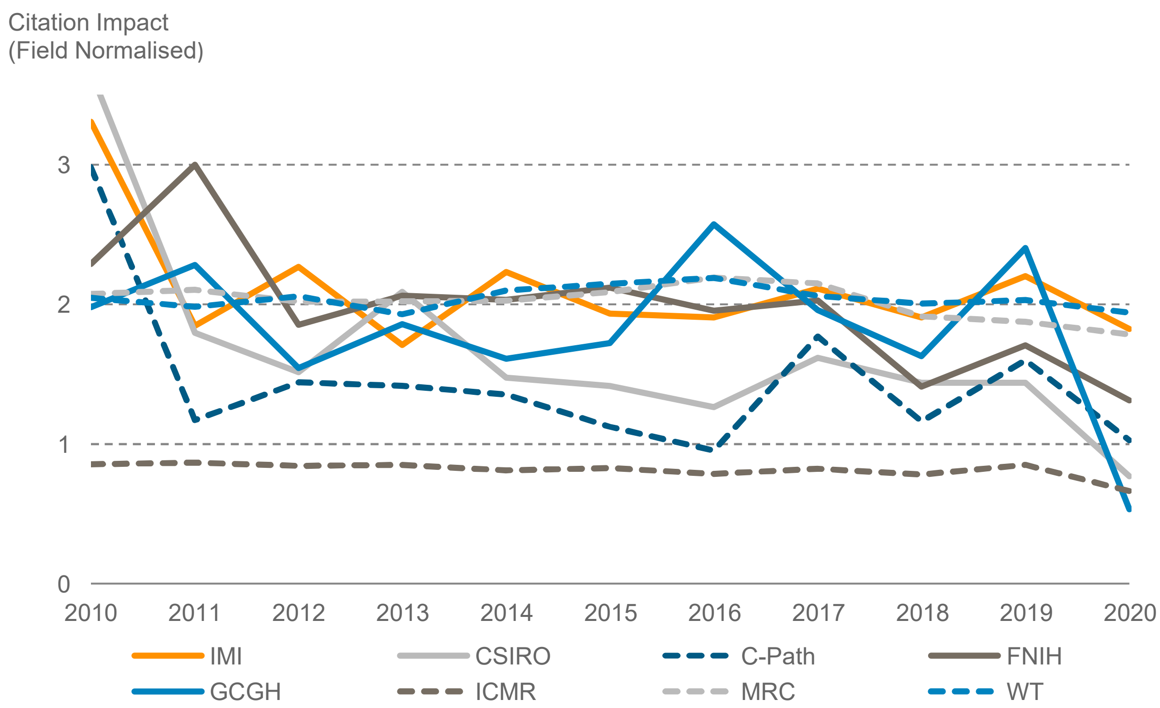
Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	26	57	20	181	139	841	8,393	5,606
2011	97	78	32	188	146	990	8,829	5,788
2012	235	80	39	240	125	1,099	9,522	6,317
2013	371	83	35	274	106	1,278	10,368	6,783
2014	469	94	40	321	114	1,432	10,419	6,740
2015	707	104	65	373	80	1,393	10,809	7,251
2016	814	89	42	345	52	1,493	10,897	7,413
2017	883	74	67	450	43	1,519	10,967	7,546
2018	953	76	56	492	33	1,397	9,314	8,006
2019	903	67	51	576	30	1,472	8,518	8,379
2020	1,108	87	43	662	13	1,829	9,167	9,133
Total	**6,566**	**889**	**490**	**4,102**	**881**	**14,743**	**107,203**	**78,962**

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.

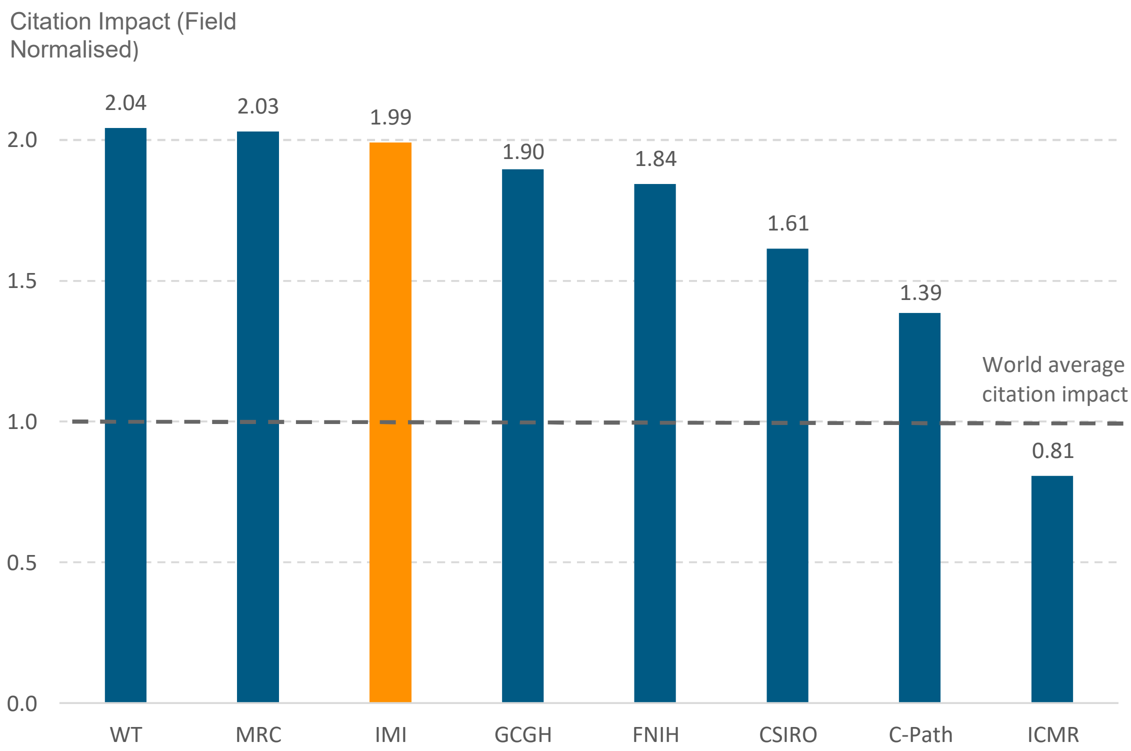
Figure 8.2.2.1 shows the annual trends in field-normalised citation impact of IMI and the comparators between 2010 and 2020 and Figure 8.2.2.2 shows the average field-normalised citation impact of IMI and the comparators between 2010 and 2020. Table 8.2.2.1 has the same data as in Figure 8.2.2.1 and Figure 8.2.2.2.

FIGURE 8.2.2.1 TRENDS IN FIELD-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- The field-normalised citation impact of IMI, 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.
- ICMR has consistently underperformed in comparison to the world average between 2010-2020.
- CSIRO's field normalized citation impact dropped significantly in 2020, but it is too early to make any definitive conclusions as the low citation impact could be due to many or most of the publications being published late in the year so has not had time to accumulate citations. This is supported by CSIRO's high percentage of uncited papers (60.9%) for the most recent year 2020 (see Figure 8.2.5.1 and Table 8.2.5.1), which was higher than last years of 48.5%.

FIGURE 8.2.2.2 AVERAGE FIELD-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- The average field-normalised citation impact of IMI project research (1.99) between 2010 and 2020 was just shy of two times the world average and ahead of five out of the seven 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, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	3.31	3.66	2.98	2.29	1.98	0.86	2.07	2.05
2011	1.85	1.80	1.17	3.00	2.28	0.87	2.10	1.98
2012	2.27	1.52	1.44	1.85	1.54	0.84	2.02	2.06
2013	1.71	2.09	1.42	2.06	1.86	0.85	2.02	1.93
2014	2.23	1.48	1.35	2.03	1.61	0.81	2.03	2.10
2015	1.93	1.42	1.12	2.12	1.72	0.83	2.09	2.15
2016	1.91	1.27	0.95	1.95	2.57	0.79	2.19	2.19
2017	2.11	1.62	1.77	2.03	1.96	0.82	2.15	2.06
2018	1.91	1.44	1.16	1.41	1.63	0.78	1.91	2.00
2019	2.20	1.44	1.60	1.71	2.40	0.85	1.88	2.03
2020	1.82	0.77	1.03	1.31	0.53	0.66	1.78	1.94
Average	**1.99**	**1.61**	**1.39**	**1.84**	**1.90**	**0.81**	**2.03**	**2.04**

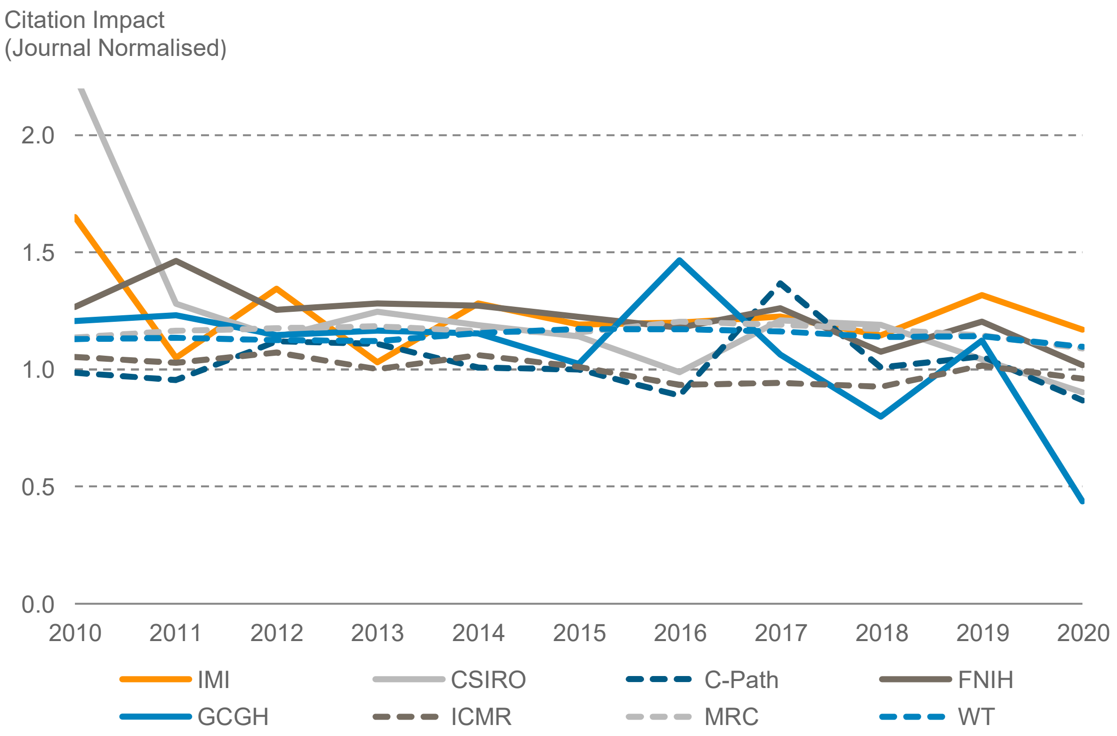
- In 2012 and 2014 IMI had the highest field-normalised citation impact (2.27 and 2.23 respectively) of the funding organisations analysed.

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.

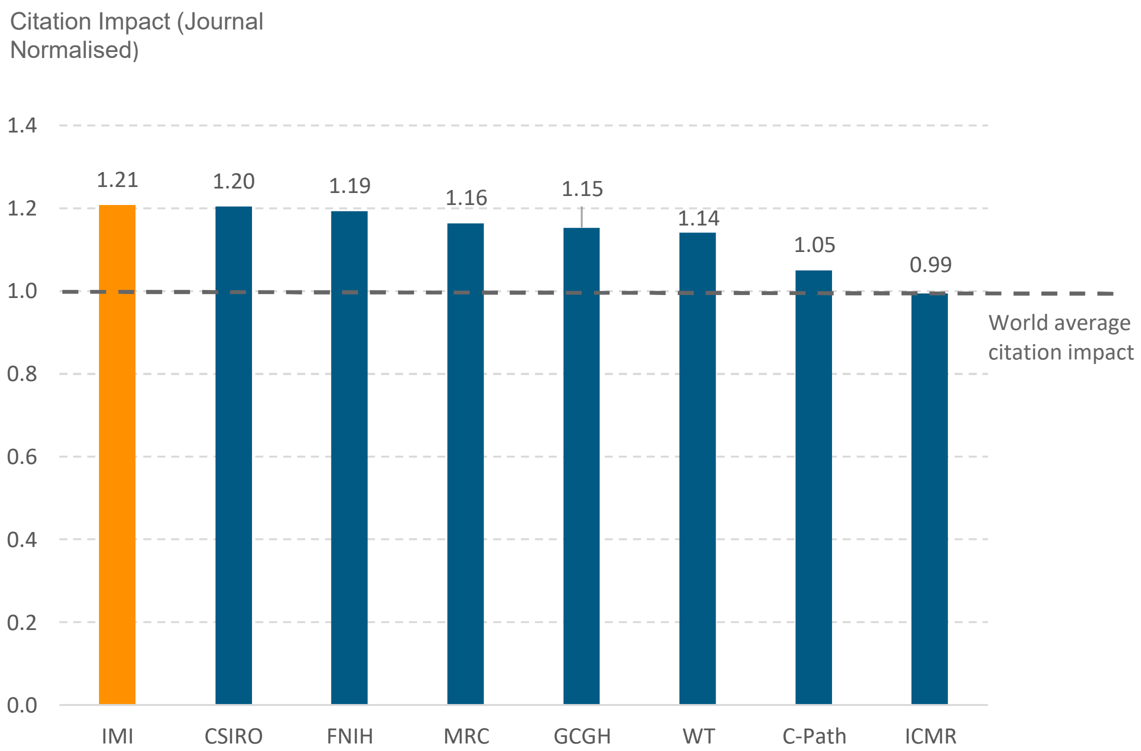
Figure 8.2.3.1 shows the annual trends in journal-normalised citation impact of IMI and the comparators between 2010 and 2020. Figure 8.2.2.2 shows the average field-normalised citation impact of IMI and the comparators between 2010 and 2020. Table 8.2.3.1 shows the same data as in Figure 8.2.3.1 and Figure 8.2.3.2.

FIGURE 8.2.3.1 TRENDS IN JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- IMI project research has a journal-normalised citation impact has remained above the world average between 2010 and 2020 and since 2014 has been relatively stable.
- IMI projects had the highest journal normalised citation impact for 2012, 2014, 2019 and the most recent year 2020.
- The journal-normalised citation impact of ICMR, MRC and WT remained relatively stable between 2010 and 2020, while that of the other comparators such as 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 research institutions like the MRC and WT.
- Since 2015 IMCR's journal normalised citation impact has been below the world average, apart from 2019 where it performed around the world average (1.02).

FIGURE 8.2.3.2 AVERAGE JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- IMI had the highest average journal-normalised citation impact (1.21) between 2010 and 2020.

TABLE 8.2.3.1 JOURNAL-NORMALISED CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

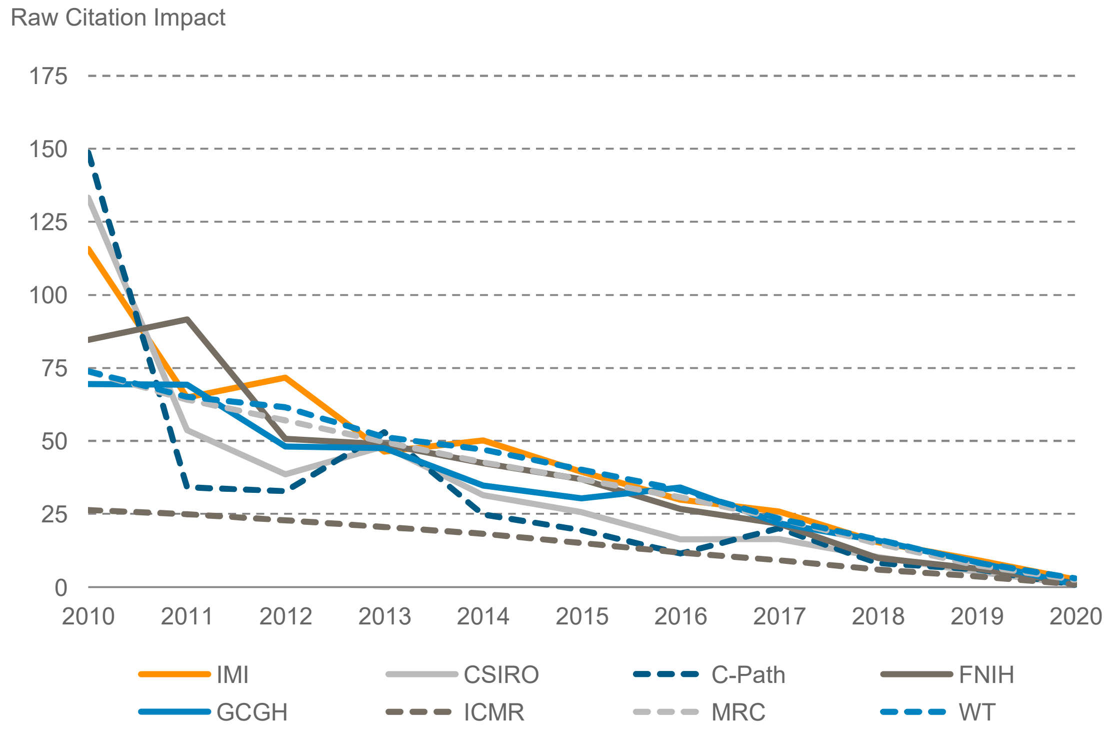
Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	1.65	2.26	0.99	1.27	1.21	1.05	1.14	1.13
2011	1.05	1.28	0.96	1.46	1.23	1.03	1.17	1.13
2012	1.35	1.14	1.12	1.25	1.15	1.07	1.18	1.13
2013	1.03	1.25	1.11	1.28	1.17	1.00	1.18	1.12
2014	1.28	1.19	1.01	1.27	1.15	1.06	1.16	1.16
2015	1.19	1.14	1.00	1.22	1.02	1.01	1.16	1.17
2016	1.20	0.99	0.89	1.18	1.47	0.93	1.20	1.17
2017	1.23	1.21	1.37	1.26	1.06	0.94	1.19	1.16
2018	1.15	1.19	1.01	1.08	0.80	0.93	1.17	1.14
2019	1.32	1.04	1.06	1.20	1.12	1.02	1.14	1.14
2020	1.17	0.90	0.87	1.02	0.44	0.96	1.09	1.10
Average	**1.21**	**1.20**	**1.05**	**1.19**	**1.15**	**0.99**	**1.16**	**1.14**

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.

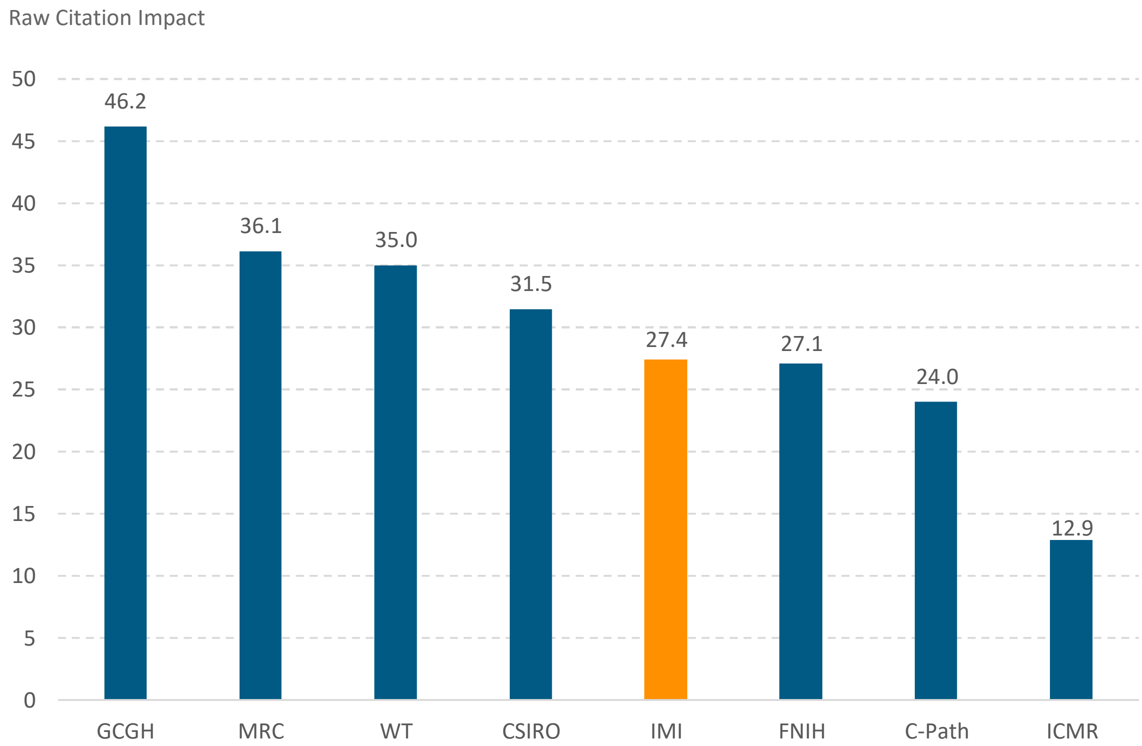
Figure 8.2.4.1 shows the annual trends in average raw citation impact of IMI and the comparators for papers published each year between 2010 and 2020. Figure 8.2.4.2 shows the average raw citation impact of IMI and the comparators for papers published between 2010 and 2020. Table 8.2.4.1 has the same 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, 2010-2020



- The raw citation impact of all organisations decreased from 2010 to 2020. This is expected as more recent publications have had less time to accumulate citations, and the raw citation impact is not normalised.
- IMI's 2020 raw citation impact (2.57) is higher than all comparators raw citation impacts except for WT.

FIGURE 8.2.4.2 AVERAGE RAW CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- IMI's average raw citation impact between 2010 and 2020 (27.39) is higher than three out of the seven comparators (C-Path (24.01) ICMR (12.88) and newly FNIH (27.09)).
- GCGH had the highest raw citation impact (46.16).

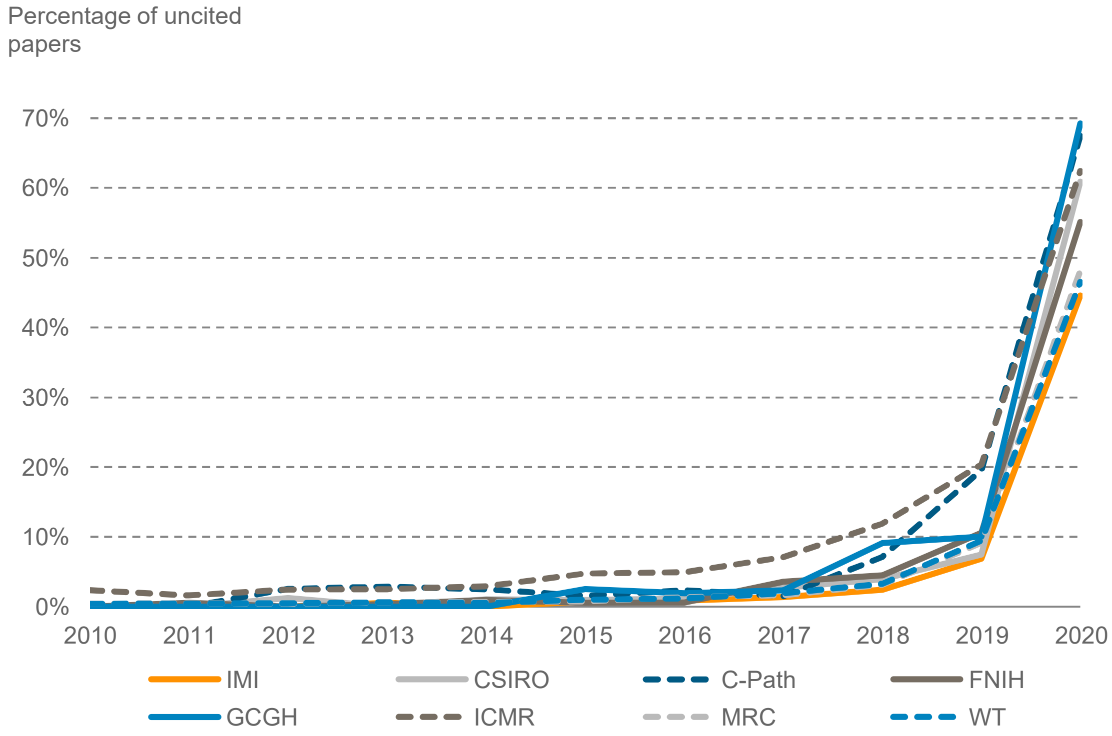
TABLE 8.2.4.1 RAW CITATION IMPACT – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	115.70	133.23	148.71	84.60	69.46	26.36	73.73	73.84
2011	64.95	53.76	34.19	91.59	69.28	24.96	64.10	65.15
2012	71.74	38.52	32.83	50.75	48.00	22.85	57.00	61.51
2013	46.29	48.11	53.03	48.86	47.52	20.55	49.69	51.29
2014	50.25	31.40	24.78	42.31	34.68	18.26	42.71	47.08
2015	39.37	25.63	19.50	36.86	30.25	15.02	36.87	40.10
2016	29.91	16.29	11.50	26.73	34.06	11.78	30.73	33.22
2017	25.86	16.35	20.07	21.68	21.77	9.15	23.55	23.38
2018	15.24	10.22	8.17	9.92	15.88	6.00	14.87	16.31
2019	9.32	5.23	6.13	6.32	8.50	3.73	7.53	8.37
2020	2.57	0.98	0.74	1.37	0.92	0.92	2.47	3.01
Average	**27.39**	**31.46**	**24.01**	**27.09**	**46.16**	**12.88**	**36.13**	**35.00**

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

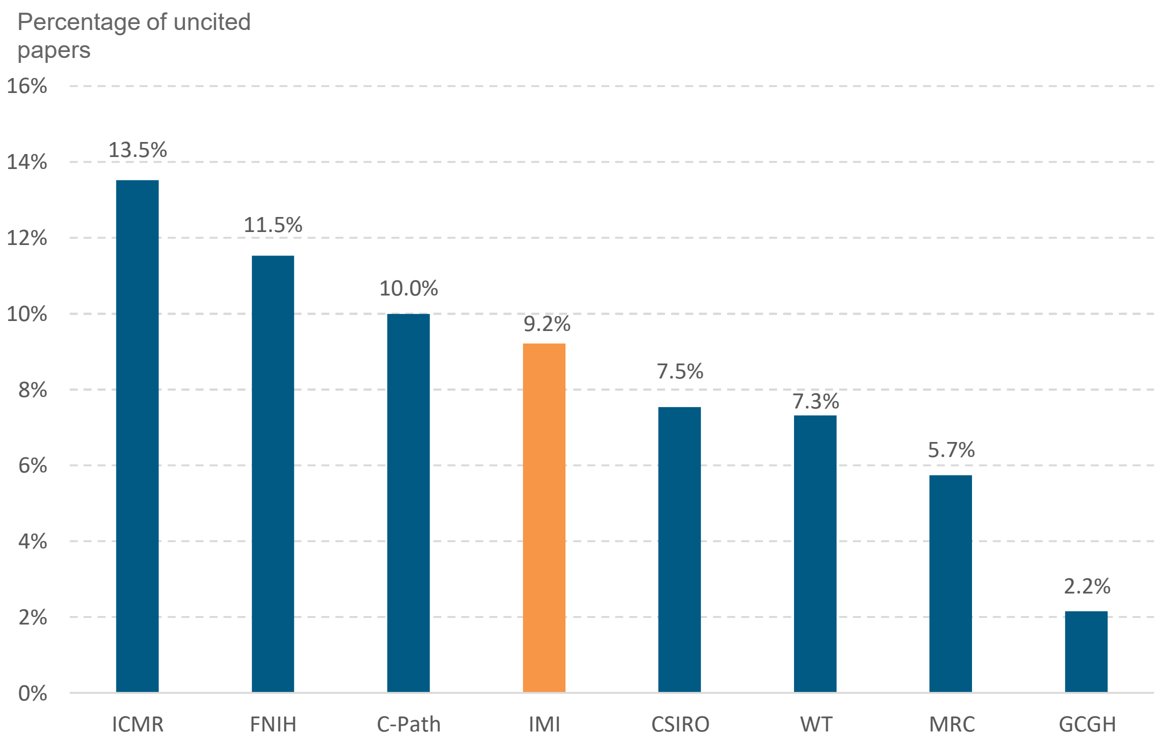
Most publication datasets will include papers which have no citations. Figure 8.2.5.1 shows the percentage of uncited papers between 2010 and 2020 for IMI and the selected comparators. Figure 8.2.5.1 shows the trend in average percentage of uncited papers between 2010 and 2020 for IMI and the selected comparators. Figure 8.2.5.2 shows the average percentage of uncited papers between 2010 and 2020 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, 2010-2020



- 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 compared to the comparators. While ICMR has consistently had the highest percentage, apart from 2020. This helps explain ICMR's lower than average citation impact.

FIGURE 8.2.5.1 AVERAGE PERCENTAGE OF UNCITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- Around 9% of IMI project papers remained uncited between 2010 and 2020
- GCGH has the lowest percentage of uncited papers, around 2% of its papers uncited

TABLE 8.2.5.1 PERCENTAGE OF UNCITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	0.0%	0.0%	0.0%	0.0%	0.0%	2.4%	0.4%	0.4%
2011	0.0%	0.0%	0.0%	0.5%	0.0%	1.6%	0.5%	0.5%
2012	0.0%	1.3%	2.6%	0.0%	0.0%	2.5%	0.4%	0.5%
2013	0.5%	0.0%	2.9%	0.4%	0.0%	2.5%	0.6%	0.6%
2014	0.0%	1.1%	2.5%	0.9%	0.0%	2.9%	0.7%	0.5%
2015	0.7%	1.0%	1.5%	0.5%	2.5%	4.7%	0.8%	1.0%
2016	0.9%	1.1%	2.4%	0.6%	1.9%	5.0%	1.4%	1.2%
2017	1.4%	2.7%	1.5%	3.6%	2.3%	7.1%	1.6%	1.9%
2018	2.4%	3.9%	7.1%	4.5%	9.1%	11.9%	3.1%	3.3%
2019	6.9%	7.5%	19.6%	10.6%	10.0%	20.4%	9.2%	9.5%
2020	44.6%	60.9%	67.4%	55.1%	69.2%	62.4%	48.2%	46.5%
Total	**9.2%**	**7.5%**	**10.0%**	**11.5%**	**2.2%**	**13.5%**	**5.7%**	**7.3%**

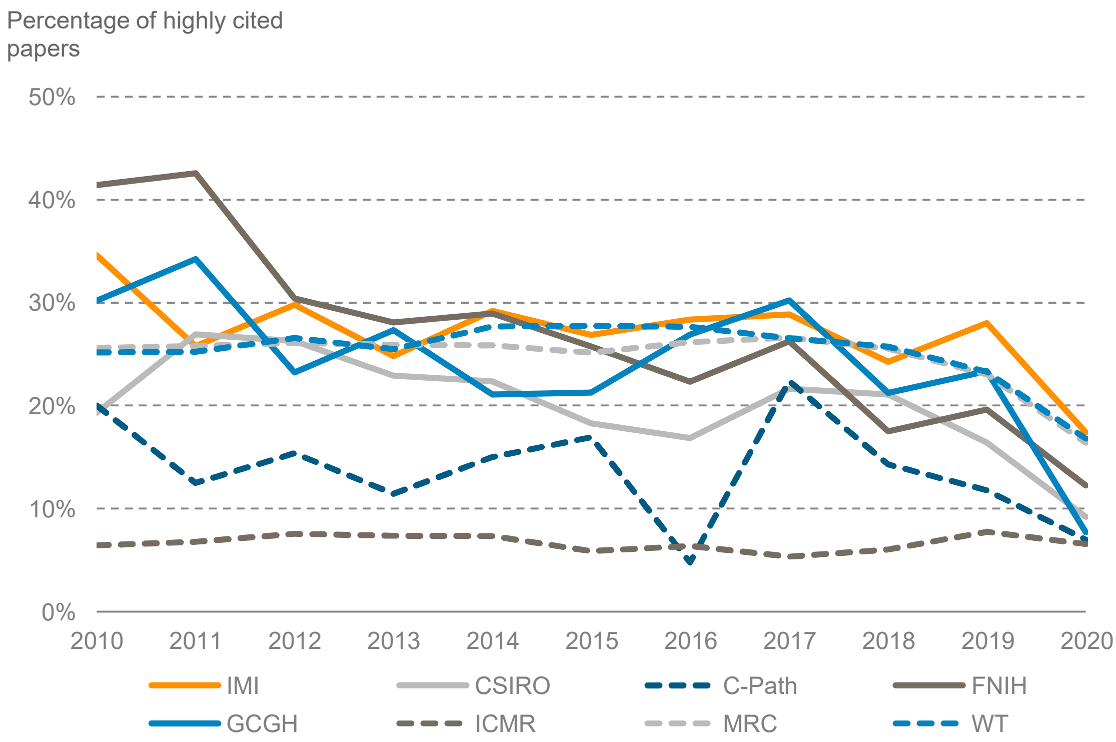
- No IMI project papers published between 2010 and 2012 are uncited. IMI's share of uncited research since 2017 has been the lowest of all the comparators.

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 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.

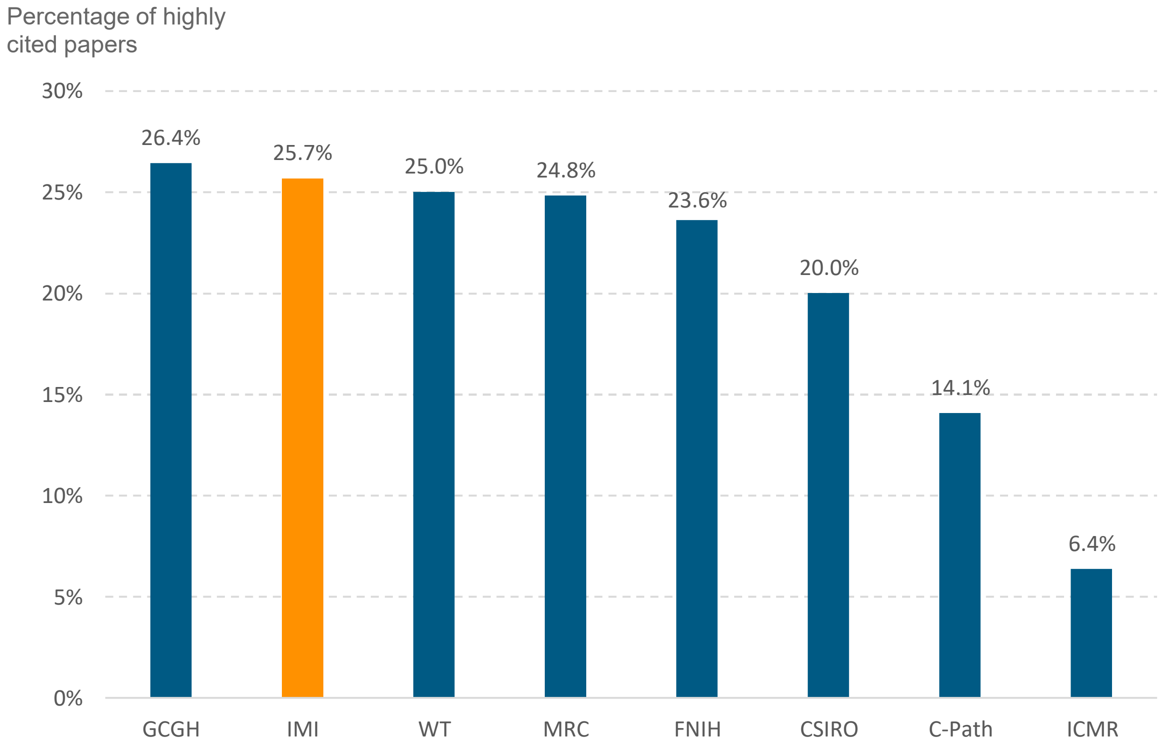
Figure 8.2.6.1 shows the annual trends in percentage of highly cited papers between 2010 and 2020 for IMI and the selected comparators. Figure 8.2.6.2 shows the total percentage of highly cited papers between 2010 and 2020 for IMI and the selected comparators. Table 8.2.6.1 has the same data as in Figure 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, 2010-2020



- Between 2010 and 2020, IMI and most of the comparators had an above average (10%) percentage of highly cited papers the exceptions being ICMR, which was consistently below the world average, and C-Path, which was below average in 2016 and 2020.
- In most years, IMI is among the organisations with the highest percentage of highly cited papers. IMI had the highest percentage of highly cited papers among the comparators in 2014, 2016, 2019 and 2020.

FIGURE 8.2.6.2 PERCENTAGE OF HIGHLY CITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- IMI ranks second in comparison to the comparators for percentage of highly-cited papers, with only GCGH outperforming IMI.
- Around a quarter of papers published by IMI and the comparators between 2010 and 2020 were highly cited. C-Path had a comparatively lower proportions of highly cited papers (14.8%) while ICMR was well below world average performance (6.4%).

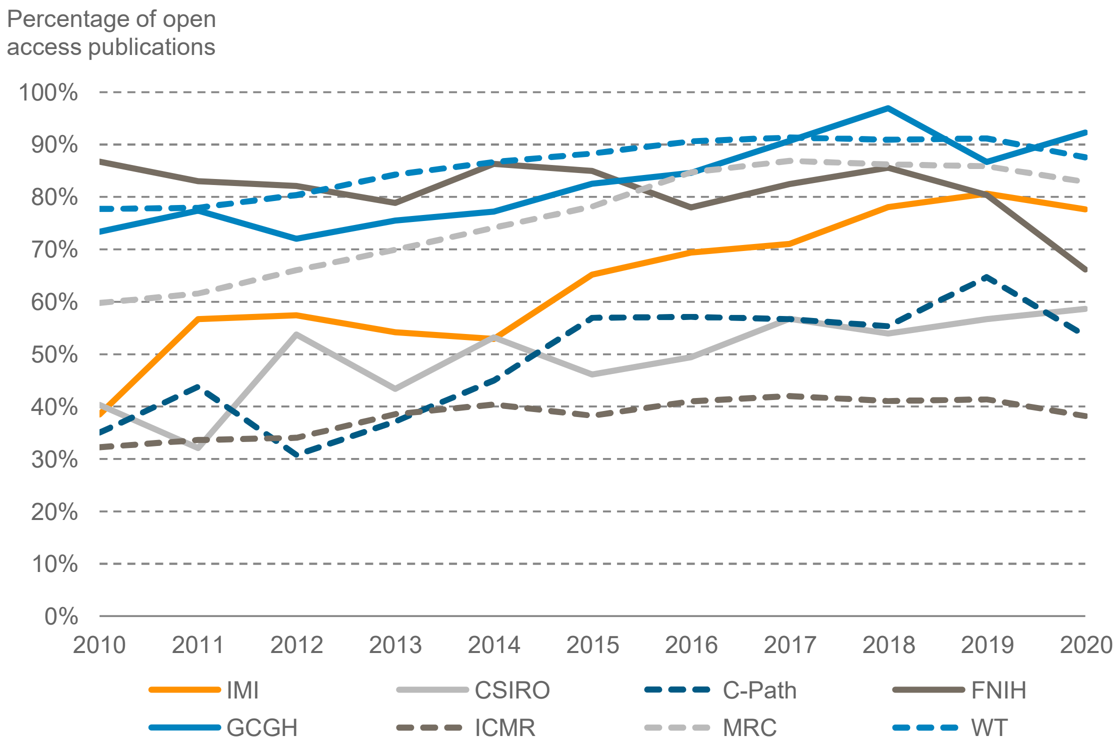
TABLE 8.2.6.1 PERCENTAGE OF HIGHLY CITED PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	34.6%	19.3%	20.0%	41.4%	30.2%	6.4%	25.6%	25.2%
2011	25.8%	26.9%	12.5%	42.6%	34.2%	6.8%	25.8%	25.2%
2012	29.8%	26.3%	15.4%	30.4%	23.2%	7.6%	26.1%	26.6%
2013	24.8%	22.9%	11.4%	28.1%	27.4%	7.4%	25.9%	25.5%
2014	29.2%	22.3%	15.0%	29.0%	21.1%	7.3%	25.9%	27.7%
2015	26.9%	18.3%	16.9%	25.7%	21.2%	5.9%	25.1%	27.7%
2016	28.4%	16.9%	4.8%	22.3%	26.9%	6.4%	26.2%	27.6%
2017	28.9%	21.6%	22.4%	26.2%	30.2%	5.3%	26.6%	26.5%
2018	24.2%	21.1%	14.3%	17.5%	21.2%	6.0%	25.5%	25.7%
2019	28.0%	16.4%	11.8%	19.6%	23.3%	7.7%	23.0%	23.3%
2020	17.4%	9.2%	7.0%	12.2%	7.7%	6.6%	16.4%	16.8%
Total	**25.7%**	**20.0%**	**14.1%**	**23.6%**	**26.4%**	**6.4%**	**24.8%**	**25.0%**

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 2020 for IMI and the selected comparators. Figure 8.2.7.2 shows the total percentage of open access publications between 2010 and 2020 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.[22]

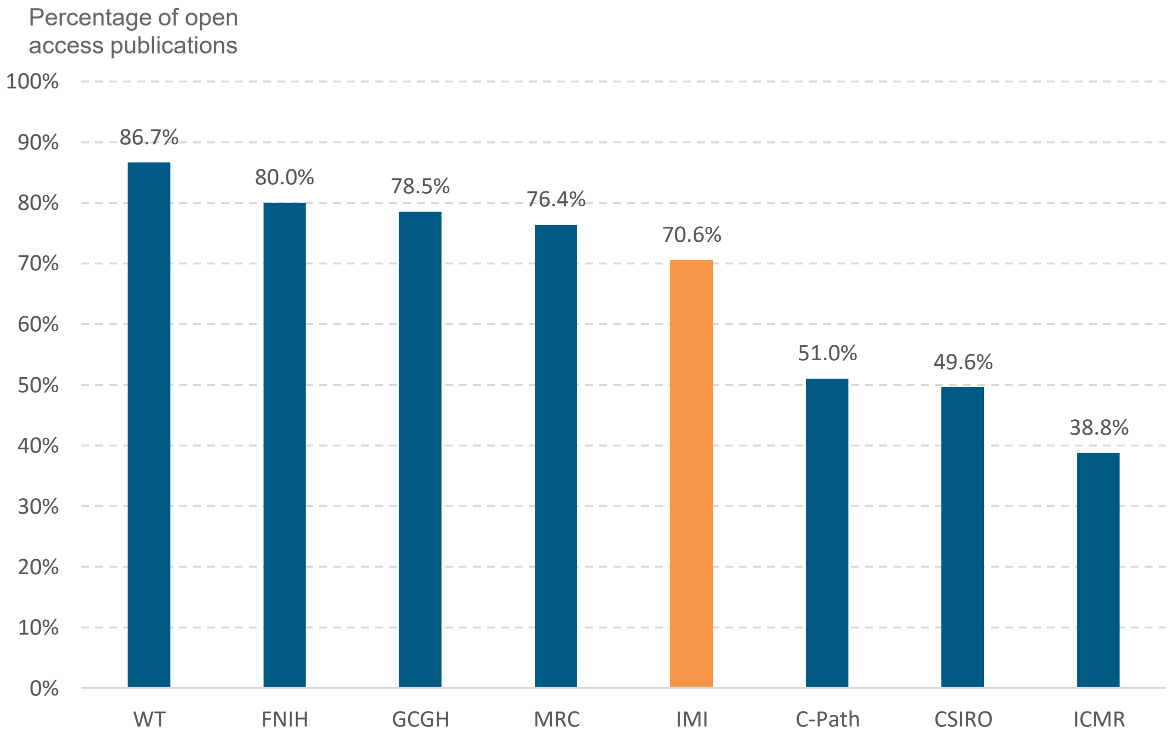
FIGURE 8.2.7.1 TRENDS IN OPEN ACCESS PUBLICATIONS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020



- IMI and most of the comparators have increased their output of open access publications between 2010 and 2020, except for FNIH which is trending slightly downward.
- IMI increased its percentage of open access publications at a faster rate than any of the comparators.

[22] 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, 2010-2020



- The majority of organisations, including IMI, have published more than half of their 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 2020, with an average of 86.7% of all publications. While ICMR, had the lowest with an average of 38.8%.

TABLE 8.2.7.1 PERCENTAGE OF OPEN ACCESS PAPERS – IMI PROJECT RESEARCH COMPARED WITH SELECTED COMPARATORS, 2010-2020

Year	IMI	CSIRO	C-Path	FNIH	GCGH	ICMR	MRC	WT
2010	38.5%	40.4%	35.0%	86.7%	73.4%	32.2%	59.8%	77.7%
2011	56.7%	32.1%	43.8%	83.0%	77.4%	33.6%	61.6%	78.0%
2012	57.4%	53.7%	30.8%	82.1%	72.0%	34.0%	66.0%	80.4%
2013	54.2%	43.4%	37.1%	78.8%	75.5%	38.6%	69.9%	84.3%
2014	52.9%	53.2%	45.0%	86.3%	77.2%	40.4%	74.2%	86.7%
2015	65.2%	46.2%	56.9%	85.0%	82.5%	38.3%	78.2%	88.3%
2016	69.4%	49.4%	57.1%	78.0%	84.6%	41.0%	84.7%	90.6%
2017	71.0%	56.8%	56.7%	82.4%	90.7%	42.0%	86.9%	91.4%
2018	78.1%	53.9%	55.4%	85.6%	97.0%	41.1%	86.2%	91.0%
2019	80.6%	56.7%	64.7%	80.4%	86.7%	41.4%	85.8%	91.2%
2020	77.6%	58.6%	53.5%	66.2%	92.3%	38.2%	82.9%	87.6%
Total	**70.6%**	**49.6%**	**51.0%**	**80.0%**	**78.5%**	**38.8%**	**76.4%**	**86.7%**

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, 2010-2020

Project	Number of papers	Citation impact (normalised at field level)	Percentage of uncited papers	Percentage of highly cited papers
IMI	6,566	1.99	9.2%	25.7%
C-Path	490	1.39	10.0%	14.1%
CSIRO	889	1.61	7.5%	20.0%
FNIH	4,102	1.84	11.5%	23.6%
GCGH	881	1.90	2.2%	26.4%
ICMR	14,743	0.81	13.5%	6.6%
MRC	107,203	2.03	5.7%	24.8%
WT	78,962	2.04	7.3%	25.0%

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).[23]

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

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[23] 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.

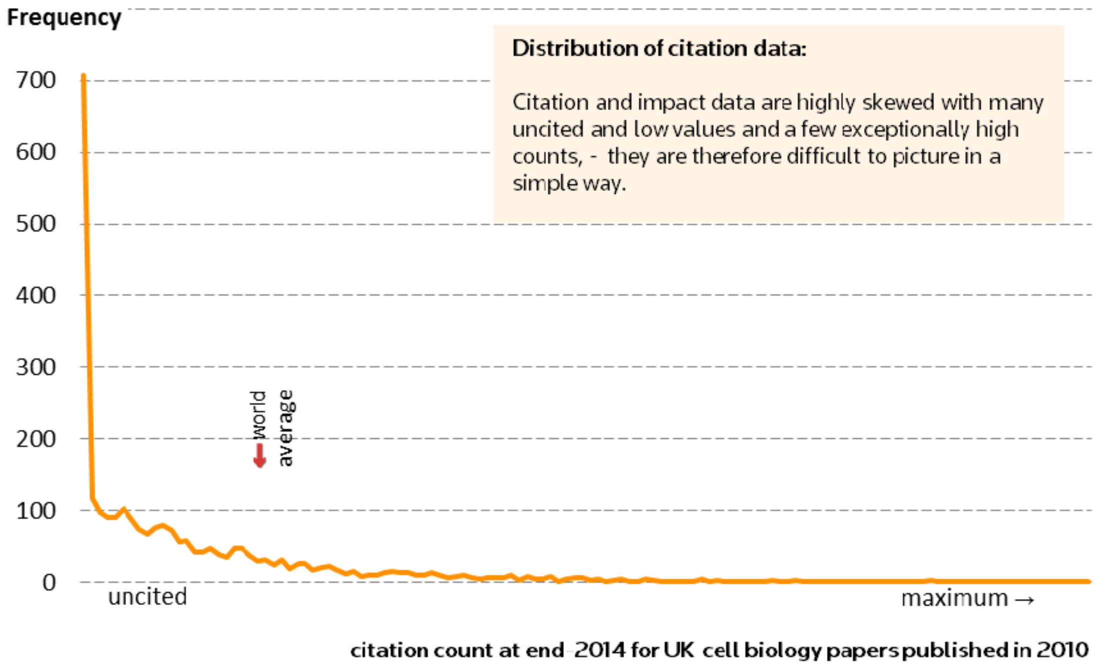
Citation counts

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.

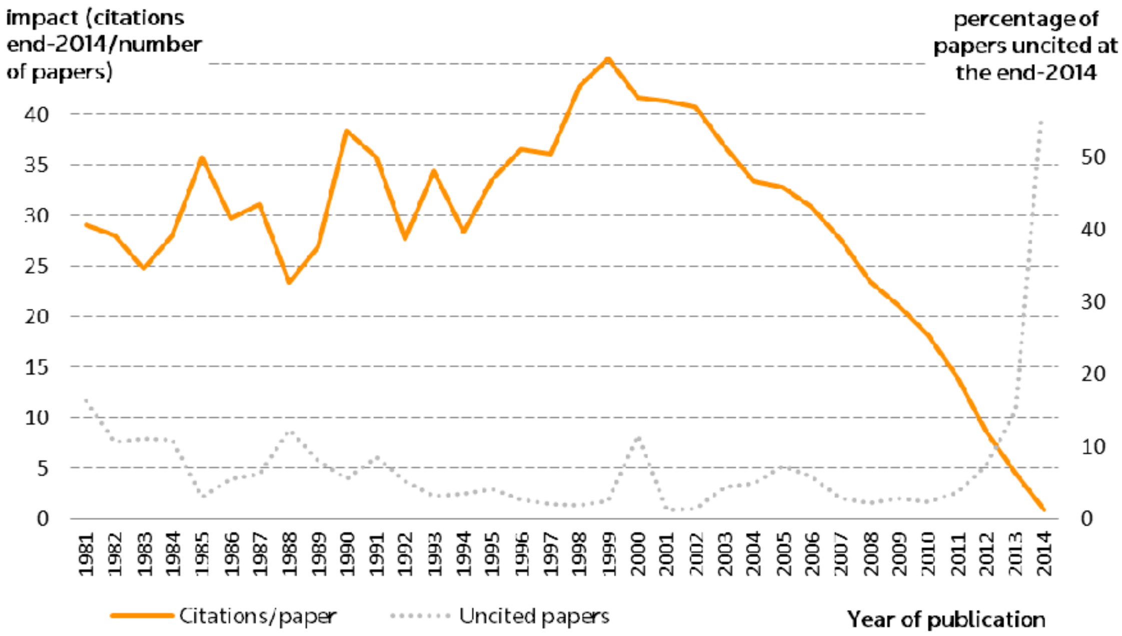
We do not seek to account separately for the effect of self-citation. If the citation count is significantly affected by self-citation then the paper is likely to have been infrequently cited. This is therefore only of consequence for low impact activity. Studies show that for large samples at national 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***.

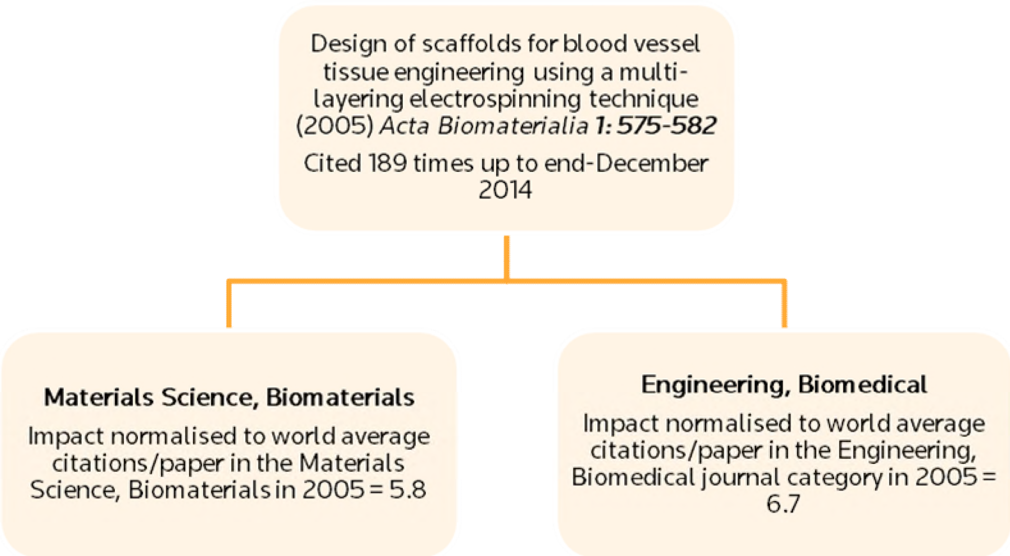
Very few papers are not assigned to any research field and as such will not be included in specific analyses using normalised citation impact data. The journals included in the Clarivate databases and how they are selected are detailed heremjl.clarivate.com/.
Some journals with a very diverse content, 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
- Agricultural economics & policy
- Agricultural engineering
- Agriculture, dairy & animal science
- Agriculture, multidisciplinary
- Agriculture, soil science
- Agronomy
- Allergy
- Anatomy & morphology
- Andrology
- Anesthesiology
- Anthropology
- Applied linguistics
- Archaeology
- Architecture
- Area studies
- Art
- Asian studies
- Astronomy & astrophysics
- Automation & control systems
- Behavioral sciences
- Biochemical research methods
- Biochemistry & molecular biology
- Biodiversity conservation
- Biology
- Biology, miscellaneous
- Biophysics
- Biotechnology & applied microbiology
- Business
- Business, finance
- Cardiac & cardiovascular systems
- Cell biology
- Chemistry, analytical
- Chemistry, applied
- Chemistry, inorganic & nuclear
- Chemistry, medicinal
- Classics
- Clinical neurology
- Communication
- Computer science, artificial intelligence
- Computer science, cybernetics
- Computer science, hardware & architecture
- Computer science, information systems
- Computer science, interdisciplinary applications
- Computer science, software engineering
- Computer science, theory & methods
- Construction & building technology
- Criminology & penology
- Critical care medicine
- Crystallography
- Dance
- Demography
- Dentistry, oral surgery & medicine
- Dermatology
- Developmental biology
- Ecology
- Economics
- Education & educational research
- Education, scientific disciplines
- Education, special
- Electrochemistry
- Emergency medicine
- Endocrinology & metabolism
- Energy & fuels
- Engineering, aerospace
- Engineering, biomedical
- Engineering, chemical
- Engineering, civil
- Engineering, electrical & electronic
- Engineering, environmental
- Engineering, geological
- Engineering, industrial
- Engineering, multidisciplinary
- Engineering, ocean
- Engineering, petroleum
- Entomology
- Environmental sciences
- Environmental studies
- Ergonomics
- Ethics
- Ethnic studies
- Evolutionary biology
- Family studies
- Film, radio, television
- Fisheries
- Folklore
- Food science & technology
- Forestry
- Gastroenterology & hepatology
- Genetics & heredity
- Geochemistry & geophysics
- Geography
- Geography, physical
- Geology
- Geosciences, multidisciplinary
- Geriatrics & gerontology
- Health care sciences & services
- Health policy & services
- Hematology
- History
- History & philosophy of science
- History of social sciences
- Horticulture
- Humanities, multidisciplinary
- Imaging science & photographic technology
- Immunology
- Industrial relations & labor
- 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 2020 BY COUNTRY

Country	Number of publications
UK	2,996
Germany	2,278
USA	1,690
Netherlands	1,681
Sweden	1,185
France	1,169
Italy	985
Switzerland	868
Spain	809
Belgium	681
Denmark	523
Canada	465
Austria	424
Finland	328
Australia	226
Greece	214
Peoples R China	207
Ireland	171
Norway	161
Poland	146
Japan	127
Brazil	113
Portugal	112
Israel	97
Singapore	71
Hungary	70
South Africa	63
Estonia	61
Czech Republic	55
Luxembourg	47
India	46
Iceland	40
Saudi Arabia	39
Taiwan	38
South Korea	37
Turkey	35
New Zealand	31
Cyprus	31
Slovenia	29

Country	Number of publications
Croatia	29
Lithuania	27
Egypt	25
Argentina	24
Russia	19
Romania	19
Thailand	18
Qatar	17
Serbia	17
Kenya	13
Iran	12
Chile	11
Lebanon	10
Bulgaria	9
Latvia	8
Mexico	8
Ukraine	7
Tanzania	7
Malta	6
Pakistan	6
Uruguay	6
Colombia	6
Vietnam	5
Tunisia	5
Uganda	5
Nigeria	5
Peru	5
Gambia	4
Kuwait	4
Liechtenstein	4
Gabon	4
Jordan	4
Philippines	4
Guinea	3
BELARUS	3
Georgia	3
Palestine	3
Slovakia	3
Mozambique	3
Sierra Leone	3
U Arab Emirates	3
Iraq	3
Malaysia	2
Monaco	2

Country	Number of publications
Bangladesh	2
Bosnia & Herceg	2
Guatemala	2
Oman	2
Ghana	2
Ethiopia	2
Sri Lanka	2
Malawi	2
Macedonia	2
Morocco	1
Algeria	1
Bolivia	1
Botswana	1
Burkina Faso	1
Burundi	1
Cambodia	1
Cameroon	1
Cook Islands	1
Cote Ivoire	1
DEM REP CONGO	1
Ecuador	1
Indonesia	1
Kazakhstan	1
Kosovo	1
Liberia	1
Libya	1
Mali	1
Moldova	1
Mongolia	1
Albania	1
Senegal	1
Uzbekistan	1
Zambia	1
Zimbabwe	1

ANNEX 4: TOTAL NUMBER OF WEB OF SCIENCE PUBLICATIONS, PAPERS AND OPEN ACCESS PUBLICATIONS BETWEEN 2010 AND 2020 BY PROJECT

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
BTCure	703	656	461	65.6%
EU-AIMS	503	488	378	75.1%
ULTRA-DD	379	371	295	77.8%
EMIF	300	279	229	76.3%
NEWMEDS	209	204	113	54.1%
CANCER-ID	193	167	136	70.5%
EUROPAIN	177	177	68	38.4%
ORBITO	168	165	47	28.0%
INNODIA	158	126	110	69.6%
TRANSLOCATION	152	152	90	59.2%
IMIDIA	149	139	120	80.5%
STEMBANCC	143	138	107	74.8%
U-BIOPRED	136	87	65	47.8%
SUMMIT	132	128	96	72.7%
CHEM21	130	127	61	46.9%
ELF	126	125	83	65.9%
PreDiCT-TB	118	112	101	85.6%
SPRINTT	113	106	63	55.8%
MIP-DILI	113	106	64	56.6%
AIMS-2-TRIALS	107	101	96	89.7%
DIRECT	105	79	66	62.9%
Quic-Concept	102	101	82	80.4%
PROTECT	101	99	42	41.6%
ABIRISK	97	76	48	49.5%
eTOX	97	92	64	66.0%
RTCure	94	87	79	84.0%
COMBACTE-MAGNET	91	81	68	74.7%
Pharma-Cog	89	83	35	39.3%
COMBACTE-NET	87	80	68	78.2%
COMPACT	87	87	42	48.3%
DDMoRe	81	76	52	64.2%
BEAT-DKD	78	73	65	83.3%
RHAPSODY	75	60	59	78.7%
Open PHACTS	73	70	63	86.3%
BigData@Heart	69	60	54	78.3%
BioVacSafe	69	66	51	73.9%
AETIONOMY	69	68	54	78.3%
None	68	50	37	54.4%
Onco Track	65	61	44	67.7%

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
K4DD	65	63	44	67.7%
PRECISESADS	64	44	36	56.3%
RADAR-CNS	64	42	31	48.4%
PRISM	58	49	44	75.9%
MARCAR	58	57	44	75.9%
DRIVE-AB	57	51	46	80.7%
ZAPI	53	50	52	98.1%
COMBACTE-CARE	52	48	44	84.6%
APPROACH	52	42	36	69.2%
eTRIKS	51	41	42	82.4%
IMPRiND	48	46	41	85.4%
Predect	47	43	36	76.6%
ENABLE	47	47	40	85.1%
RAPP-ID	46	45	24	52.2%
GETREAL	41	35	31	75.6%
EPAD	39	35	25	64.1%
iPiE	38	37	24	63.2%
FLUCOP	37	36	29	78.4%
iABC	36	22	18	50.0%
PROACTIVE	32	27	25	78.1%
EBiSC	31	28	27	87.1%
RESCEU	31	29	27	87.1%
EBOVAC1	31	29	31	100.0%
TransQST	30	28	25	83.3%
PHAGO	29	29	28	96.6%
HARMONY	27	15	17	63.0%
AMYPAD	26	20	18	69.2%
ADVANCE	26	25	23	88.5%
EbolaMoDRAD	26	25	18	69.2%
ROADMAP	26	20	21	80.8%
LITMUS	26	21	17	65.4%
PREFER	23	14	18	78.3%
SAFE-T	22	20	6	27.3%
EHR4CR	21	19	13	61.9%
eTRANSAFE	20	15	15	75.0%
EUbOPEN	20	20	13	65.0%
ADAPTED	20	18	18	90.0%
MOBILISE-D	18	16	10	55.6%
WEB-RADR	16	15	12	75.0%
COMBACTE	15	14	10	66.7%
EBOVAC2	15	15	15	100.0%
TRISTAN	15	15	14	93.3%
INNODIA HARVEST	14	11	11	78.6%
IMI-PainCare	14	9	4	28.6%

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
Hypo-RESOLVE	13	8	7	53.8%
CARDIATEAM	13	11	9	69.2%
DRIVE	12	11	10	83.3%
VSV-EBOPLUS	12	11	9	75.0%
EHDEN	11	8	7	63.6%
3TR	11	11	8	72.7%
VSV-EBOVAC	11	10	7	63.6%
EQIPD	10	5	9	90.0%
BIOMAP	9	6	7	77.8%
VAC2VAC	9	9	8	88.9%
PERISCOPE	9	9	9	100.0%
RADAR-AD	8	5	5	62.5%
PD-MitoQUANT	8	8	7	87.5%
MACUSTAR	7	3	7	100.0%
EUPATI	7	6	7	100.0%
ITCC-P4	6	6	6	100.0%
DRAGON	5	5	5	100.0%
ReSOLUTE	5	4	5	100.0%
ERA4TB	5	5	5	100.0%
SafeSciMET	5	4	2	40.0%
EU-PEARL	4	2	3	75.0%
MOPEAD	4	4	4	100.0%
ADAPT-SMART	4	4	2	50.0%
TransBioLine	4	4	3	75.0%
SOPHIA	4	4	4	100.0%
c4c	4	2	2	50.0%
EBODAC	4	4	4	100.0%
FAIRplus	3	3	2	66.7%
ConcePTION	3	2	1	33.3%
PEVIA	3	2	3	100.0%
Eu2P	3	3	2	66.7%
DO->IT	3	3	3	100.0%
MAD-CoV 2	3	2	3	100.0%
COMBACTE-CDI	3	2	2	66.7%
VITAL	3	3	3	100.0%
CARE	2	1	2	100.0%
NECESSITY	2	2	1	50.0%
PIONEER	2	1	2	100.0%
EMTRAIN	2	1	0	0.0%
MELLODDY	2	1	0	0.0%
EBOMAN	2	2	2	100.0%
EBiSC2	2	2	2	100.0%
IMMUCAN	2	2	2	100.0%
ND4BB	2	2	2	100.0%

Project	Number of publications	Number of papers	Number of open access publications	% of open access publications
Immune-Image	2	2	1	50.0%
VHFMoDRAD	2	2	2	100.0%
EBOVAC3	1	1	1	100.0%
IDEA-FAST	1	1	1	100.0%
KRONO	1	1	1	100.0%
imSAVAR	1	0	0	0.0%
Pharmatrain	1	1	1	100.0%
PARADIGM	1	1	1	100.0%
FILODIAG	1	0	1	100.0%
VALUE-Dx	1	1	1	100.0%
NeuroDeRisk	1	1	1	100.0%
IM2PACT	1	1	0	0.0%
COVID-RED	1	1	1	100.0%
COMBINE	1	1	1	100.0%
EBOVAC	1	1	1	100.0%
NGN-PET	1	1	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	0.83	1.98	656	1.85
EU-AIMS	0.73	0.65	0.80	2.18	488	2.03
ULTRA-DD	0.61	0.66	0.75	2.02	371	1.74
EMIF	0.81	0.66	0.84	2.31	279	2.66
NEWMEDS	0.63	0.57	0.81	2.01	204	2.16
EUROPAIN	0.54	0.37	0.84	1.75	177	2.48
CANCER-ID	0.74	0.43	0.75	1.92	167	3.27
ORBITO	0.62	0.47	0.76	1.85	165	1.84
TRANSLOCATION	0.37	0.49	0.80	1.66	152	1.39
IMIDIA	0.53	0.50	0.83	1.85	139	1.63
STEMBANCC	0.49	0.46	0.80	1.75	138	1.95
SUMMIT	0.76	0.63	0.82	2.21	128	1.53
CHEM21	0.24	0.29	0.79	1.31	127	1.75
INNODIA	0.83	0.67	0.88	2.38	126	1.63
ELF	0.33	0.52	0.73	1.58	125	1.15
PreDiCT-TB	0.54	0.48	0.79	1.81	112	1.22
SPRINTT	0.72	0.54	0.80	2.05	106	2.22
MIP-DILI	0.67	0.45	0.81	1.94	106	1.82
Quic-Concept	0.71	0.58	0.80	2.09	101	4.34
AIMS-2-TRIALS	0.75	0.70	0.68	2.13	101	1.88
PROTECT	0.97	0.63	0.86	2.46	99	1.08
eTOX	0.30	0.36	0.86	1.53	92	1.71
U-BIOPRED	0.82	0.70	0.86	2.38	87	2.57
COMPACT	0.22	0.45	0.71	1.39	87	1.86
RTCure	0.77	0.52	0.71	2.00	87	2.68
Pharma-Cog	0.84	0.74	0.85	2.44	83	1.19
COMBACTE-MAGNET	0.67	0.60	0.73	1.99	81	1.18
COMBACTE-NET	0.75	0.52	0.78	2.05	80	1.01
DIRECT	0.75	0.72	0.88	2.35	79	2.98
ABIRISK	0.76	0.48	0.86	2.10	76	1.32
DDMoRe	0.64	0.56	0.81	2.01	76	1.08
BEAT-DKD	0.71	0.74	0.61	2.05	73	1.46
Open PHACTS	0.60	0.55	0.76	1.92	70	3.47
AETIONOMY	0.65	0.44	0.78	1.87	68	1.71
BioVacSafe	0.44	0.47	0.81	1.72	66	1.27
K4DD	0.54	0.51	0.79	1.84	63	1.74

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
Onco Track	0.64	0.43	0.83	1.90	61	2.30
BigData@Heart	0.92	0.68	0.56	2.16	60	1.53
RHAPSODY	0.53	0.64	0.83	2.00	60	2.10
MARCAR	0.44	0.42	0.82	1.68	57	1.08
DRIVE-AB	0.75	0.62	0.71	2.08	51	1.37
None	0.76	0.72	0.92	2.40	50	3.41
ZAPI	0.68	0.65	0.71	2.03	50	5.61
PRISM	0.73	0.66	0.66	2.05	49	2.14
COMBACTE-CARE	0.92	0.64	0.73	2.29	48	1.78
ENABLE	0.60	0.41	0.80	1.80	47	1.61
IMPRiND	0.63	0.54	0.76	1.93	46	6.47
RAPP-ID	0.33	0.43	0.89	1.65	45	0.88
PRECISESADS	0.77	0.77	0.69	2.23	44	1.23
Predect	0.67	0.62	0.74	2.04	43	2.52
APPROACH	0.76	0.76	0.73	2.24	42	1.95
RADAR-CNS	0.60	0.76	0.76	2.11	42	1.64
eTRIKS	0.85	0.87	0.72	2.45	41	2.44
iPiE	0.54	0.25	0.71	1.50	37	1.32
FLUCOP	0.89	0.51	0.69	2.08	36	1.09
EPAD	0.71	0.64	0.73	2.08	35	1.01
GETREAL	0.89	0.77	0.74	2.39	35	1.82
PHAGO	0.66	0.60	0.71	1.97	29	3.34
RESCEU	0.90	0.77	0.71	2.38	29	2.00
EBOVAC1	0.69	0.64	0.72	2.04	29	1.93
EBiSC	0.71	0.64	0.75	2.11	28	7.64
TransQST	0.57	0.70	0.74	2.01	28	3.25
PROACTIVE	1.00	0.80	0.82	2.62	27	2.17
EbolaMoDRAD	0.68	0.52	0.65	1.85	25	1.45
ADVANCE	0.88	0.85	0.85	2.58	25	1.87
iABC	0.82	0.65	0.81	2.27	22	0.87
LITMUS	0.81	0.68	0.69	2.18	21	4.14
ROADMAP	0.90	0.72	0.68	2.30	20	0.90
EUbOPEN	0.65	0.53	#N/A	#N/A	20	0.45
AMYPAD	0.90	0.79	0.77	2.46	20	1.45
SAFE-T	0.95	0.53	0.85	2.32	20	1.88
EHR4CR	0.89	0.63	#N/A	#N/A	19	1.17
ADAPTED	0.94	0.67	#N/A	#N/A	18	2.34
MOBILISE-D	0.88	0.59	#N/A	#N/A	16	2.61
HARMONY	0.80	0.42	#N/A	#N/A	15	0.87
eTRANSAFE	0.33	0.38	#N/A	#N/A	15	3.25
EBOVAC2	0.40	0.38	#N/A	#N/A	15	1.46
TRISTAN	0.80	0.58	#N/A	#N/A	15	1.17
WEB-RADR	0.73	0.73	#N/A	#N/A	15	1.80

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
COMBACTE	0.50	0.13	#N/A	#N/A	14	2.78
PREFER	0.86	0.80	#N/A	#N/A	14	0.99
3TR	1.00	0.39	#N/A	#N/A	11	0.23
CARDIATEAM	1.00	0.95	#N/A	#N/A	11	0.89
DRIVE	0.82	0.23	#N/A	#N/A	11	1.23
INNODIA HARVEST	0.91	0.93	#N/A	#N/A	11	0.93
VSV-EBOPLUS	0.64	0.73	#N/A	#N/A	11	0.81
VSV-EBOVAC	0.50	0.60	#N/A	#N/A	10	1.00
IMI-PainCare	0.56	0.33	#N/A	#N/A	9	1.05
VAC2VAC	0.56	0.56	#N/A	#N/A	9	0.68
PERISCOPE	0.44	0.42	#N/A	#N/A	9	1.28
Hypo-RESOLVE	0.50	0.75	#N/A	#N/A	8	0.72
PD-MitoQUANT	0.88	0.38	#N/A	#N/A	8	2.33
EHDEN	0.75	0.81	#N/A	#N/A	8	1.13
BIOMAP	1.00	0.96	#N/A	#N/A	6	3.62
ITCC-P4	1.00	0.79	#N/A	#N/A	6	1.73
EUPATI	1.00	1.00	#N/A	#N/A	6	0.97
ERA4TB	0.60	0.50	#N/A	#N/A	5	0.81
RADAR-AD	0.80	0.40	#N/A	#N/A	5	0.77
DRAGON	1.00	0.90	#N/A	#N/A	5	1.40
EQIPD	0.60	0.70	#N/A	#N/A	5	2.72
MOPEAD	1.00	0.69	#N/A	#N/A	4	0.89
ADAPT-SMART	0.75	0.50	#N/A	#N/A	4	0.61
EBODAC	0.75	0.69	#N/A	#N/A	4	3.04
TransBioLine	0.75	0.25	#N/A	#N/A	4	0.18
ReSOLUTE	0.25	0.19	#N/A	#N/A	4	0.63
SafeSciMET	1.00	1.00	#N/A	#N/A	4	0.97
SOPHIA	0.75	0.69	#N/A	#N/A	4	1.54
FAIRplus	0.33	0.33	#N/A	#N/A	3	4.72
VITAL	0.33	0.58	#N/A	#N/A	3	0.76
DO->IT	1.00	0.83	#N/A	#N/A	3	1.32
Eu2P	0.33	0.67	#N/A	#N/A	3	1.95
MACUSTAR	0.67	0.67	#N/A	#N/A	3	1.67
MAD-CoV 2	0.50	0.88	#N/A	#N/A	2	0.29
ND4BB	0.50	0.88	#N/A	#N/A	2	1.85
NECESSITY	1.00	1.00	#N/A	#N/A	2	1.40
Immune-Image	1.00	0.75	#N/A	#N/A	2	0.97
IMMUCAN	0.50	0.50	#N/A	#N/A	2	1.24
PEVIA	1.00	0.88	#N/A	#N/A	2	0.92
EU-PEARL	1.00	0.50	#N/A	#N/A	2	4.17
EBOMAN	1.00	0.88	#N/A	#N/A	2	5.40
EBiSC2	1.00	0.88	#N/A	#N/A	2	1.60
ConcePTION	1.00	0.50	#N/A	#N/A	2	0.00

Project	Cross-sector score	International score	Stability score	Collaboration Index	Total papers	Citation impact (field-normalised)
COMBACTE-CDI	1.00	0.75	#N/A	#N/A	2	0.25
c4c	1.00	0.88	#N/A	#N/A	2	0.00
VHFMoDRAD	1.00	0.38	#N/A	#N/A	2	0.00
PIONEER	1.00	1.00	#N/A	#N/A	1	4.49
COVID-RED	1.00	1.00	#N/A	#N/A	1	0.00
Pharmatrain	1.00	1.00	#N/A	#N/A	1	0.09
KRONO	1.00	1.00	#N/A	#N/A	1	0.00
COMBINE	1.00	0.00	#N/A	#N/A	1	0.00
NGN-PET	0.00	0.00	#N/A	#N/A	1	1.02
CARE	1.00	0.00	#N/A	#N/A	1	23.03
NeuroDeRisk	1.00	1.00	#N/A	#N/A	1	0.00
IM2PACT	0.00	0.00	#N/A	#N/A	1	1.68
VALUE-Dx	1.00	1.00	#N/A	#N/A	1	0.67
MELLODDY	0.00	0.00	#N/A	#N/A	1	0.00
EBOVAC	1.00	1.00	#N/A	#N/A	1	3.53
EBOVAC3	0.00	1.00	#N/A	#N/A	1	0.20
PARADIGM	1.00	1.00	#N/A	#N/A	1	0.40
EMTRAIN	1.00	1.00	#N/A	#N/A	1	0.12
IDEA-FAST	0.00	0.75	#N/A	#N/A	1	0.79

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

AIMS-2-TRIALS: Moreno, Carmen et al. How mental health care should change as a consequence of the COVID-19 pandemic, LANCET PSYCHIAT (2020) 7: 813-824

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

eTRANSAFE: Pinero, Janet et al. The DisGeNET knowledge platform for disease genomics: 2019 update, NUCLEIC ACIDS RES (2020) 48: D845-D855

IMPRiND: Zhang, Wenjuan et al. Novel tau filament fold in corticobasal degeneration, NATURE (2020) 580: 283-+

PHAGO: Meinhardt, Jenny et al. Olfactory transmucosal SARS-CoV-2 invasion as a port of central nervous system entry in individuals with COVID-19, NAT NEUROSCI (2020) 24: 168-+

PRISM: Moreno, Carmen et al. How mental health care should change as a consequence of the COVID-19 pandemic, LANCET PSYCHIAT (2020) 7: 813-824

RTCure: Cossarizza, Andrea et al. Guidelines for the use of flow cytometry and cell sorting in immunological studies (second edition), EUR J IMMUNOL (2019) 49: 1457-1973

RTCure: Nemeth, Tamas et al. Neutrophils as emerging therapeutic targets, NAT REV DRUG DISCOV (2020) 19: 253-275

TransQST: Pinero, Janet et al. The DisGeNET knowledge platform for disease genomics: 2019 update, NUCLEIC ACIDS RES (2020) 48: D845-D855

ULTRA-DD: Douangamath, Alice et al. Crystallographic and electrophilic fragment screening of the SARS-CoV-2 main protease, NAT COMMUN (2020) 11:

ULTRA-DD: Schapira, Matthieu et al. Targeted protein degradation: expanding the toolbox, NAT REV DRUG DISCOV (2019) 18: 949-963

ZAPI: Okba, Nisreen M. A. et al. Severe Acute Respiratory Syndrome Coronavirus 2-Specific Antibody Responses in Coronavirus Disease Patients, EMERG INFECT DIS (2020) 26: 1478-1488

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