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A bibliometric analysis of Regenerative Medicine

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Contact details

Evidence, Thomson Reuters 103 Clarendon Road, Leeds LS2 9DF, UK

t/ +44(0)113 384 5680

f/ +44(0)113 384 5874

e/ scientific.enquiries.evidence@thomson.com


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Executive summary

- This report describes a study carried out by *Evidence*, a business of Thomson Reuters, for the UK Department of Business, Innovation and Skills (BIS). The primary aims are to map the global landscape of regenerative medicine research using bibliometric analysis of research publications and their citations as a proxy for impact; and to compare the overall UK strength in the field with the rest of the world.
- The core 'regenerative medicine' data have been drawn from the PubMed database by *Evidence* using MeSH terms agreed with BIS and its agencies and which they considered to give appropriate coverage. Data used for this study are primary peer-reviewed papers collated from Thomson Reuters Web of Knowledge databases for 5 years of publications from 2005 to 2009 with citation data to the end of 2010.
- The report covers aggregate regional groups (e.g. EU27, Latin America), specific countries (e.g. UK, Singapore) and States within the USA (e.g. California, New York, Wisconsin). The focus is on the UK's key partners and emerging research-orientated nations.
- The overall data-set generically describes 'regenerative medicine' while Regenerative Medicine is a MeSH term nested within this. The major MeSH terms used for disaggregated analyses in this study are:
  - Stem Cells;
  - Tumour Stem Cells;
  - Stem Cell Transplantation;
  - Tissue Engineering;
  - Regenerative Medicine.
- The overview analysis presents a consistent picture of a very dynamic and globally competitive field in which the UK is performing consistently well. However, the competitiveness of the field is also an important feature and sustaining national competitiveness is likely to be challenging. The high levels of citation impact across the countries analysed mean that comparisons of national performance are better made within the regenerative medicine dataset than against standard national expectations.
- Summary data on the full regenerative medicine data-set show that:
  - There has been a rapid increase in volume over the last five years. This has been faster in Asia than in North America and Europe. UK growth is in line with global change. (Table 3)
  - Average citation impact is relatively high compared to world and national averages for most countries, which is indicative of a highly active and competitive area. UK citation impact is higher than for the UK science base generally. (Table 4)
  - There is an unusually rapid pattern of citation for new publications and a generally low level of uncitedness. The UK data are similar to global averages and the UK has a lower percentage of uncited papers than is typical for the science base. (Table 5)
  - There is a generally high relative volume of highly cited papers, which for most countries is well above typical levels and in line with high average citation impact and low frequency of uncited papers. The UK is among the countries with the greatest proportion of highly cited papers. (Table 6)

- Impact Profiles® explore the distribution of citation impact underlying the average data points in the summary tables. These show that:
  - The UK's citation impact in regenerative medicine is higher than in cognate background areas of the research base. Regenerative medicine papers are more frequently cited and there are relatively more highly cited papers. (Figure 4)
  - The UK Impact Profile® is better than that of Europe generally and remains well ahead of emerging Asian competitors. (Figures 5, 6 and 9) It is also better than comparator research economies such as France and Germany. (Figure 7) Some smaller European research economies have profiles that are better than the UK in the most highly cited categories. (Figure 8)
  - The UK Impact Profile® is similar to and marginally better than Canada's. Compared to the USA, the UK has a greater percentage of papers cited just above and a smaller percentage cited well above world average. (Figure 10)
- The UK is a leading collaborator in regenerative medicine research, along with the USA and Germany. The UK is a top-three partner for all 15 countries analysed except Brazil, Israel and South Korea, while the USA is a top-three partner for all countries although a smaller percentage of its papers have an international co-author. Germany is also a top-three partner for 11 partners, but the four not favouring Germany are all in Asia (China, India, Japan and S Korea). (Table 7)
- At a disaggregated subject level, the UK has a greater share of its activity in Regenerative Medicine and less in Stem Cell Transplantation than does Germany, while overall the UK also has a relatively greater portfolio share for Tissue Engineering than the other countries. The significance of this needs interpretation and may be simply the consequence of particular initiatives in different countries. (Table 8)
  - Across categories, the UK has large volume relative to other countries in all areas but often had better growth early in the period than most recently. Its citation impact is good relative to most other countries, and very good relative to the science base generally, but it is not internationally exceptional within these data. This is partly a consequence of diversity. Its performance relative to Germany, its closest comparator, is very similar except in Tissue Engineering where the UK is much the better.
  - In Stem Cells, the largest category, UK average citation impact is around 1.8 where no country reaches 2.4. Japan has a substantial output but lower impact. China's output now exceeds the UK but its average impact is not greatly above world average. Average UK citation impact is similar to Germany on smaller output and very similar to the USA except in the highest impact category. (Figures 11 and 12, Annex 3)
  - Tumour Stem Cells is the smallest category but is rapidly growing and is diverse in performance. The UK has a slower growth rate than the rest of the world but has its highest average impact (2.5) in this area, as does Germany and also China for which this is an area of relatively high volume and hence share of domestic output in regenerative medicine. However, the UK has grown at a much slower rate than the rest of the world and has relatively fewer higher impact (> 4 times world) papers and the UK curve is rather flatter and broader than in other categories, implying greater variation in impact. (Figures 13 and 14, Annex 4)
  - UK Stem Cell Transplantation output is two-thirds of Germany's but similar to France, which it elsewhere significantly exceeds. However, the UK's average citation impact (1.45) is in line with Germany and most other European counties. China is just above world average and India is well below, but Brazil has higher average impact (1.21) than any Asian country. UK

modal impact is better than Germany and slightly higher than the USA but a higher share of USA papers is cited more than four times world average. Japan has a substantial output but an average impact (0.97) below world average. (Figures 15 and 16, Annex 5)

- Tissue Engineering output for the UK is greater than Germany and only slightly less than Japan with a better average citation impact (1.73) than either, but growth has plateaued. EU countries have unclear growth trends while Asian nations feature strongly. China's output exceeds and its average impact (1.31) is only slightly less than Germany's (1.36). South Korea has a larger output than all European countries except the UK and Germany and a higher average impact (1.85) than all except Switzerland. India, despite a very small output (46 papers in 2009), also has high impact (1.6). The UK's Impact Profile® is relatively 'peaked' with a modal output close to 30% in the category 1-2 times world average. The USA has a strong profile with a low proportion of papers cited below world average balanced by a relative excess of papers in the categories above twice world average. (Figures 17 and 18, Annex 6)
- The specific Regenerative Medicine category (i.e. the papers with that MeSH term) covers about 5% of the data. Only six countries (China, Canada, Germany, UK, Japan and USA) produced more than 100 papers over the period. The UK has a greater output but a lower average citation impact (1.63) and a poorer Impact Profile® than Germany (1.93). The USA has a strong performance in the three citation impact categories above twice world average. Japan's modal impact is below world average despite its substantial volume (more than twice Germany's). Over 30% of UK papers are in the impact category 1-2 times world average, so it has fewer relatively low cited or relatively well cited papers compared to Germany. (Figures 19 and 20, Annex 7)


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Bibliometric analysis of Regenerative Medicine

Aims

1. This report describes a study carried out by *Evidence*, a business of Thomson Reuters, for the UK Department of Business, Innovation and Skills (BIS). The primary aims of this report are to:
    a. Map the global landscape of Regenerative Medicine research using bibliometric analysis of research publications and their citations as a proxy for impact.
    b. Compare the overall UK strength in the field with the rest of the world, focussing on particular partner and emergent research-orientated economies.
2. The study has not considered which organisations funded any part of the research.

Background on consultant

3. *Evidence* has carried out a wide range of quantitative and qualitative research-based consultancy for BIS, for its predecessor agencies with responsibilities for the science base, and for the UK Funding and Research Councils.
4. *Evidence* is now part of the Scientific and Scholarly business of Thomson Reuters. This provides us with enhanced access to a much wider range of data, including data on patents and patent citations as well as the full data suite available within the Web of Knowledge[SM]. We have also been able to expand our capacity and draw on extended data management expertise.
5. Our continuing consultancy has included contracts for the EC and in Australia, Brazil, China, India Saudi Arabia and Singapore in the last twelve months. We are additionally involved in a range of other Thomson Reuters projects and have staff in Philadelphia and Singapore working to our office. Commentary from our reports is often quoted in policy documents and we bridge the dissemination of information by contributing articles through print media. Senior staff act as advisors to national research bodies and have chaired or been members of European and Australasian research assessment bodies.
6. We have developed a series of Global Research Reports on the international research base, which have been widely covered in the media. These are available at http://researchanalytics.thomsonreuters.com/grr/

Data sources

7. The core 'regenerative medicine' data set for this study has been drawn from the PubMed database by *Evidence* using MeSH terms. Annex 1 of this document contains a list of the MeSH terms that were agreed by BIS and its relevant agencies (MRC, BBSRC, EPSRC, TSB) and which they considered to give the most complete coverage possible of 'regenerative medicine'.
8. Search and collation was carried out by *Evidence*, based on search terms (see below on this definition) agreed with MRC. Each publication record was identified uniquely with the appropriate PubMed ID. *Evidence* then drew the relevant matching data from the Thomson Reuters Web of Knowledge and acquired associated citation data for bibliometric analysis.

9. Publication records used for this study:
    a. Include all primary peer-reviewed papers (substantive articles and reviews, which definition excludes letters and conference abstracts) using the agreed definition of 'regenerative medicine'.
    b. Cover 5 years of publications from 2005 to 2009 inclusive. This makes the sample relatively recent while providing sufficient data points for smaller topics and countries.
    c. Are linked to citation data through to the end of 2010. This takes account of the relatively low citation counts to most papers in their first year after publication, particularly for papers published late in the year.
    d. Draw on bibliometric data collated by *Evidence* from Thomson Reuters databases.

Geographical comparisons

10. The focus of the analysis is on the UK's key partners and emerging research-orientated nations. The report covers aggregate regional groups (e.g. EU27, Latin America), specific countries (e.g. UK, Singapore) and states within the USA (e.g. California, New York, Wisconsin).
11. Country data were extracted using the addresses of all authors of each paper. This means that each paper may be associated with multiple countries. A sum of individual countries would exceed the total of unique publications but any regional total has been correctly deduplicated.
12. Europe is included as well as EU-27 because the EU does not include Switzerland or Norway.

Table 1. Regions, countries and states evaluated in analyses on regenerative medicine

Regions	Countries	USA states
UN defined	UK	California
Europe	Brazil	Illinois
Africa	Canada	Maryland
Asia	China	Massachusetts
Latin America	France	Michigan
Northern America	Germany	Minnesota
Oceania	India	New York
	Israel	North Carolina
Other	Italy	Ohio
World	Japan	Pennsylvania
EU-27	Netherlands	Texas
	South Korea	Washington
	Spain	Wisconsin
	Sweden	
	Switzerland	
	USA	

Disciplinary structure

13. The major MeSH terms used in this study, and under which disaggregated data have been grouped in later analyses, are:
    a. Stem Cells;
    b. Tumour Stem Cells;
    c. Stem Cell Transplantation;
    d. Tissue Engineering;
    e. Regenerative Medicine.
14. Note that the overall data-set generically describes 'regenerative medicine' and that Regenerative Medicine is a MeSH term nested within this.

Analysis and indicators

15. This report first focuses on the volume of regenerative medicine papers – for the total data set and by major category - being published within the UK, and the pattern of quality and disciplinary structure in this sample compared to other countries and regions. The main variables are:
    a. Number of regenerative medicine papers by country/region and year.
    b. The numbers and percentages of uncited papers for each country.
    c. The average nci of the papers for each country.
    d. The numbers and percentages of highly-cited papers for each country.
16. The report then reviews the data as Impact Profiles®, which is a graphical presentation designed to address the problem of highly-skewed citation distributions.
17. The pattern of collaboration between countries is also analysed.

Numbers of publications

18. Numbers of publications reflect basic research capacity by showing the volume of papers being produced (or contributed to) by researchers in each region. Volume is affected not only by variations in research capacity, however, but also by local research culture and relative funding.
19. Volume by itself is no indicator of quality, but trends in capacity should be seen as important information about investment decisions and resource availability. Growth in quantity often foreshadows improvements in quality as the national research base develops.

Average normalised citation impact

20. Publication impact (academic impact) is measured using citations, but citation counts grow over time and rates vary by discipline. It is essential to take into account not only 'time since publication' but also the journal category to which an article belongs (Annex 2).
21. The most informative way of analysing citation data is to use the normalised citation impact (or nci – this may be expressed as nci_F for fields and nci_J for journals), which is the citation count normalised (or 'rebased') for subject (field or journal) and year by comparison with the relevant world average. An nci value of 1 is the world average. The average nci for the UK is usually in the range 1.3 to 1.4.

Highly-cited papers

22. A 'highly-cited' paper has generally been considered by Thomson Reuters to be one that falls into the top 1% of cited world publications. For the UK this approximates to papers with an nci of more than 8 times the world average for most subject areas.
23. While this certainly identifies the most exceptional papers, in order to allow meaningful national comparisons a lower cut-off (say, 4 times world average or papers in the top 5% or 10% by field and year) should be used to identify papers that are relatively highly-cited. For the UK approximately 5% of papers achieve a citation rate that is at least four times world average and around 10% exceed three times world average normalised citation impact.
24. In this study we have used the top decile as the cut-off for highly cited papers. This means that papers in the dataset will be deemed highly cited if their normalised citation impact is in the top decile for their journal category in the year of publication; it will be recognised that each journal category will include other publications that are not part of this dataset.

Uncited papers

25. Many papers remain uncited in the first year after publication. Some papers never acquire any citations. While 'uncitedness' is not a sufficient quality index in itself, comparisons with other indicators and across countries will convey information. If we compare two organisations in the same field, the one with a lower proportion of uncited papers is often also the one with other indicators of relatively good research performance. For the UK research base, approximately 30% of papers in any ten-year sample are usually uncited at that time, but in biomedical fields this falls to 10 -12%. Over the longer term, around 10% of papers authored in major research economies will tend to remain uncited.

Impact Profiles®

26. Publication and citation data, like other variables associated with research activity, are skewed. There are many instances of low value and a smaller number of instances of very high value. The 'average' in such right-skewed distributions is typically much greater than the central or median value. The average may therefore be considered to be less representative of the distribution as a whole than in a normal distribution (a normal distribution follows a familiar bell-shaped curve).

27. We use a graphical presentation to enable a more transparent picture of the underlying impact distribution. The nci values are presented as Impact Profiles® to address the disparity in interpretation which an average creates. This illustrates the number of papers in each nci interval where the standard intervals are 0 (uncited papers), and a series of cited categories pivoting around the world average: < 0.125, 0.125 > 0.249, 0.25 > 0.499, 0.5 > 0.99, 1 > 1.99, 2 - >3.99, 4 > 7.99 and 8+ (Annex 2).

28. The Impact Profile® of each organisation or country shows the numbers and % of the papers for each categorical interval. From this analysis it is straightforward to determine how the impact of regenerative medicine papers (or any sub-set) being published within the UK compares with the rest of the world.

Collaboration

29. Collaboration among research organisations is increasing in all fields. Collaboration, particularly international collaboration, is associated with high impact research outcomes. Analysis of the collaboration within the publication data for this report will use the addresses of all authors on each publication.

30. The percentage of an institution's papers that are collaborative is broadly correlated with other indicators of research performance. At a national level this is probably a less important indicator of performance since it is affected by geography, language and regional and national policies, but it is a significant indicator of knowledge flows. While the global literature is entirely accessible through journals, collaboration provides much greater access to background knowledge not included in publications, methodological insights and a clearer understanding of priorities and objectives amongst potential competitors.

Bibliometric analysis by total data set

31. Table 2 shows the total number of regenerative medicine publications of all types extracted from the Web of Science using the set of MeSH terms agreed with BIS.

Table 2. Publications of all data types in regenerative medicine by country/region and year

	2005	2006	2007	2008	2009	Total
UK	**959**	**1,130**	**1,325**	**1,426**	**1,456**	**6,296**
EU-27	4282	4876	5383	6376	6590	27,507
UN Macroregions						
Europe	4,537	5,181	5,672	6,726	6,949	29,065
Africa	59	52	68	94	110	383
Asia	2,657	3,101	3,674	4,464	4,912	18,808
Latin America	209	244	266	392	464	1,575
Northern America	4,865	5,643	6,020	7,209	7,428	31,165
Oceania	315	343	450	493	592	2,193
Countries						
Brazil	126	136	175	272	323	1,032
Canada	516	529	602	772	841	3,260
China	385	570	798	1,105	1,373	4,231
France	574	586	664	740	784	3,348
Germany	1,138	1,305	1,396	1,668	1,758	7,265
India	95	105	128	184	242	754
Israel	150	201	235	228	231	1,045
Italy	610	675	828	1,019	1,051	4,183
Japan	1,301	1,384	1,558	1,708	1,654	7,605
Netherlands	369	385	425	542	566	2,287
South Korea	292	344	413	500	598	2,147
Spain	223	285	318	430	502	1,758
Sweden	277	299	338	372	387	1,673
Switzerland	291	330	337	412	437	1,807
USA	4,460	5,255	5,564	6,638	6,839	28,756
US States						
California	719	871	989	1,256	1,310	5,145
Illinois	235	298	289	338	343	1,503
Maryland	391	503	557	525	591	2,567
Massachusetts	586	724	794	940	897	3,941
Michigan	189	232	219	283	320	1,243
Minnesota	188	227	228	298	294	1,235
New York	488	586	624	762	827	3,287
North Carolina	197	234	260	298	280	1,269
Ohio	248	258	331	385	425	1,647
Pennsylvania	397	462	456	552	591	2,458
Texas	374	426	478	571	642	2,491
Washington	197	230	249	248	284	1,208
Wisconsin	95	131	128	169	190	713
World	**11,416**	**13,136**	**14,298**	**17,095**	**17,791**	**73,736**

32. Total publications are given here only to complete the background information. This table is not repeated for the disaggregated analyses but enables those interested to review the full range of material in Thomson Reuters Web of Knowledge. Table 2 includes not only what we would regard as substantive research papers, in the form of articles and reviews, but other material such as editorial items, notes and some conference reports. Most of these are cited rarely or

not at all and they are therefore not included in analyses of baseline citation counts used for benchmarking. In this report, all subsequent analysis of output and citation impact will therefore focus only on the articles and reviews and their citations and benchmarks.

33. The bulk (over 90%) of the regenerative medicine dataset is made up of papers (articles and reviews) (Table 3). Annual global output has increased by roughly 60% over the five-year period, but this change is far from even.

Table 3. Papers in regenerative medicine by country/region and year

	2005	2006	2007	2008	2009	Total
UK	**891**	**1,017**	**1,200**	**1,301**	**1,316**	**5,725**
EU-27	3990	4523	5013	5886	6085	25,497
UN Macroregions						
Europe	4,234	4,819	5,283	6,212	6,421	26,969
Africa	57	52	66	91	99	365
Asia	2,556	2,967	3,541	4,283	4,722	18,069
Latin America	201	231	252	380	435	1,499
Northern America	4,559	5,305	5,608	6,657	6,856	28,985
Oceania	291	328	417	451	552	2,039
Countries						
Brazil	122	130	170	265	305	992
Canada	485	505	562	721	784	3,057
China	375	552	782	1,079	1,329	4,117
France	541	542	614	672	713	3,082
Germany	1,081	1,233	1,333	1,569	1,649	6,865
India	88	93	120	169	229	699
Israel	143	193	223	213	214	986
Italy	566	634	758	931	971	3,860
Japan	1,262	1,338	1,500	1,634	1,581	7,315
Netherlands	337	359	403	509	534	2,142
South Korea	287	335	405	490	587	2,104
Spain	207	264	300	394	469	1,634
Sweden	263	291	320	352	365	1,591
Switzerland	280	323	317	383	415	1,718
USA	4,181	4,936	5,185	6,132	6,310	26,744
US States						
California	674	822	935	1,159	1,209	4,799
Illinois	223	285	273	315	322	1,418
Maryland	372	478	512	481	555	2,398
Massachusetts	554	683	741	883	843	3,704
Michigan	182	227	210	259	301	1,179
Minnesota	178	215	213	272	281	1,159
New York	457	543	575	700	753	3,028
North Carolina	184	230	248	269	266	1,197
Ohio	236	243	311	361	396	1,547
Pennsylvania	377	441	425	515	552	2,310
Texas	357	403	453	530	604	2,347
Washington	189	216	235	240	270	1,150
Wisconsin	90	128	119	152	180	669
World	**10,513**	**12,137**	**13,250**	**15,727**	**16,348**	**67,975**

34. The UK produces more papers in regenerative medicine than France, Italy and Spain but less than Germany. The UK's growth (just under 50% in the period) is also faster than France, Sweden and Switzerland but less than Germany and the Netherlands (about 60%) and much less

than Spain (more than doubling) and Italy. The UK's output has grown from much less than Japan to a more similar volume, but it has recently been overtaken by China.

35. While the EU produces fewer papers than the USA, the total for Europe including Switzerland is greater. The growth rates across Europe and North America are similar.

36. China has shown huge growth and has come from well behind the UK to an output that is now slightly greater than the UK. To put this in wider research context, China has focussed largely on physical sciences and engineering over the last two decades, building on a research base engaged with a traditional manufacturing economy. This growth in regenerative medicine is part of a more recent phase of investment which appears to focus on research in areas related to health and biotechnology; it seems reasonable to expect the same kind of growth trajectories in these fields as has been seen for China in disciplines related to e.g. materials sciences. South Korea has more than doubled output over five years and produces considerably more regenerative medicine papers than e.g. Netherlands, Sweden and Switzerland. Japan, by contrast, has had weaker growth around 25% of its 2005 total though it remains the second largest producer after the USA. Overall, Asia is the region with much the strongest growth trajectory.

37. The USA has had a similar growth rate to the UK and remains much the largest single producer-country with slightly less than 40% of global output over the five-year period to 2009. That output is led by California and Massachusetts, which collectively account for about one-third of USA output. New York, Pennsylvania and Maryland are also major research concentrations on the East coast. Twelve states exceed one thousand regenerative medicine papers over the five-year period. Wisconsin, a critical centre for innovative research, is a much smaller contributor.

38. Quantity is nothing without quality. Citation impact is a proxy indicator that reflects the extent to which other researchers have referenced and drawn upon prior work. This is analysed in Table 4. Citation counts are adjusted for field and for year of publication to a global benchmark, so world average citation impact is 1.0. Table 4 immediately identifies regenerative medicine as a relatively highly-cited field with a global average of 1.44.

39. The UK has sustained an average citation impact of 1.62 over the period with no evident trend. Larger EU comparators have an average impact around 1.5: France and Italy fluctuate around this point while Germany has a more stable and very slowly but progressively increasing impact. Netherlands, Sweden and Switzerland all have higher average impact than the UK. Canada is on a similar benchmark to the UK.

40. The USA is a very close second in Table 4, just behind Switzerland but with a far greater output (see Table 3). All the USA states with significant research capacity in regenerative medicine also have higher average impact than the UK.

41. Asian nations, including Japan, all have markedly lower impact than the UK. There is no evidence that the relative impact of the Asian research is improving at this time.

Table 4. Citation impact of papers in regenerative medicine by country/region and year

	2005	2006	2007	2008	2009	Average
UK	**1.61**	**1.55**	**1.61**	**1.59**	**1.72**	**1.62**
EU-27	1.39	1.46	1.46	1.43	1.47	1.45
UN Macroregions						
Europe	1.40	1.45	1.45	1.43	1.46	1.44
Africa	0.69	0.91	0.87	0.79	1.01	0.87
Asia	1.21	1.17	1.12	1.22	1.09	1.16
Latin America	0.89	0.86	1.17	0.87	1.09	0.98
Northern America	1.79	1.82	1.76	1.94	1.83	1.84
Oceania	1.47	1.81	1.59	1.63	1.72	1.65
Countries						
Brazil	0.97	0.82	1.35	0.92	0.96	1.00
Canada	1.60	1.67	1.65	1.57	1.65	1.62
China	1.13	1.08	1.01	1.11	1.02	1.06
France	1.32	1.50	1.62	1.42	1.57	1.49
Germany	1.47	1.48	1.50	1.51	1.63	1.53
India	1.00	0.95	0.62	1.23	1.00	0.99
Israel	1.66	1.58	1.44	1.39	1.76	1.56
Italy	1.32	1.58	1.72	1.44	1.57	1.53
Japan	1.21	1.20	1.20	1.34	1.14	1.22
Netherlands	1.60	1.81	1.82	1.88	1.79	1.79
South Korea	1.44	1.28	1.07	1.21	1.21	1.22
Spain	1.12	1.76	1.28	1.53	1.91	1.58
Sweden	1.64	2.12	1.68	1.51	1.67	1.72
Switzerland	2.00	2.02	2.02	1.83	1.81	1.92
USA	1.83	1.85	1.79	1.99	1.88	1.87
US States						
California	2.09	1.99	2.11	2.36	2.42	2.23
Illinois	1.69	1.62	1.57	1.54	1.73	1.63
Maryland	2.26	2.29	2.24	1.90	1.98	2.13
Massachusetts	2.46	2.50	2.64	3.05	2.65	2.69
Michigan	1.99	2.13	2.44	1.92	2.01	2.08
Minnesota	1.55	1.52	1.74	1.55	1.84	1.65
New York	2.16	2.08	1.92	2.11	1.97	2.04
North Carolina	2.02	2.24	1.91	1.70	2.33	2.04
Ohio	1.69	1.81	1.58	1.65	1.76	1.69
Pennsylvania	1.85	1.87	1.82	1.69	1.83	1.81
Texas	2.03	1.90	1.78	1.74	1.81	1.84
Washington	2.00	2.09	1.76	1.69	1.87	1.87
Wisconsin	1.89	2.10	1.93	3.33	2.77	2.50
World	**1.43**	**1.46**	**1.42**	**1.48**	**1.40**	**1.44**

Table 5. Number (a) and percentage (b) of uncited papers in regenerative medicine by country/region and year

(a)	2005	2006	2007	2008	2009	Total
UK	**21**	**27**	**41**	**76**	**220**	**385**
EU-27	122	155	247	475	1,183	2,182
UN Macroregions						
Europe	153	203	281	535	1,284	2,456
Africa	4	5	5	17	30	61
Asia	75	126	204	432	1,238	2,075
Latin America	19	21	18	58	154	270
Northern America	68	116	132	385	1,086	1,787
Oceania	1	13	19	33	87	153
Countries						
Brazil	8	12	9	40	114	183
Canada	2	13	13	38	128	194
China	10	23	38	108	335	514
France	20	24	31	62	149	286
Germany	34	55	73	135	278	575
India	6	3	12	21	74	116
Israel	2	5	9	18	37	71
Italy	15	20	35	70	158	298
Japan	32	60	78	136	367	673
Netherlands	5	14	13	25	81	138
South Korea	7	7	23	44	131	212
Spain	8	2	13	28	79	130
Sweden	8	3	12	21	67	111
Switzerland	2	11	14	20	64	111
USA	66	105	121	357	978	1,627
US States						
California	8	14	17	69	154	262
Illinois	1	7	6	22	48	84
Maryland	3	6	13	18	69	109
Massachusetts	9	10	17	34	87	157
Michigan	4	4	3	16	44	71
Minnesota	2	3	5	26	60	96
New York	4	8	8	34	109	163
North Carolina	5	6	5	10	33	59
Ohio	4	6	10	25	74	119
Pennsylvania	6	7	10	27	82	132
Texas	4	10	10	42	95	161
Washington	4	5	4	15	48	76
Wisconsin	0	1	5	14	30	50
World	**319**	**462**	**626**	**1,370**	**3,520**	**6,297**

(b)	2005	2006	2007	2008	2009	Overall
UK	**2.4%**	**2.7%**	**3.4%**	**5.8%**	**16.7%**	**6.7%**
EU-27	3.1%	3.4%	4.9%	8.1%	19.4%	8.6%
UN Macroregions						
Europe	3.6%	4.2%	5.3%	8.6%	20.0%	9.1%
Africa	7.0%	9.6%	7.6%	18.7%	30.3%	16.7%
Asia	2.9%	4.2%	5.8%	10.1%	26.2%	11.5%
Latin America	9.5%	9.1%	7.1%	15.3%	35.4%	18.0%
Northern America	1.5%	2.2%	2.4%	5.8%	15.8%	6.2%
Oceania	0.3%	4.0%	4.6%	7.3%	15.8%	7.5%
Countries						
Brazil	6.6%	9.2%	5.3%	15.1%	37.4%	18.4%
Canada	0.4%	2.6%	2.3%	5.3%	16.3%	6.3%
China	2.7%	4.2%	4.9%	10.0%	25.2%	12.5%
France	3.7%	4.4%	5.0%	9.2%	20.9%	9.3%
Germany	3.1%	4.5%	5.5%	8.6%	16.9%	8.4%
India	6.8%	3.2%	10.0%	12.4%	32.3%	16.6%
Israel	1.4%	2.6%	4.0%	8.5%	17.3%	7.2%
Italy	2.7%	3.2%	4.6%	7.5%	16.3%	7.7%
Japan	2.5%	4.5%	5.2%	8.3%	23.2%	9.2%
Netherlands	1.5%	3.9%	3.2%	4.9%	15.2%	6.4%
South Korea	2.4%	2.1%	5.7%	9.0%	22.3%	10.1%
Spain	3.9%	0.8%	4.3%	7.1%	16.8%	8.0%
Sweden	3.0%	1.0%	3.8%	6.0%	18.4%	7.0%
Switzerland	0.7%	3.4%	4.4%	5.2%	15.4%	6.5%
USA	1.6%	2.1%	2.3%	5.8%	15.5%	6.1%
US States						
California	1.2%	1.7%	1.8%	6.0%	12.7%	5.5%
Illinois	0.4%	2.5%	2.2%	7.0%	14.9%	5.9%
Maryland	0.8%	1.3%	2.5%	3.7%	12.4%	4.5%
Massachusetts	1.6%	1.5%	2.3%	3.9%	10.3%	4.2%
Michigan	2.2%	1.8%	1.4%	6.2%	14.6%	6.0%
Minnesota	1.1%	1.4%	2.3%	9.6%	21.4%	8.3%
New York	0.9%	1.5%	1.4%	4.9%	14.5%	5.4%
North Carolina	2.7%	2.6%	2.0%	3.7%	12.4%	4.9%
Ohio	1.7%	2.5%	3.2%	6.9%	18.7%	7.7%
Pennsylvania	1.6%	1.6%	2.4%	5.2%	14.9%	5.7%
Texas	1.1%	2.5%	2.2%	7.9%	15.7%	6.9%
Washington	2.1%	2.3%	1.7%	6.3%	17.8%	6.6%
Wisconsin	0.0%	0.8%	4.2%	9.2%	16.7%	7.5%
World	**3.0%**	**3.8%**	**4.7%**	**8.7%**	**21.5%**	**8.4%**

42. Table 5a shows the number of uncited regenerative medicine papers and Table 5b expresses this as a percentage of the count of papers in Table 3. Some of these papers may subsequently be cited.

43. The overall analysis shows that there is a very high relative level of citedness in this field. In general, about 5-10% of UK papers across all research disciplines remain uncited after about ten years whereas for regenerative medicine the level is below 5% by year 3 for the UK papers. The fact that around 80% of papers are cited at least once in their first year after publication is also indicative of an extremely active field where a high proportion of research publications appear to be of immediate relevance to continuing work.

44. China's papers are as quickly cited as those of the established research economies, indicating that its work is also achieving rapid recognition even if not yet being cited on average as frequently. India, however, has somewhat higher uncitedness rate.

45. The achievement of Wisconsin in having 0% uncited papers for 2005 is remarkable.

46. The threshold for highly-cited papers that has been applied in this report is that of the world's top 10% by citation impact normalised for year of publication and journal category, i.e. the top decile.

47. Table 6a shows the number of highly cited regenerative medicine papers and Table 6b expresses this as a percentage of the count of papers in Table 3. The citation category of individual papers may change from year to year.

48. Note that the 'highly cited' marker here compares impact for these papers – identified using a specific MeSH term - against other papers in the same journal category, not against a world baseline for regenerative medicine. Thus the UK indicators tell us that the UK's papers that refer to regenerative medicine are much more frequently highly cited than other papers referring to related but distinct research topics covered by the same set of journals.

49. It is clear that the same pattern is true for much of Europe and North America. The reference is the global 10%, and these scores are generally well above that threshold. The consistency of the pattern across countries indicates that it is not the performance of any particular region that is exceptional but the field itself. This indicator therefore identifies this field as exceptional at this time.

50. Analysis of relative national performance *in regenerative medicine* relies on comparisons *within the table* rather than against global background.

Table 6. Number (a) and percentage (b) of highly cited papers in regenerative medicine by country/region and year

(a)	2005	2006	2007	2008	2009	Total
UK	**193**	**224**	**268**	**288**	**251**	**1,224**
EU-27	722	905	1,012	1,087	1,005	4,731
UN Macroregions						
Europe	771	948	1,058	1,146	1,050	4,973
Africa	3	5	7	5	9	29
Asia	408	412	463	574	522	2,379
Latin America	15	20	33	35	42	145
Northern America	1,143	1,381	1,403	1,676	1,441	7,044
Oceania	63	75	82	102	103	425
Countries						
Brazil	8	10	24	23	26	91
Canada	113	118	141	145	135	652
China	58	75	90	140	125	488
France	100	111	142	129	134	616
Germany	214	259	278	290	311	1,352
India	9	7	5	21	27	69
Israel	35	45	35	43	37	195
Italy	87	134	184	159	150	714
Japan	195	169	212	220	195	991
Netherlands	71	84	105	134	121	515
South Korea	67	58	51	66	70	312
Spain	27	66	44	81	91	309
Sweden	58	79	69	78	78	362
Switzerland	84	94	91	96	83	448
USA	1,062	1,304	1,309	1,585	1,369	6,629
US States						
California	206	239	280	345	329	1,399
Illinois	63	75	59	72	64	333
Maryland	110	156	161	131	121	679
Massachusetts	185	241	264	325	250	1,265
Michigan	52	67	65	69	74	327
Minnesota	46	51	48	69	65	279
New York	145	155	166	209	179	854
North Carolina	44	66	70	62	77	319
Ohio	53	53	69	77	85	337
Pennsylvania	95	112	109	139	124	579
Texas	97	101	119	140	138	595
Washington	54	58	63	68	64	307
Wisconsin	24	37	33	44	41	179
World	**1,074**	**1,331**	**1,421**	**1,656**	**1,491**	**6,973**

(b)	2005	2006	2007	2008	2009	Overall
UK	**21.7%**	**22.0%**	**22.3%**	**22.1%**	**19.1%**	**21.4%**
EU-27	18.1%	20.0%	20.2%	18.5%	16.5%	18.6%
UN Macroregions						
Europe	18.2%	19.7%	20.0%	18.4%	16.4%	18.4%
Africa	5.3%	9.6%	10.6%	5.5%	9.1%	7.9%
Asia	16.0%	13.9%	13.1%	13.4%	11.1%	13.2%
Latin America	7.5%	8.7%	13.1%	9.2%	9.7%	9.7%
Northern America	25.1%	26.0%	25.0%	25.2%	21.0%	24.3%
Oceania	21.6%	22.9%	19.7%	22.6%	18.7%	20.8%
Countries						
Brazil	6.6%	7.7%	14.1%	8.7%	8.5%	9.2%
Canada	23.3%	23.4%	25.1%	20.1%	17.2%	21.3%
China	15.5%	13.6%	11.5%	13.0%	9.4%	11.9%
France	18.5%	20.5%	23.1%	19.2%	18.8%	20.0%
Germany	19.8%	21.0%	20.9%	18.5%	18.9%	19.7%
India	10.2%	7.5%	4.2%	12.4%	11.8%	9.9%
Israel	24.5%	23.3%	15.7%	20.2%	17.3%	19.8%
Italy	15.4%	21.1%	24.3%	17.1%	15.4%	18.5%
Japan	15.5%	12.6%	14.1%	13.5%	12.3%	13.5%
Netherlands	21.1%	23.4%	26.1%	26.3%	22.7%	24.0%
South Korea	23.3%	17.3%	12.6%	13.5%	11.9%	14.8%
Spain	13.0%	25.0%	14.7%	20.6%	19.4%	18.9%
Sweden	22.1%	27.1%	21.6%	22.2%	21.4%	22.8%
Switzerland	30.0%	29.1%	28.7%	25.1%	20.0%	26.1%
USA	25.4%	26.4%	25.2%	25.8%	21.7%	24.8%
US States						
California	30.6%	29.1%	29.9%	29.8%	27.2%	29.2%
Illinois	28.3%	26.3%	21.6%	22.9%	19.9%	23.5%
Maryland	29.6%	32.6%	31.4%	27.2%	21.8%	28.3%
Massachusetts	33.4%	35.3%	35.6%	36.8%	29.7%	34.2%
Michigan	28.6%	29.5%	31.0%	26.6%	24.6%	27.7%
Minnesota	25.8%	23.7%	22.5%	25.4%	23.1%	24.1%
New York	31.7%	28.5%	28.9%	29.9%	23.8%	28.2%
North Carolina	23.9%	28.7%	28.2%	23.0%	28.9%	26.6%
Ohio	22.5%	21.8%	22.2%	21.3%	21.5%	21.8%
Pennsylvania	25.2%	25.4%	25.6%	27.0%	22.5%	25.1%
Texas	27.2%	25.1%	26.3%	26.4%	22.8%	25.4%
Washington	28.6%	26.9%	26.8%	28.3%	23.7%	26.7%
Wisconsin	26.7%	28.9%	27.7%	28.9%	22.8%	26.8%
World	**10.2%**	**11.0%**	**10.7%**	**10.5%**	**9.1%**	**10.3%**

51. In summary, the main characteristics arising from the Tables above regarding the regenerative medicine literature are that:

    a. Table 3 shows that there has rapid increase in volume over the last five years, and that this has been faster in Asia than in North America and Europe. UK growth is in line with global change.

    b. Table 4 records a relatively high average citation impact for papers from most countries, which is indicative of a highly active and competitive area. UK citation impact is higher than for the UK science base generally.

    c. Table 5 confirms that impression and records an unusually rapid pattern of citation for new publications and a generally low level of uncitedness. The UK data are similar to global averages and the UK has a lower percentage of uncited papers than is typical for the science base.

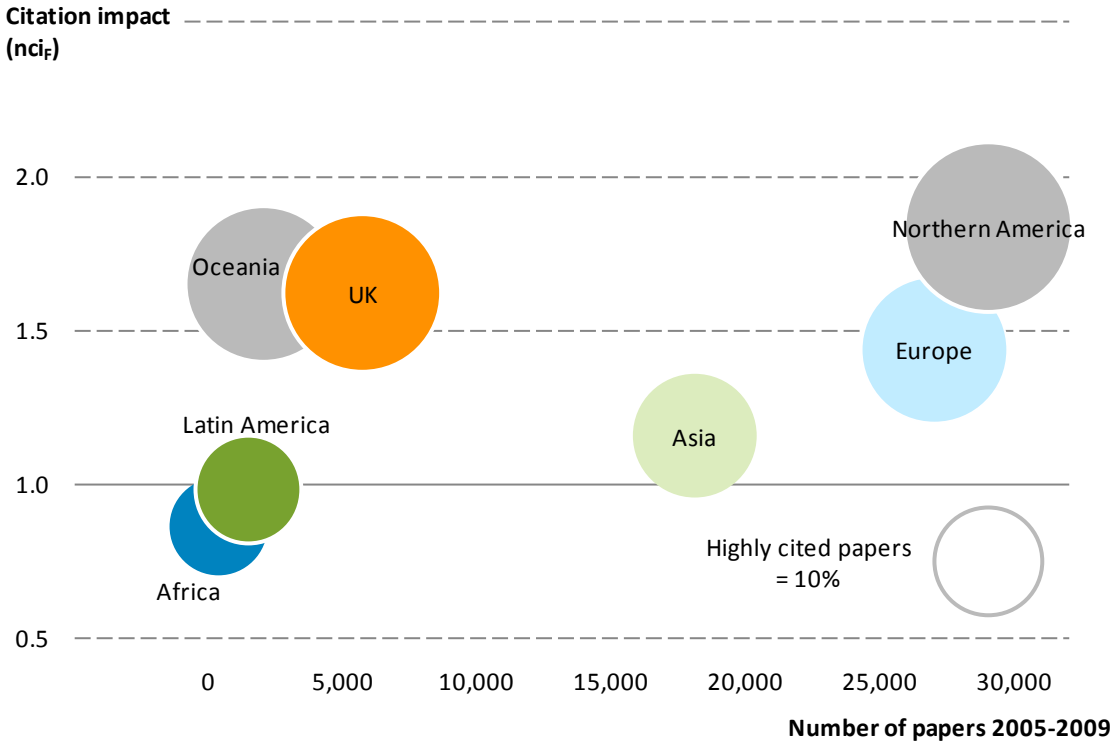
    d. Table 6 suggest that there is a generally high relative volume of highly cited papers, which for most countries is well above what would be expected and is a reflection of the high average citation impact and the low frequency of uncited papers. The UK is among the countries with the greatest proportion of highly cited papers.

52. The main Tables therefore present a consistent picture of a very dynamic and globally competitive field in which the UK is performing consistently well. However, the competitiveness of the field is also an important feature and sustaining national competitiveness is likely to be challenging in such a dynamic field, especially where Asian countries are making in-roads and likely only to continue to invest and to improve in quality.

53. Linking the various indicators across so many countries is difficult, and this is best done through graphics rather than further data manipulation.

54. The indicators in the preceding Tables are brought together and summarised in the next series of Figures. These are 'bubble diagrams' which incorporate three variables for each country or region: the location of the bubble along the horizontal axis; the location of the bubble along the vertical axis; and the relative size of the bubble. This enables very rapid performance comparisons between countries.

Figure 1. Output of research papers compared with average normalised citation impact for the UK and for major world regions. The bubble size is scaled to the percentage of each region's papers that are relatively highly-cited (cited more than four times world average) and a non-shaded reference bubble of 10% is shown in the lower-right of the graph.



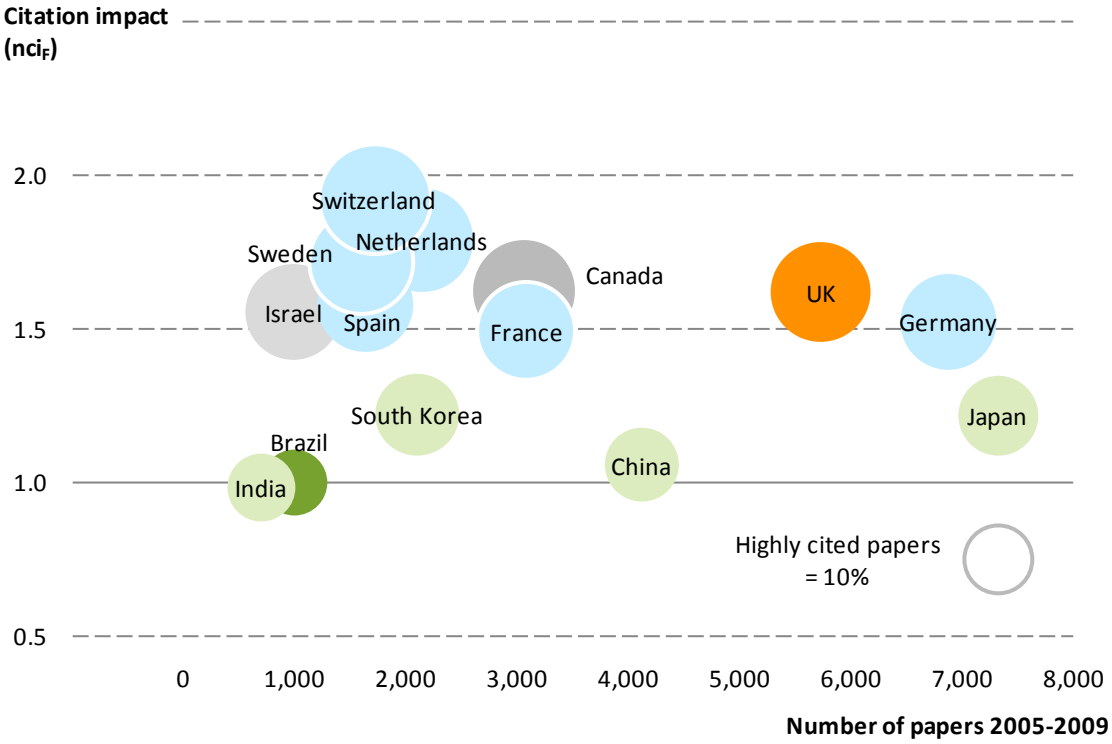
55. The regional colour coding is preserved through subsequent figures: orange to highlight the UK, pale blue for other European countries, pale green for Asian countries, dark green for Brazil and grey for North American countries.

56. North America evidently has a strong global position on regenerative medicine research in terms of volume and average citation impact, which are both better than for Europe. The relative position of Asia is also made clear in this summary, while Latin America and Africa can be seen still only to be around world average impact. However, the excellent position of Oceania is brought out here: this small but high impact outcome is likely to be due to Australian research which has not been included at country level.

57. The UK performs well in a highly competitive global context. Its volume output in regenerative medicine is substantial and it therefore contributes relatively high impact papers to the overall European outcome, which is similar in volume to North America but on average not as highly cited.

58. Asia has a rapidly growing volume but, as noted, on average somewhat lags other regions on impact and the impact trend (Table 4) does not suggest a rapidly improving trajectory. However, more detailed analyses later in this report show that individual Asian countries perform well above this regional benchmark in particular areas, such as tissue engineering, within the broader regenerative medicine field.

Figure 2. Output of research papers compared with average normalised citation impact for the UK and for other research-active countries. Bubble size is scaled to the percentage of each country's papers that are relatively highly-cited (cited more than four times world average) and a non-shaded reference bubble of 10% is shown in the lower-right of the graph.

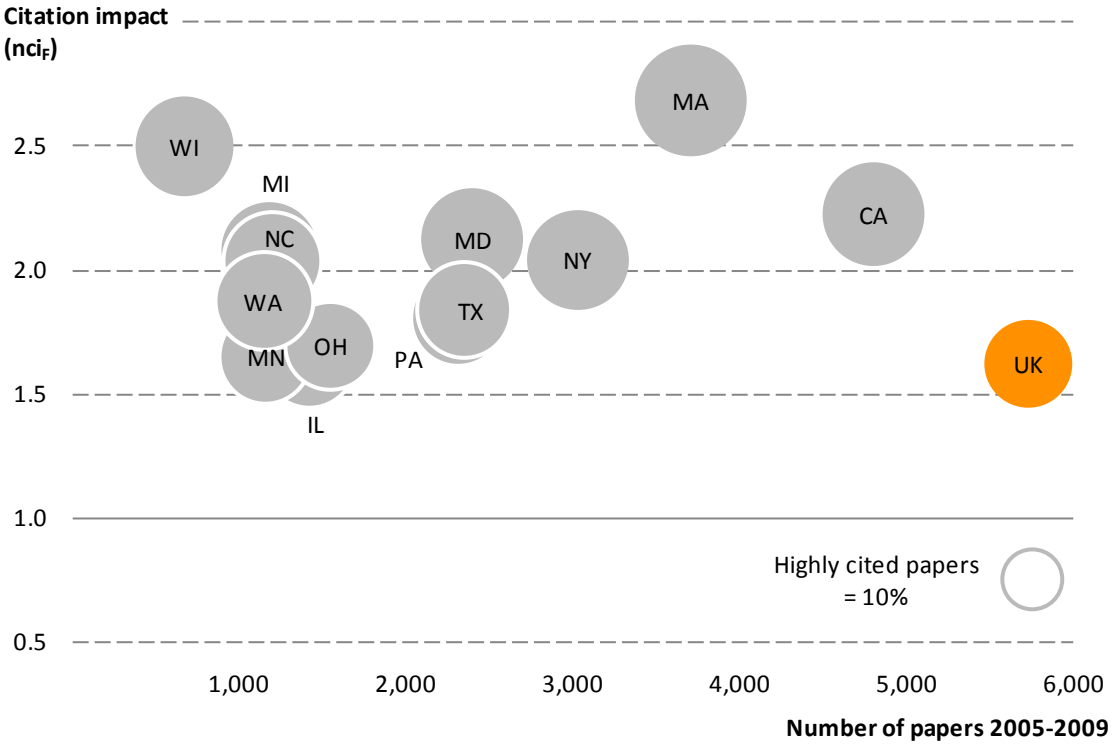


59. The UK is a major country in regenerative medicine, exceeded in volume only by the USA, Germany and Japan. The annual trends indicate that China will overtake the UK in the very near future, but no other country is currently likely to do this.

60. The UK has greater impact than Germany and Japan but some smaller European countries – Netherlands, Sweden and Switzerland - have greater citation impact.

61. Asian nations have lower average citation impact across the full data-set but they have better niche performance in particular areas discussed below.

Figure 3. Output of research papers compared with average normalised citation impact for the UK and for selected USA states. Bubble size is scaled to the percentage of each state's papers that are relatively highly-cited (cited more than four times world average) and a non-shaded reference bubble of 10% is shown in the lower-right of the graph.



62. If the UK were a USA state then its regenerative medicine research would stand out on volume but not on citation impact. It produces more papers than California but its average impact is no better than most of the smaller states in the analysis (USA states not included were smaller and had lower impact).

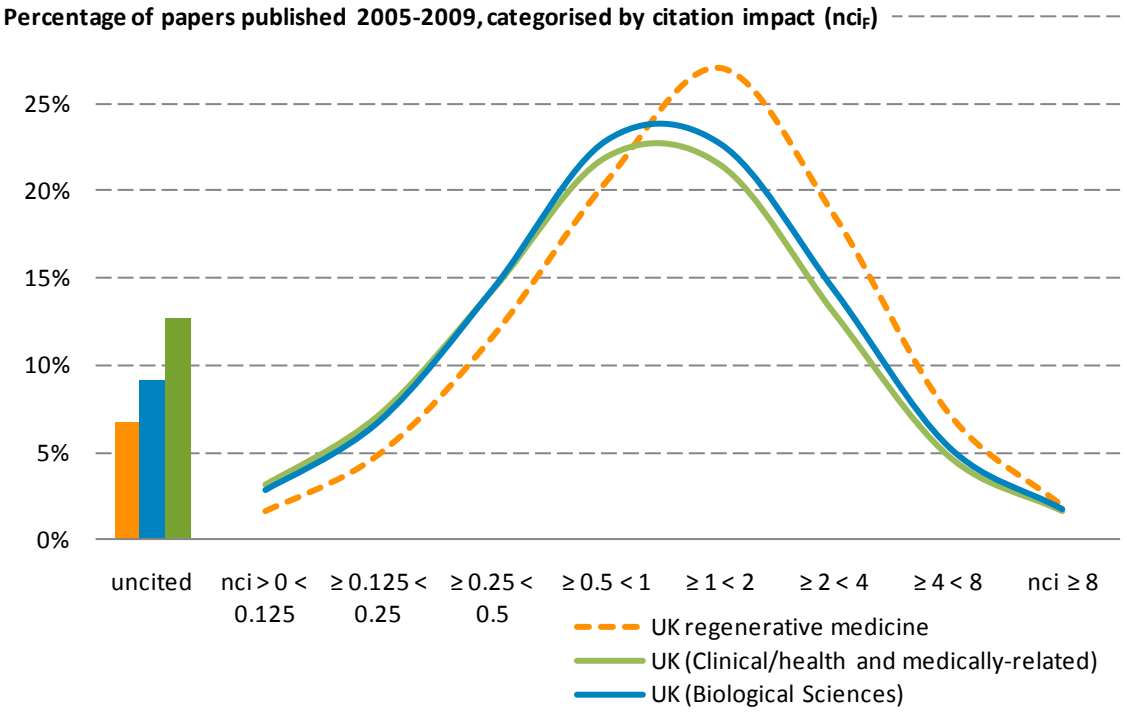
63. The relative citation impact of USA research is arguably affected by the large internal volume, which may be self-referential drawing more on domestic activity in a rapidly growing field where appreciation of overseas research takes time to catch-up. However, the exceptional performance of research outputs from Massachusetts and, particularly, from Wisconsin are strong indicators of very high quality and widely-regarded activity.

Impact Profiles®

64. The previous analyses have reported citation impact in terms of both averages relative to world baselines and in terms of the proportions of papers that exceed a threshold above that baseline. The average and the proportion highly-cited are evidently related, but these two statistics do not provide a complete reflection of the spread of excellent, weak and good activity. A key factor in any research performance analysis is that the underlying distribution is skewed, with many low-value data points and a few very high-value points. The average is always much greater than the median of the distribution, so most individual data points fall below the average.

65. To overcome the misperception that reported averages might cause, we also present the data as a distribution using data categorised relative to the world average. This is an Impact Profile®.

Figure 4. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with UK background distributions for biological sciences and for clinical and health. Each curve shows the percentage of papers in each of eight categories of citation impact relative to world average.

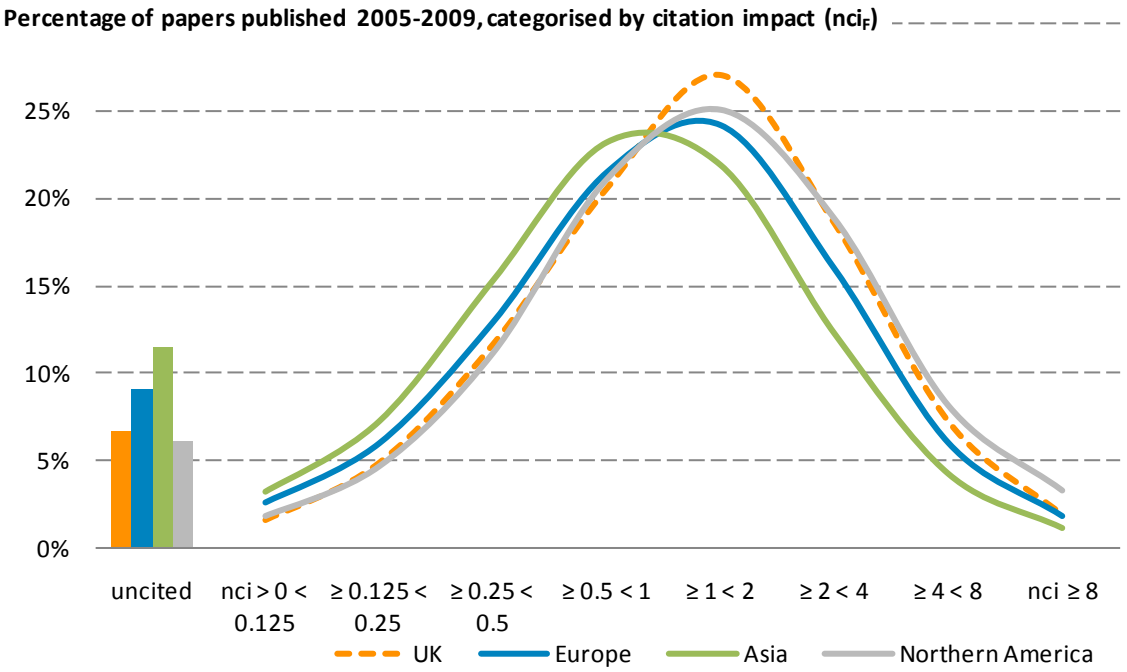


66. Figure 4 compares UK outputs in regenerative medicine with UK output in research associated with clinical and health sciences generally and with the UK background in biological sciences. It will be seen that the two UK background curves follow similar trajectories. The peak, or mode, of the cited papers is around or just below world average (1.0) so that although the UK's average normalised citation impact is around 1.5 in these fields there are in fact more than half of the UK's papers that are below world average.

67. The curve for regenerative medicine differs from these background curves. First, there are relatively fewer uncited papers. Second, the curve is below the two background comparators in categories below world average (to the left) so there are relatively fewer papers that fail to reach the global benchmark. Third, the peak (the modal group) of the curve is shifted rightwards, to a higher citation impact level (1-2 times world average). Finally, the regenerative medicine curve rises above the background to the right: there are relatively more papers in the categories above world average. It is a consequence of this relative excess of papers in these

categories that previous analyses show that much more than 10% of regenerative medicine papers are among the global top 10% (see Figure 1). There is no direct equivalence between a profiled categorisation and a percentile analysis, typically less than 10% of UK output lies above the '4 times' threshold, but both indicators suggest that regenerative medicine is well cited even among biomedical research . Research in the regenerative medicine area evidently runs ahead of the UK and therefore well ahead of global averages in these high impact categories, so pushing to a striking balance of impact.

Figure 5. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with background distributions for regenerative medicine papers authored by researchers in Europe, North America and Asia. Each curve shows the percentage of papers in each of eight categories of citation impact relative to world average.

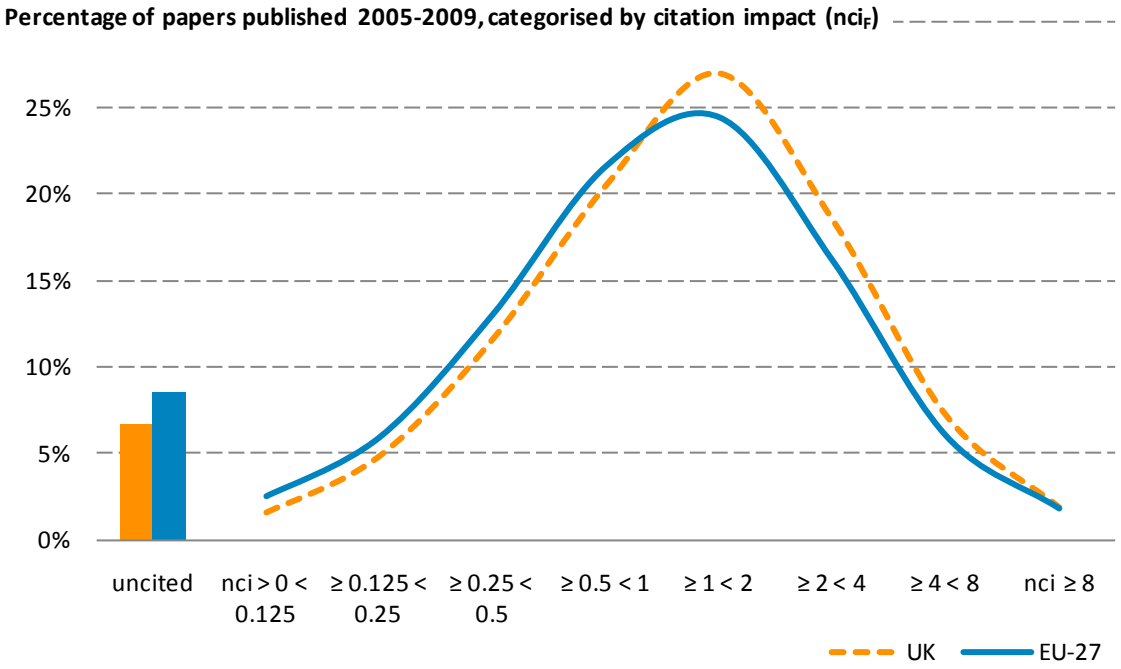


68. The curve for the UK is right-shifted compared to Europe and Asia, showing that it produces relatively more papers cited above world average.

69. The UK generally follows the North America curve in terms of uncitedness and in categories up to four times world average. The key differences explain why the UK average overall is less than for North America: It has relatively fewer papers in the most highly-cited categories above four times world average and this is balanced by a greater percentage of papers in those categories just above world average. In other words, whereas its impact is better than that of most of the world, it is not producing as great a percentage of papers at the very highest impact level compared to North America.

70. Figure 6 confirms that the UK has relatively fewer uncited papers; fewer papers with impact below world average and a higher percentage of papers with impact above world average than does the rest of the EU. The UK is a major contributor to EU strength in regenerative medicine.

Figure 6. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with the background distribution for regenerative medicine papers authored by researchers across the EU27 group of countries.



71. The UK performs better across the impact distribution than individual major EU economies (Figure 7). It has relatively fewer uncited papers, fewer paper with impact below world average and generally has a higher percentage of papers with impact above world average. The sole exception to this is that Spain, which has a lower volume than the UK, has a slightly greater percentage of papers in the very highest categories. This is insufficient, however, to shift its overall performance.

Figure 7. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with background distributions for regenerative medicine papers authored by researchers in larger European research economies.

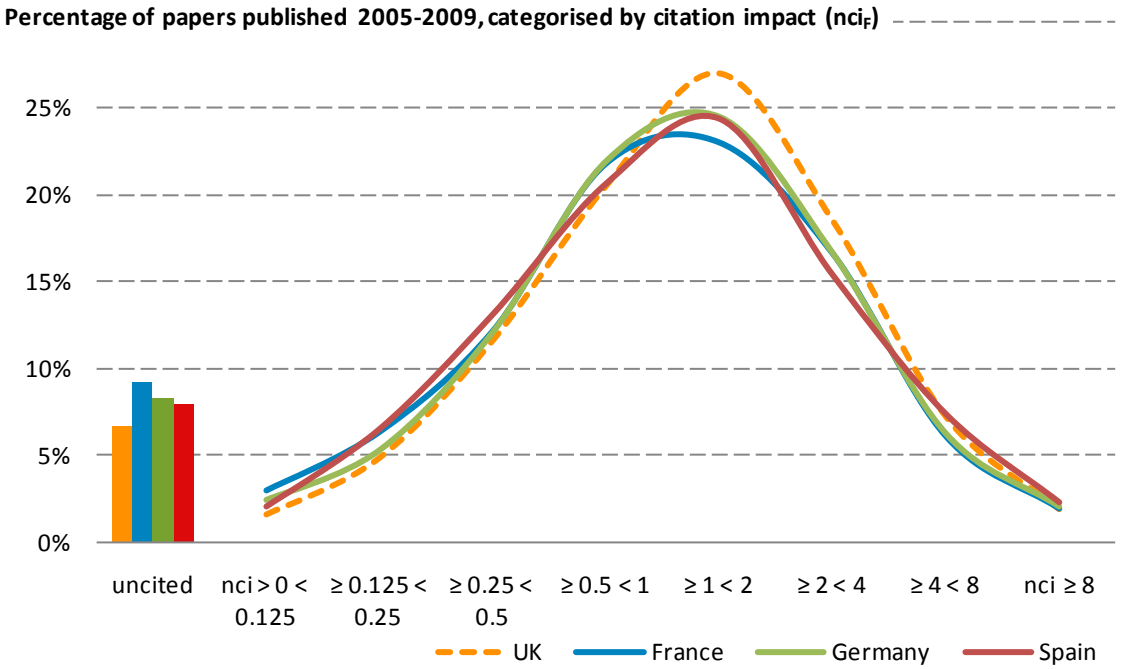
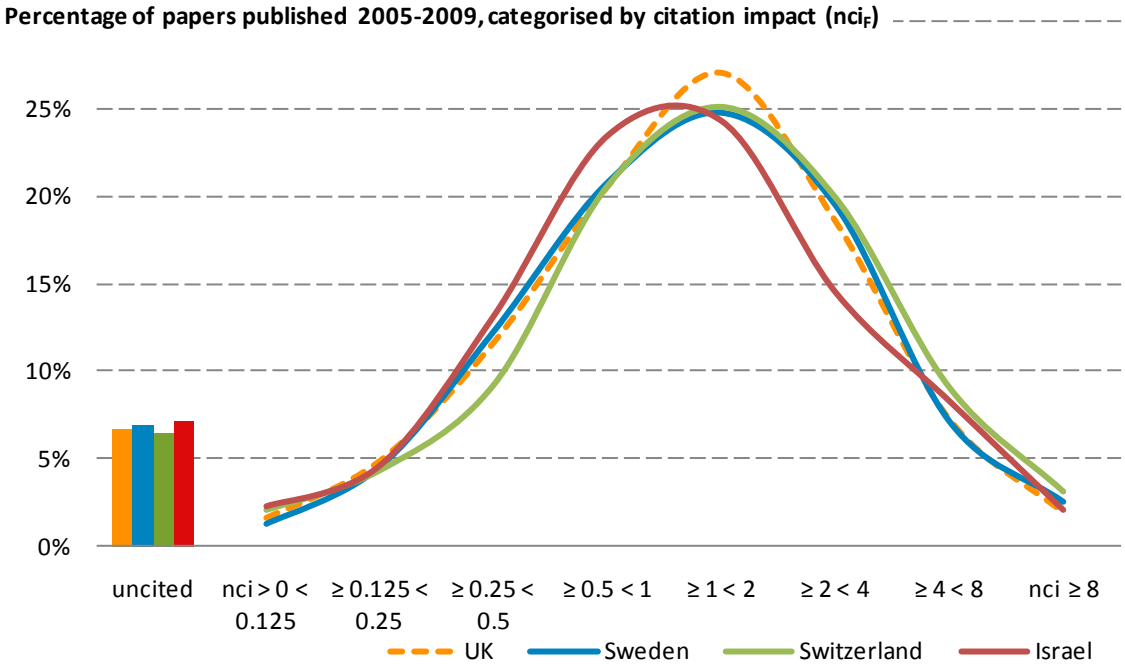


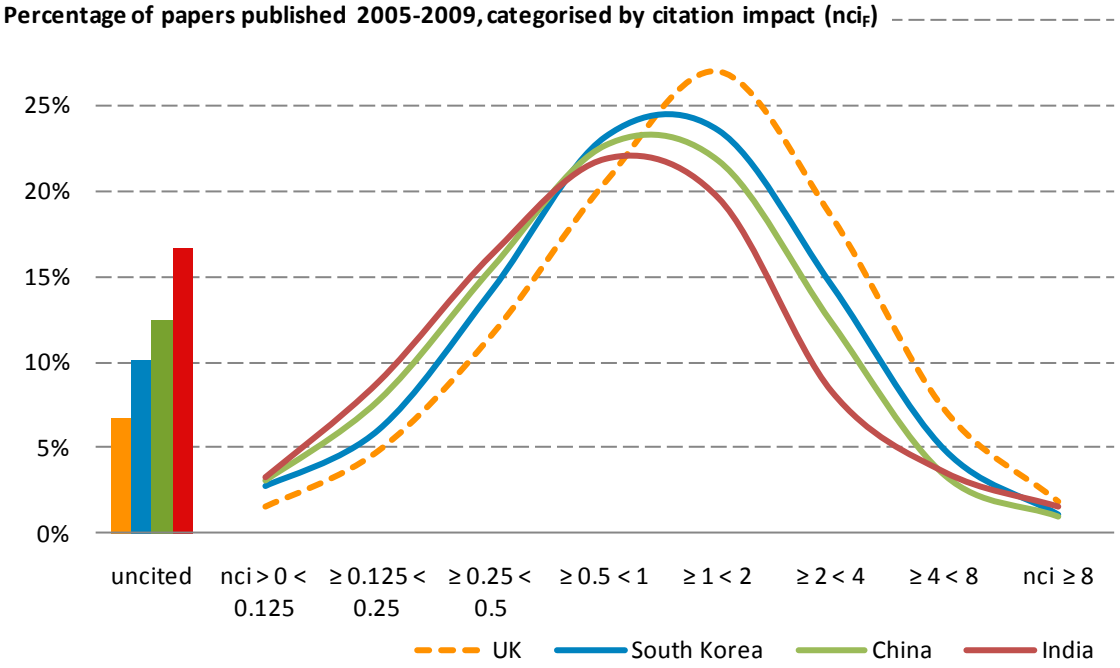
Figure 8. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with background distributions for regenerative medicine papers authored by researchers in three smaller but high-performing research economies. Each curve shows the percentage of papers in each of eight categories of citation impact relative to world average.



72. While the UK performs better than other large research economies in Europe, it is not so clearly distinguished from some smaller economies. In fact, Sweden's Impact profile follows an extremely similar pattern but has slightly greater variance so it is flatter than the UK with

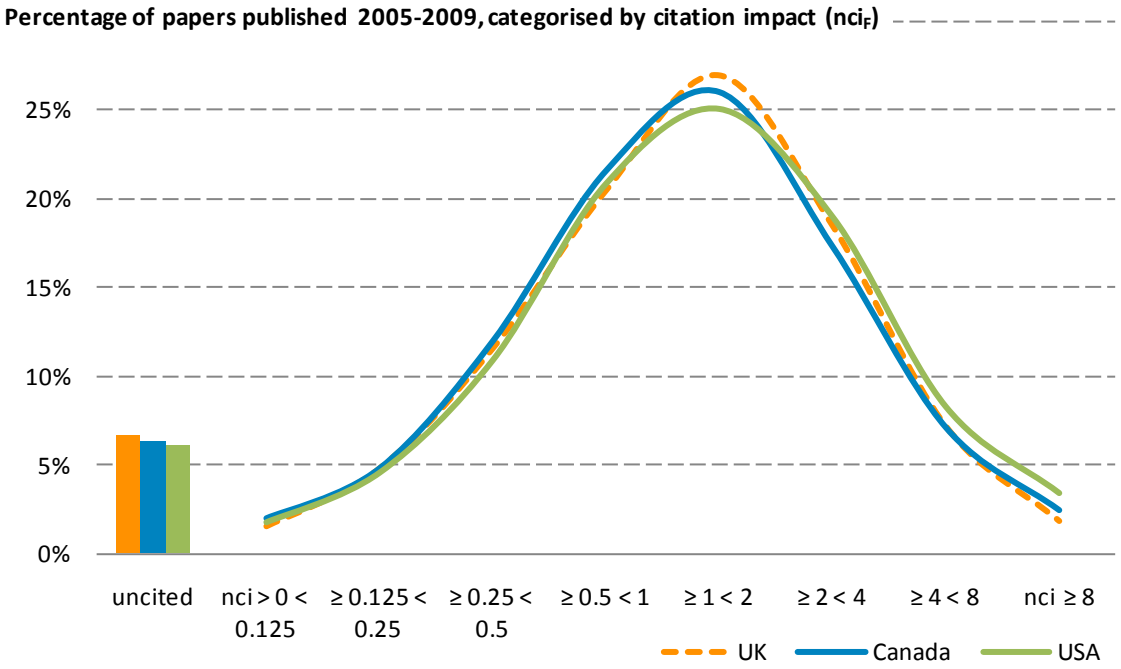
relatively more above and below than around world average. The Swiss Impact Profile® is right-shifted with relatively fewer papers below world average but more in the categories above. Israel is left shifted overall, but produces relatively more paper sin the very highest impact categories.

Figure 9. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with background distributions for regenerative medicine papers authored by researchers in three leading research economies in Asia. Each curve shows the percentage of papers in each of eight categories of citation impact relative to world average.



73. The UK's performance relative to Asian nations is clearly consistent across all impact categories. It is also of interest to note that the Asian nations themselves show a consistent pattern, with a progressive rightward shift in improving performance from India to China to South Korea.

Figure 10. Impact Profile® analysing the distribution by citation impact of regenerative medicine papers published by the UK compared with background distributions for regenerative medicine papers authored by researchers in Canada and the USA. Each curve shows the percentage of papers in each of eight categories of citation impact relative to world average.



74. The UK is slightly better in performance across all impact categories than Canada, except in having relatively more uncited and relatively fewer very highly-cited papers, though the margins are small. However, the USA performance is consistently right shifted across all categories compared to these two.

75. In summary, the main conclusions arising from the Impact Profiles® above regarding the regenerative medicine literature are that:

    a. The UK's citation impact in regenerative medicine is higher than in cognate background areas of the research base. Regenerative medicine papers are more frequently cited and there are relatively more highly cited papers.

    b. The UK Impact Profile® is better than that of Europe or the EU27 generally and of other large research economies such as France and Germany. Some smaller European research economies have profiles that tend marginally to better the UK's in the most highly cited categories.

    c. The UK profile is similar in many respects to that of Northern America, except in the most highly cited category (>8 times world average). Its profile is similar to and marginally better than Canada's. Compared to the USA, the UK has a greater percentage of papers cited just above and a smaller percentage cited well above world average.

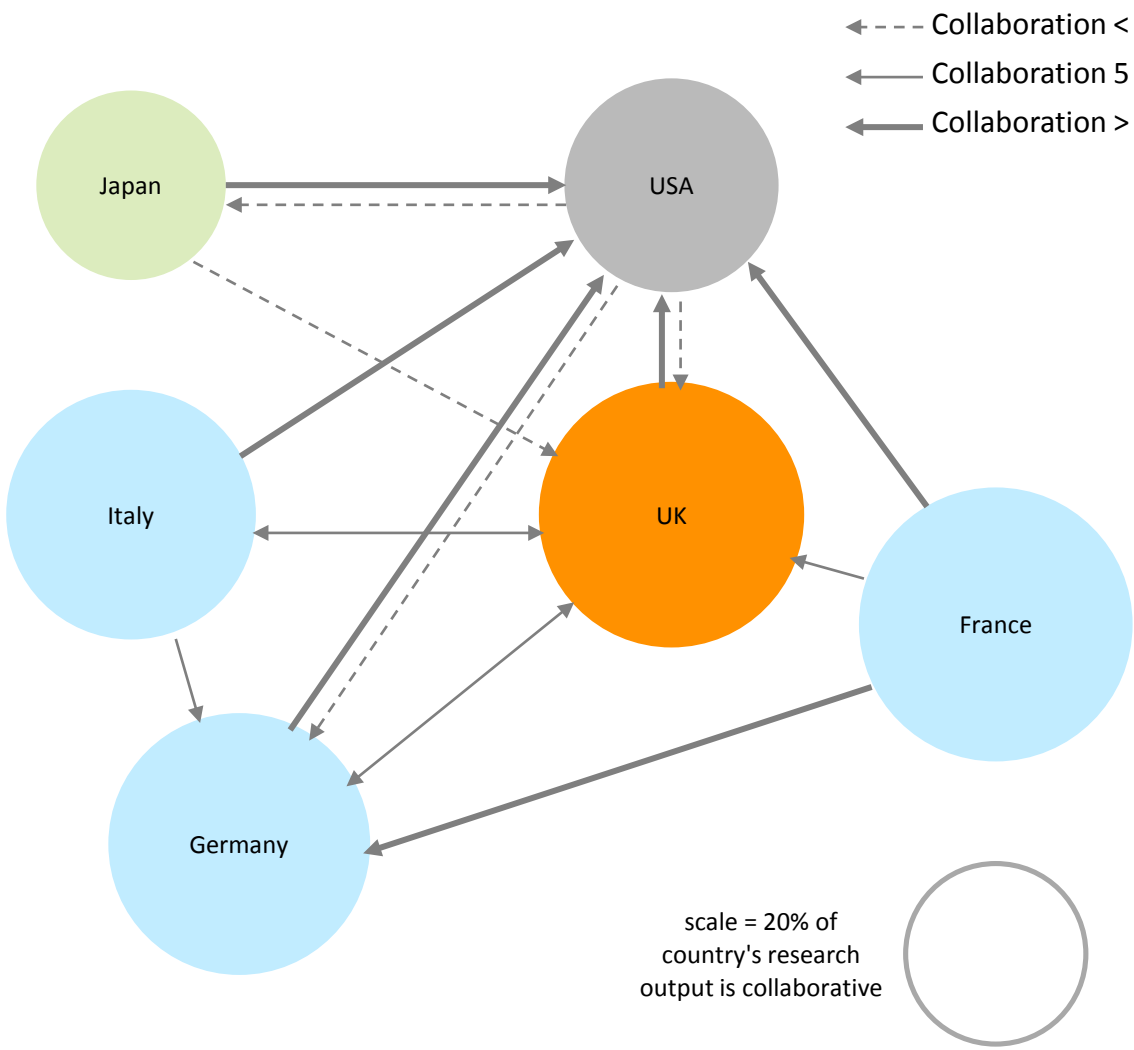
    d. The UK remains well ahead of emerging Asian competitors.

Collaboration

Table 7. Collaboration analysis by country. The table is symmetrical, but the orange highlighting should be read down the columns as indicating the three most frequent partners for that country. Across the rows, the highlight indicates where that country is a frequent partner in that column. Summed column values will add to more than the total collaborative papers for that country because of multi-authorship.

Country Collaborating ↓ / Publishing →	UK	Brazil	Canada	China	France	Germany	India	Israel	Italy	Japan	Netherlands	South Korea	Spain	Sweden	Switzerland	USA
UK		25	159	89	278	484	17	52	308	150	225	27	161	181	171	896
Brazil	25		29	3	36	37	1	3	44	8	6	5	11	29	5	155
Canada	159	29		75	110	157	8	25	59	97	43	61	40	39	56	816
China	89	3	75		55	74	3	3	26	133	43	44	12	22	28	701
France	278	36	110	55		316	9	44	222	71	118	10	142	93	166	485
Germany	484	37	157	74	316		13	95	291	127	241	29	153	160	412	1,165
India	17	1	8	3	9	13		4	5	20	1	10	4	8	2	80
Israel	52	3	25	3	44	95	4		67	12	30	3	34	17	24	229
Italy	308	44	59	26	222	291	5	67		54	113	11	131	120	165	668
Japan	150	8	97	133	71	127	20	12	54		50	103	31	62	40	965
Netherlands	225	6	43	43	118	241	1	30	113	50		4	55	67	100	383
South Korea	27	5	61	44	10	29	10	3	11	103	4		6	13	4	348
Spain	161	11	40	12	142	153	4	34	131	31	55	6		63	54	296
Sweden	181	29	39	22	93	160	8	17	120	62	67	13	63		66	282
Switzerland	171	5	56	28	166	412	2	24	165	40	100	4	54	66		340
USA	896	155	816	701	485	1,165	80	229	668	965	383	348	296	282	340	
Total collaborative	2,482	289	1,399	1,211	1,420	2,896	167	404	1,479	1,619	1,031	556	713	862	1,107	7,531
% collaborative research	43.4%	29.1%	45.8%	29.4%	46.1%	42.2%	23.9%	41.0%	38.3%	22.1%	48.1%	26.4%	43.6%	54.2%	64.4%	28.2%
Total output	5,725	992	3,057	4,117	3,082	6,865	699	986	3,860	7,315	2,142	2,104	1,634	1,591	1,718	26,744

Figure 11. Schematic showing selected collaborations between countries in Regenerative Medicine research



Each country disk is scaled to the percentage of that country's papers that have at least one international co-author; the reference disk is scaled to 20% collaboration. Arrows show the level (percentage) of bilateral collaboration between one country and the country to which the arrow points. Because domestic volumes vary, the same absolute volume of collaboration represents different percentages for each country in a pair. Only the top three partners for each country are shown.

76. In this collaboration analysis, a paper is assigned to a country if one or more author addresses include that country. A paper co-authored by two UK universities and one German laboratory would be assigned once to the UK and once to Germany. There is no fractional counting.
77. The USA, UK and Germany are all large research economies, active in this area, so they present a substantial capacity and target for collaboration.
    a. The USA is a top-three partner for all other countries.
    b. The UK is a top-three partner for all except Brazil, Israel and South Korea.
    c. Germany is a top-three partner for 11 out of 15 possible partners, but the four not favouring Germany are all in Asia (China, India, Japan and S Korea).
78. The UK has similar levels of relative collaboration to its major European partners.
79. Note that although the USA appears to be highly collaborative this is driven in part by its sheer volume. It is simply a partner of choice for all other countries. However, only 28% of its output in regenerative medicine has an international co-author so in fact most of its papers are entirely domestic. It is assumed that this is probably because of the opportunities of intra-national collaboration between research groups across States.
80. Given the relative capacity of different countries, the Germany-Switzerland link is notably intense given the size of Switzerland. Switzerland is highly collaborative in regenerative medicine, a pattern seen for this country in other subject studies, with almost two-thirds of its papers carrying an international co-author.
81. The general pattern for European research economies is around 40-50% international co-authorship, whereas the Asian countries and Brazil are much less collaborative so far. Canada is about as collaborative as Europe but the USA less so – as noted.

Analysis by MeSH term

82. The full data-set was also disaggregated by the MeSH terms indicated earlier (and see also Annex 1). It will be recalled that although the entire analysis is focused broadly on 'regenerative medicine' there is also a specific sub-set of data in which this occurs as an identifiable MeSH term. The disaggregated categories are:

    a. Stem Cells;

    b. Tumour Stem Cells;

    c. Stem Cell Transplantation;

    d. Tissue Engineering;

    e. Regenerative Medicine.

83. Detailed data tables for each of these main terms, presented as for the overall dataset, are in Annexes 3 to 7. Here, in the body of the report, these are presented as summary graphics.

84. There is likely to be an appreciable variation between regions and countries in the balance of specific activity within the general 'regenerative medicine' portfolio. This will be because of differences in policy emphasis or subject specialisms, and some of these differences will reflect significant information about the competencies and about the choices made by each country.

85. The data are summarised in the bubble charts below so as to indicate not only the capacity and the citation impact of each country but also the percentage of the total portfolio that is assigned to each specialism.

86. The Impact Profiles® compare the UK with the major research economies of the USA, Japan and Germany. Other countries are covered in the data, however, and can be studied in the tables in the relevant Annex.

Table 8. The numbers of papers associated with each MeSH term for the UK and major comparators

Country	Stem Cells	Tumour Stem Cells	Stem Cell Transplantation	Tissue Engineering	Regenerative Medicine
(a) as count of papers					
UK	2842	145	1016	926	366
Germany	3279	145	1610	811	221
Japan	3840	110	1277	998	520
USA	14220	744	5253	3406	1202
(b) as % national total					
UK	53.7	2.7	19.2	17.5	6.9
Germany	54.1	2.4	26.5	13.4	3.6
Japan	56.9	1.6	18.9	14.8	7.7
USA	57.3	3	21.2	13.7	4.8

87. There are no very major differences for the overall regenerative medicine portfolio among these major research economies. Papers with the Stem Cells tag make up more than half the total activity for each while Tumour Stem Cells and specific Regenerative Medicine make up a much smaller share.

88. The UK has a greater share of its activity in Regenerative Medicine and less in Stem Cell Transplantation than does Germany, while overall the UK also has a relatively greater portfolio share for Tissue Engineering than the other countries. The significance of this needs interpretation and may be simply the consequence of particular initiatives in different countries.

89. Across categories, the UK has large volume relative to other countries in all areas but often had better growth early in the period than most recently. Its citation impact is usually good relative to other countries, and very good relative to the science base generally, but it is not exceptional. This is partly a consequence of diversity and its performance relative to the closest comparator, Germany, is very similar except in Tissue Engineering where it is much better.

Overview across MeSH terms

90. Stem Cells is the largest category (Table 8). The UK performance relative to other countries is good, with average impact around 1.8 where no country exceeds 2.4. Japan has a substantial output but lower impact. China's output now exceeds the UK but its average impact is not greatly above world average. (Figure 11)

91. Average UK citation impact (1.85) is similar to Germany, although output is smaller, but the UK has relatively fewer uncited and low-cited papers while doing better than Germany in the impact category just above world average. The UK's performance is very similar to the USA except at the high end (> 8 times world) and USA average citation impact is 2.2 times world. (Figure 12)

92. Tumour Stem Cells is the smallest category but is particularly diverse in performance. There has been rapid output growth with a five-fold greater global volume in 2009 than 2005 (but only a doubling for the UK). The disparity in performance between countries is greatest in this area and this is also where average impact is exceptionally high for smaller European research economies (fewer than 50 papers over five years) such as Netherlands (3.5 times world average) and Switzerland (more than 4.5 but only five papers per year on average). The UK also has its highest average impact (2.51) in this area, as does Germany and also China for which this is area is a relatively high volume and hence share of domestic output in regenerative medicine. (Figure 13)

93. The Impact Profile® shows that, despite its relatively good average impact in Tumour Stem Cells, the UK has relatively fewer higher impact (> 4 times world) papers than Germany and many fewer than the USA. However, the profiles are somewhat atypical, perhaps because of the lower numbers of papers in this category. The pattern may settle as this area evolves but the UK curve is currently rather flatter and broader here than in other categories, implying greater variation around average citation impact, and its growth rate is less. (Figure 14)

94. Stem Cell Transplantation is an area where Germany's output is half as great again as the UK, which has a similar output to France – a country whose regenerative medicine output it otherwise significantly exceeds. However, the UK's average impact (1.45) is as good as Germany's and it is noticeable that average citation impact for most European counties is fairly narrowly banded around 1.5, with the exception of Switzerland (just below 2 times world average). China is just above world average and India is well below, but Brazil has higher average impact (1.21) than any Asian country. (Figure 15)

95. The UK Impact Profile® is very similar to that of the USA. In fact, its modal impact is slightly higher than that of the USA although a slightly higher share of USA papers is cited more than four times world average. The UK's profile in Stem Cell Transplantation is better than that of Germany's in all but the very highest impact category. Japan, despite a very substantial output, has an average impact (0.97) below world average and its profile is well to the left. (Figure 16)

96. Tissue Engineering is a category in which the UK has a substantial output relative to other countries, greater than Germany and only slightly less than Japan with an average citation

impact (1.73) clearly greater than both. Though UK output in 2009 is greater than 2005, it seems to have plateaued. This is an interesting area because some other EU countries have a much lower share with unclear growth trends and it is one in which at the same time the Asian nations feature strongly. China's expanding output now exceeds Germany's (which is also flat) and its average impact (1.31) is only slightly less (Germany = 1.36), while South Korea has a larger output than all European countries except the UK and Germany and a higher average impact (1.85) than all except Switzerland. India, despite a very small output (46 papers in 2009), also has its highest impact (1.6) relative to the other countries in this category. The UK's position, the variance within Europe and the strong position of Asia will make this an important area for policy attention. (Figure 17)

97. The UK's Impact Profile® in Tissue Engineering is better than Japan and better than Germany in almost every category. The curve is relatively 'peaked' with a UK modal output close to 30% in the category 1-2 times world average (compared to 25% in Stem Cells). However, the USA has a very strong profile which is not only to the right of the other countries but has an inflexion showing a very low proportion of papers cited below world average balanced by a relative excess of papers in the categories 2-4 and 4-8 times world. (Figure 18)

98. The specific Regenerative Medicine category within the overall regenerative medicine data-set (i.e. the sub-set of papers that are tagged with the specific MeSH term) is a relatively small part, covering about 5% of the data and including fewer than 100 papers over five years for all but six countries (China, Canada, Germany, UK, Japan and USA). Although the UK has a greater output but a lower average citation impact (1.63) than Germany (1.93), though higher than Japan's (1.33). The Netherlands has an exceptionally high average impact (3.2) but this is on an average output of fewer than 10 papers per year, though the upward trajectory is steep. (Figure 19)

99. The UK has a poorer Impact Profile® in the Regenerative Medicine category than does Germany, while the USA has a substantially better outcome in the three citation impact categories above twice world average. Japan's modal impact is below world average despite its substantial volume (more than twice Germany's). The UK's curve peaks with over 30% of papers in the category 1-2 times world citation impact which suggests rather little variation around average impact, hence fewer papers either relatively low cited or relatively well cited compared to Germany. (Figure 20)

Stem Cells

Figure 11. For research papers tagged with the 'Stem Cells' MeSH term, national count of papers compared with average normalised citation impact. Data for the UK and for select comparator countries. Bubble size is scaled to the percentage of each country's papers in the total regenerative medicine dataset that carry this specific term.

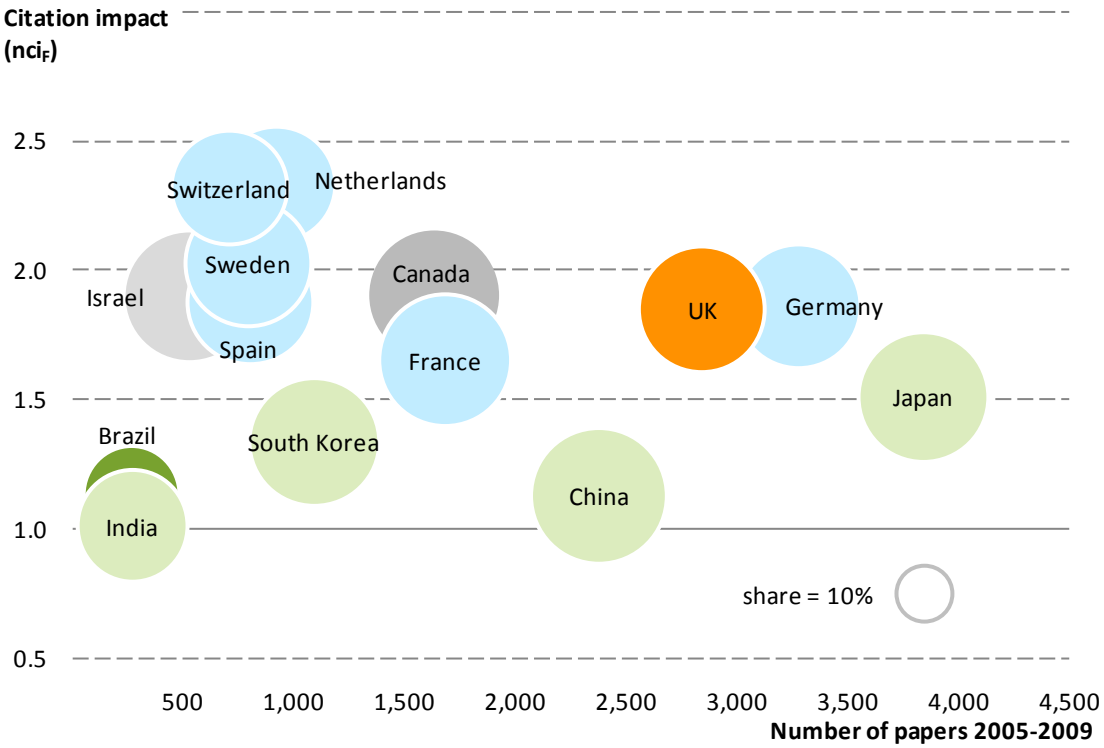
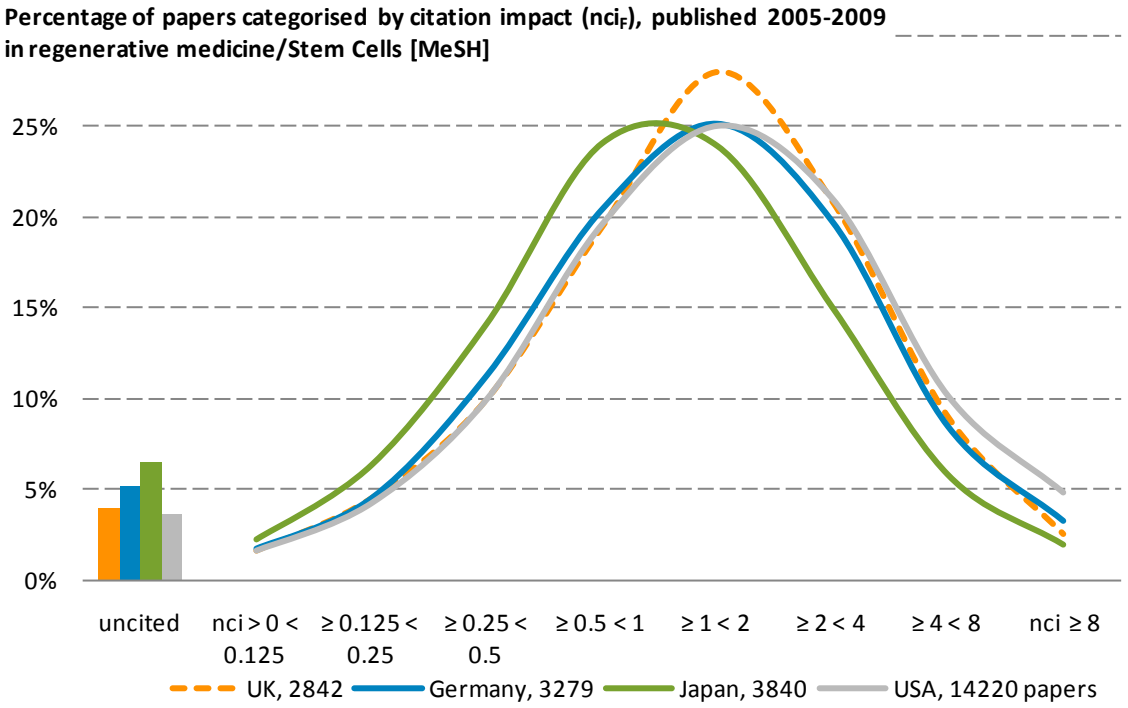


Figure 12. Impact Profile® analysing the distribution by citation impact of papers carrying the 'Stem Cells' MeSH term.



Tumour Stem Cells

Figure 13. For research papers tagged with the 'Tumour Stem Cells' MeSH term, national count of papers compared with average normalised citation impact. Data for the UK and for select comparator countries. Bubble size is scaled to the percentage of each country's papers in the total regenerative medicine dataset that carry this specific term.

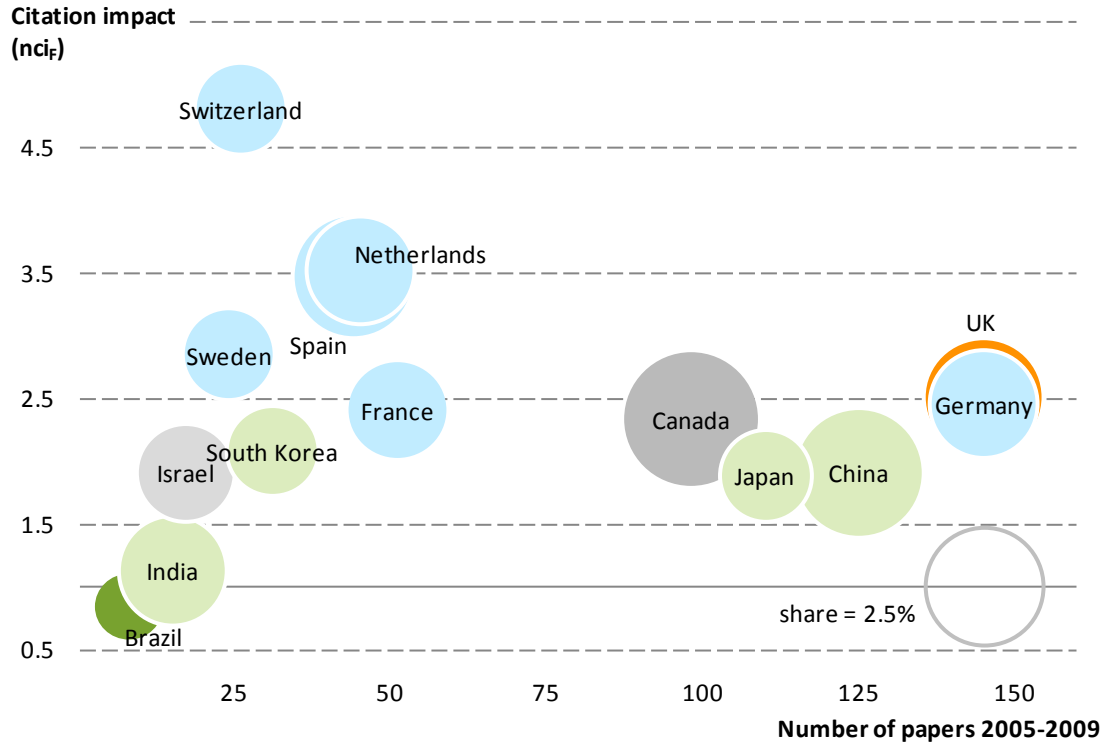
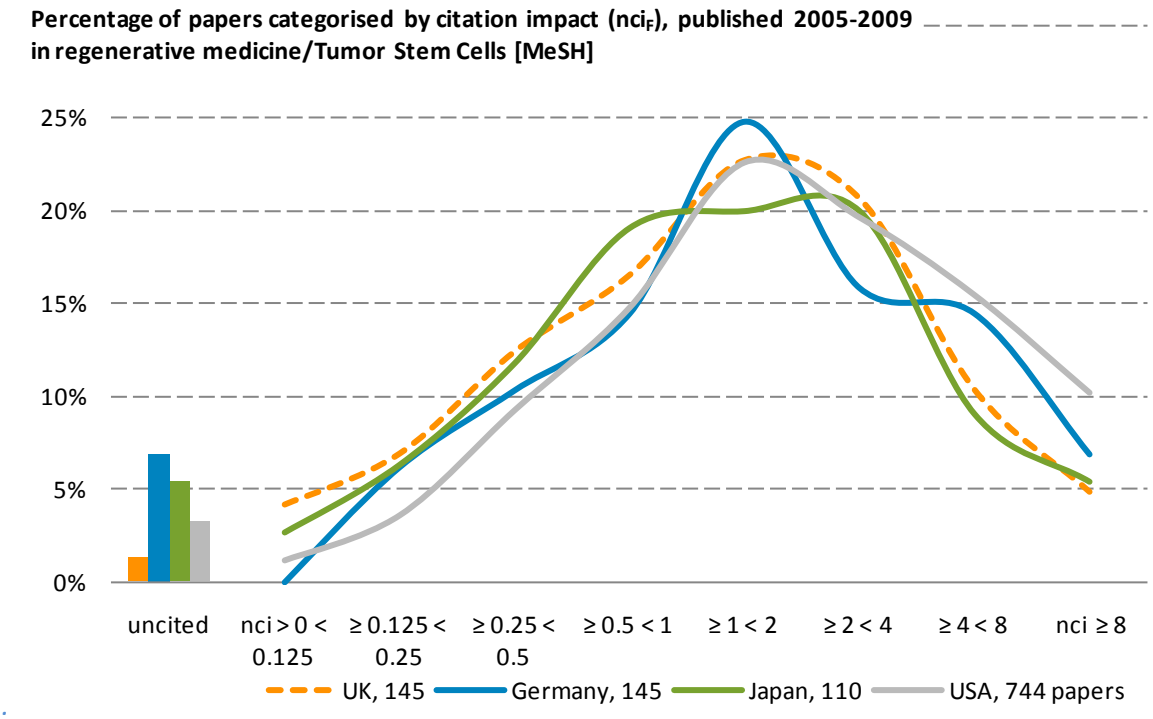


Figure 14. Impact Profile® analysing the distribution by citation impact of papers carrying the 'Tumour Stem Cells' MeSH term. Low paper counts result in profiles that depart from a bell-shaped curve.



Stem Cell Transplantation

Figure 15. For research papers tagged with the 'Stem Cell Transplantation' MeSH term, national count of papers compared with average normalised citation impact. Data for the UK and for select comparator countries. Bubble size is scaled to the percentage of each country's papers in the total regenerative medicine dataset that carry this specific term.

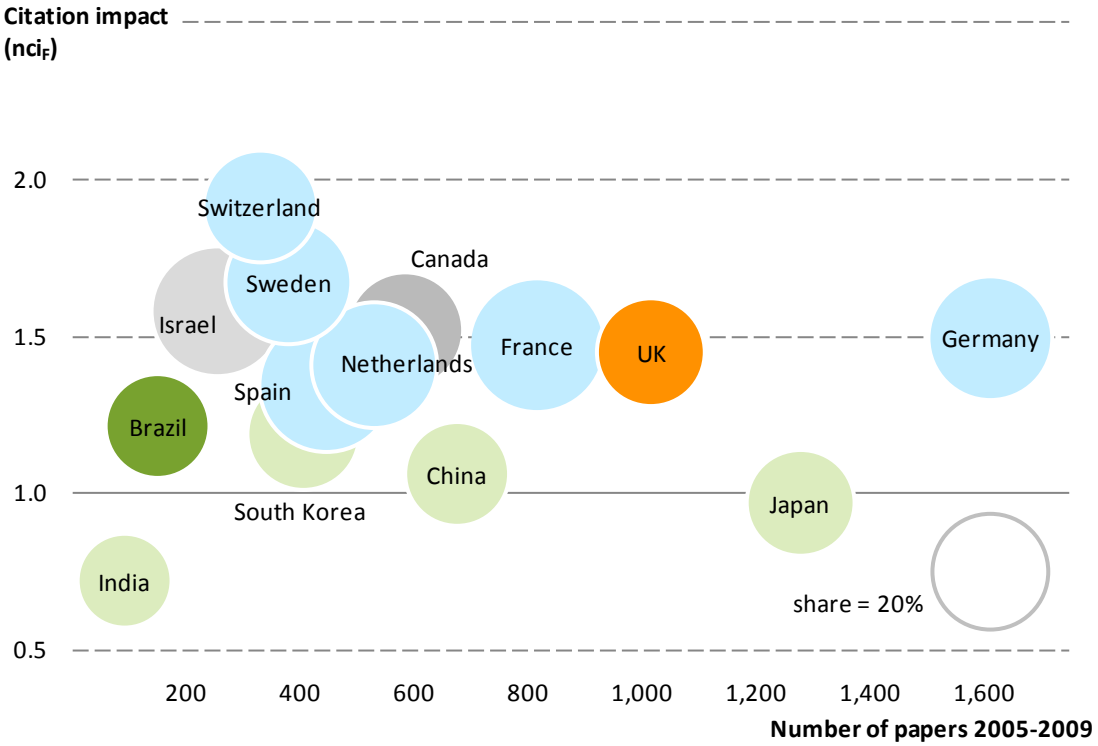
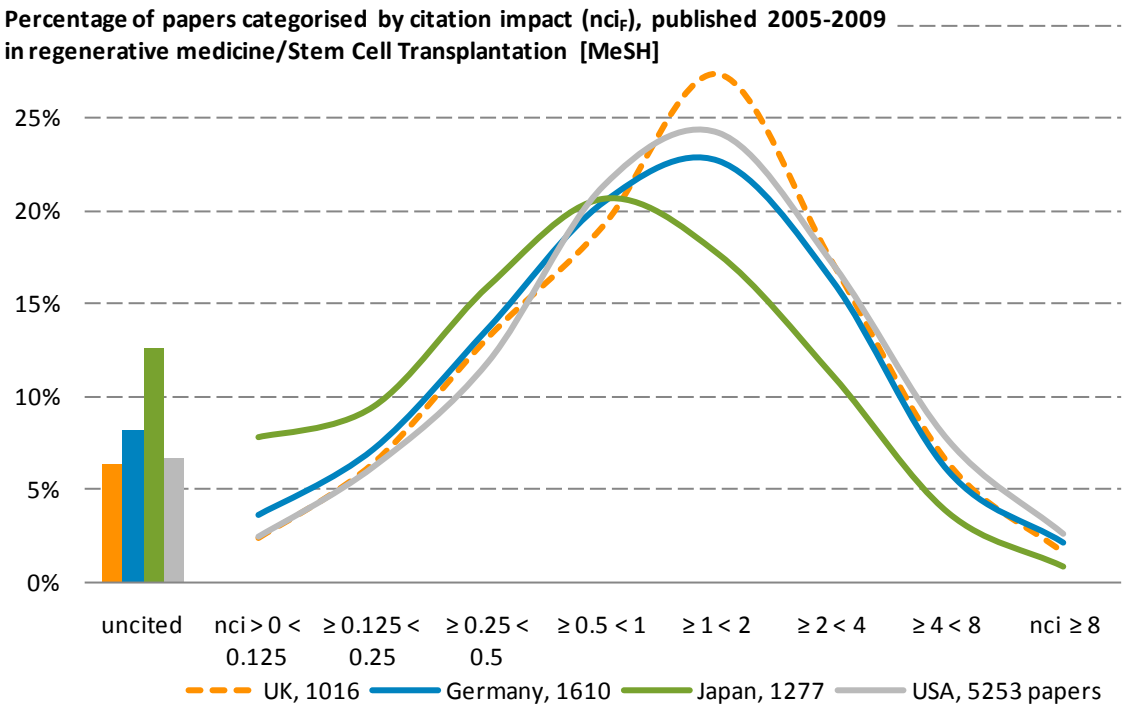


Figure 16. Impact Profile® analysing the distribution by citation impact of papers carrying the 'Stem Cell Transplantation' MeSH term.



Tissue Engineering

Figure 17. For research papers tagged with the 'Tissue Engineering' MeSH term, national count of papers compared with average normalised citation impact. Data for the UK and for select comparator countries. Bubble size is scaled to the percentage of each country's papers in the total regenerative medicine dataset that carry this specific term.

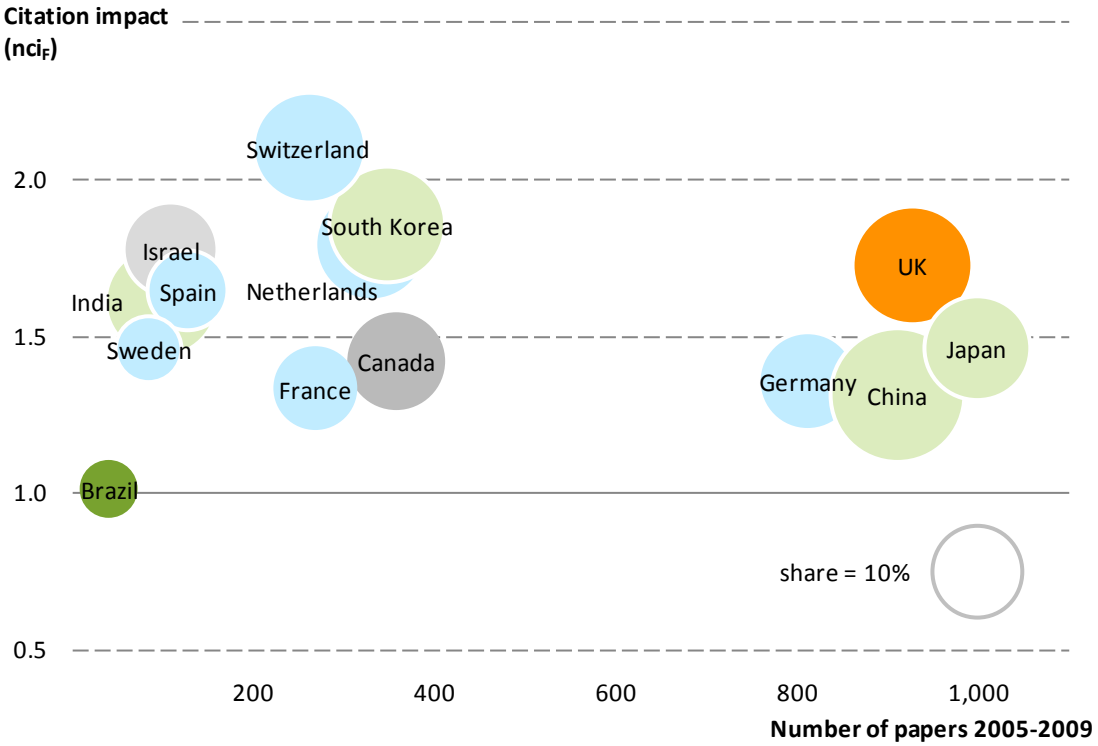
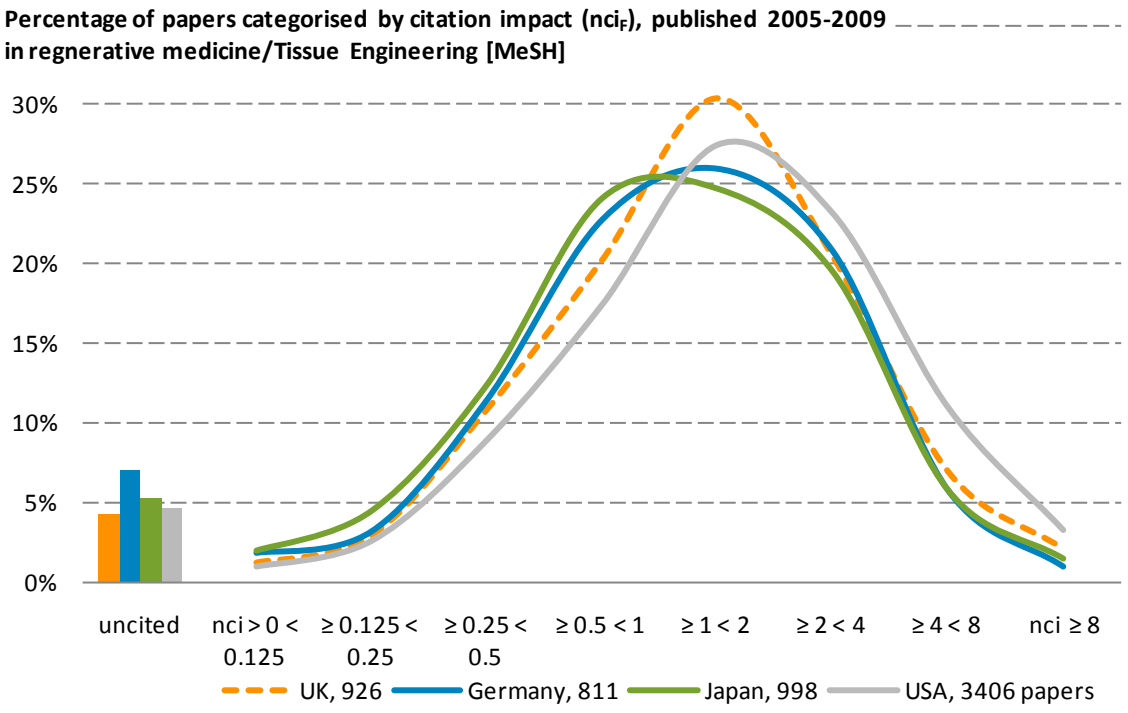
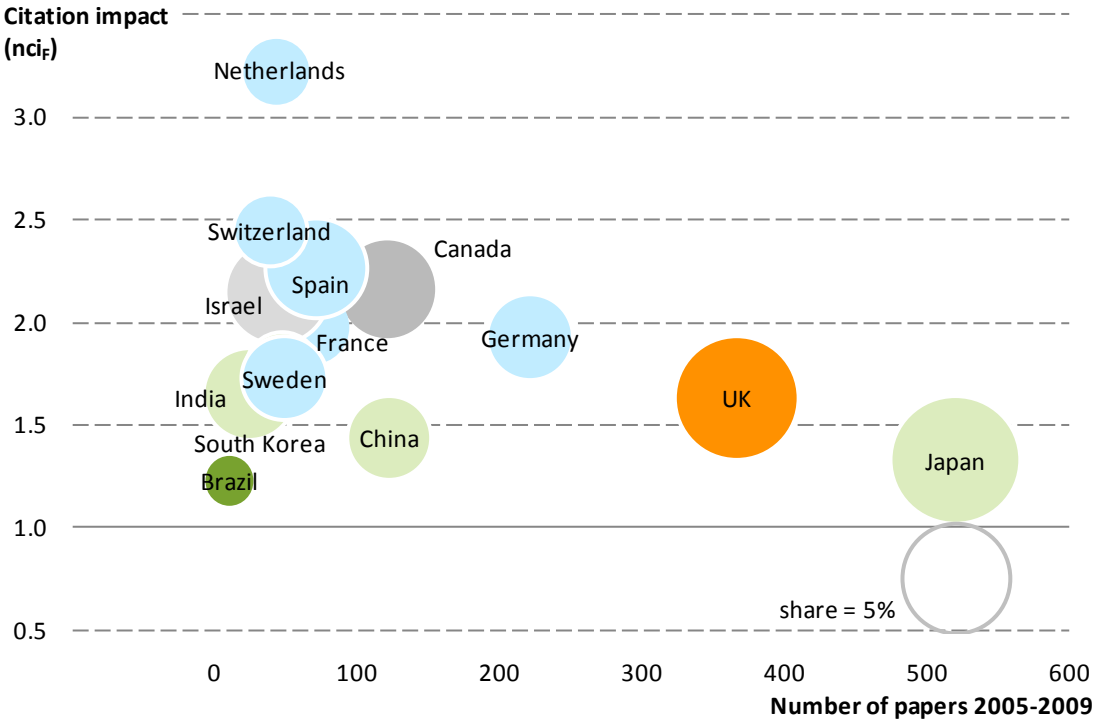


Figure 18. Impact Profile® analysing the distribution by citation impact of papers carrying the 'Tissue Engineering' MeSH term.



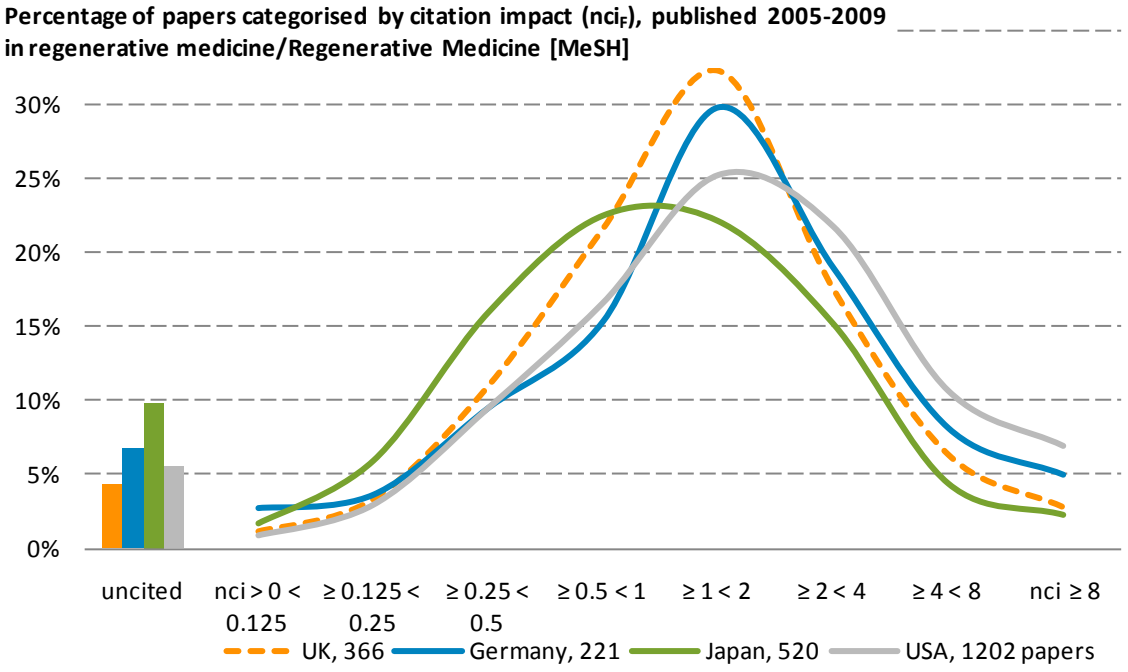
Regenerative Medicine

Figure 19. For research papers tagged with the 'Regenerative Medicine' MeSH term, national count of papers compared with average normalised citation impact. Data for the UK and for select comparator countries. Bubble size is scaled to the percentage of each country's papers in the total regenerative medicine dataset that carry this specific term.



NB. India and South Korea are overlapping in Figure 19

Figure 20. Impact Profile® analysing the distribution by citation impact of papers carrying the 'Regenerative Medicine' MeSH term. Low paper counts result in profiles that depart from a bell-shaped curve.



Annex 1 MeSH terms used in defining the total BIS 'regenerative medicine' dataset

In Annexes 3-7, the data under specific major MeSH terms (bold in Table 1.1) are reported separately as sub-sets of the total BIS dataset. Note that

- The total data for the analysis are referred to as the regenerative medicine data
- There are specific data associated with the Regenerative Medicine MeSH term.

Table 1.1 MeSH terms used in defining the total BIS 'regenerative medicine' dataset

	MeSH Term
1.	Hematopoietic Stem Cell Transplantation
2.	Hematopoietic Stem Cell Transplantation/ADVERSE EFFECTS
3.	Hematopoietic Stem Cell Transplantation/IMMUNOLOGY
4.	Hematopoietic Stem Cell Transplantation/INSTRUMENTATION
5.	Hematopoietic Stem Cell Transplantation/ISOLATION AND PURIFICATION
6.	Hematopoietic Stem Cell Transplantation/LEGISLATION AND JURISPRUDENCE
7.	Hematopoietic Stem Cell Transplantation/METHODS
8.	Hematopoietic Stem Cell Transplantation/STANDARDS
9.	Hematopoietic Stem Cells
10.	Hematopoietic Stem Cells/CYTOLOGY
11.	Hematopoietic Stem Cells/DRUG EFFECTS
12.	Hematopoietic Stem Cells/ENZYMOLOGY
13.	Hematopoietic Stem Cells/GENETICS
14.	Hematopoietic Stem Cells/GROWTH AND DEVELOPMENT
15.	Hematopoietic Stem Cells/IMMUNOLOGY
16.	Hematopoietic Stem Cells/ISOLATION AND PURIFICATION
17.	Hematopoietic Stem Cells/METABOLISM
18.	Hematopoietic Stem Cells/PATHOLOGY
19.	Hematopoietic Stem Cells/PHYSIOLOGY
20.	Hematopoietic Stem Cells/RADIATION EFFECTS
21.	Liver Regeneration
22.	Liver Regeneration/PHYSIOLOGY
23.	Pluripotent Stem Cells
24.	Pluripotent Stem Cells/CHEMISTRY
25.	Pluripotent Stem Cells/CYTOLOGY
26.	Pluripotent Stem Cells/IMMUNOLOGY
27.	Pluripotent Stem Cells/METABOLISM
28.	Pluripotent Stem Cells/PATHOLOGY
29.	Pluripotent Stem Cells/PHYSIOLOGY
30.	Pluripotent Stem Cells/TRANSPLANTATION
31.	Pluripotent Stem Cells/VIROLOGY
32.	Regeneration
33.	Regeneration/GENETICS
34.	Regeneration/IMMUNOLOGY
35.	Regeneration/PHYSIOLOGY

36.	**Regenerative Medicine**
37.	Regenerative Medicine/METHODS
38.	Regenerative Medicine/ORGANIZATION AND ADMINISTRATION
39.	**Stem Cell Transplantation**
40.	Stem Cell Transplantation/CLASSIFICATION
41.	Stem Cell Transplantation/ECONOMICS
42.	Stem Cell Transplantation/ETHICS
43.	Stem Cell Transplantation/METHODS
44.	Stem Cell Transplantation/STANDARDS
45.	**Stem Cells**
46.	Stem Cells/BLOOD
47.	Stem Cells/CHEMISTRY
48.	Stem Cells/CLASSIFICATION
49.	Stem Cells/CYTOLOGY
50.	Stem Cells/DRUG EFFECTS
51.	Stem Cells/ENZYMOLOGY
52.	Stem Cells/GENETICS
53.	Stem Cells/GROWTH AND DEVELOPMENT
54.	Stem Cells/IMMUNOLOGY
55.	Stem Cells/ISOLATION AND PURIFICATION
56.	Stem Cells/METABOLISM
57.	Stem Cells/PATHOLOGY
58.	Stem Cells/PHYSIOLOGY
59.	Stem Cells/THERAPEUTIC USE
60.	Stem Cells/TRANSPLANTATION
61.	Stem Cells/ULTRASONOGRAPHY
62.	Stem Cells/ULTRASTRUCTURE
63.	Stem Cells/VIROLOGY
64.	**Tissue Engineering**
65.	Tissue Engineering/INSTRUMENTATION
66.	Tissue Engineering/METHODS
67.	**Tumour Stem Cells**
68.	Tumour Stem Cells/ISOLATION AND PURIFICATION
69.	Tumour Stem Cells/PATHOLOGY
70.	Tumour Stem Cells/PHYSIOLOGY
71.	Tumour Stem Cells/PHYSIOPATHOLOGY

Annex 2 Bibliometrics and citation analysis

Bibliometrics are about publications and their citations. The field has emerged from 'information science' and refers to analyses and methods used to study and index texts and information.

Publications cite and are cited by other publications. This provides linkages and networks. Many links are likely to be related to significance or impact. Meaning is determined from keywords and content. Citation analysis and content analysis are therefore commonly used bibliometric methods. Historically, bibliometric methods had been used to trace relationships amongst academic journal citations. Bibliometrics now are increasingly 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', interpreted as significance or influence in 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 widespread tool of 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 (currently the Science business of Thomson Reuters).

Most impact measures 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 used by *Evidence* come from Thomson Reuters databases, including the Web of Science, a single source collated to the same standard and therefore providing a level of comparability not found in other databases. These data are also valuable because they can readily be disaggregated by field, by year, by country and by institution. The Web of Science is part of a larger entity, the Web of Knowledge℠, focussing on research published in journals and conferences in science, medicine, arts, humanities and social sciences. The Web of Science was primarily regarded as an awareness and information retrieval tool but has an increasingly important secondary use for citation analysis and bibliometrics for research evaluation. Coverage is both current and 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'.

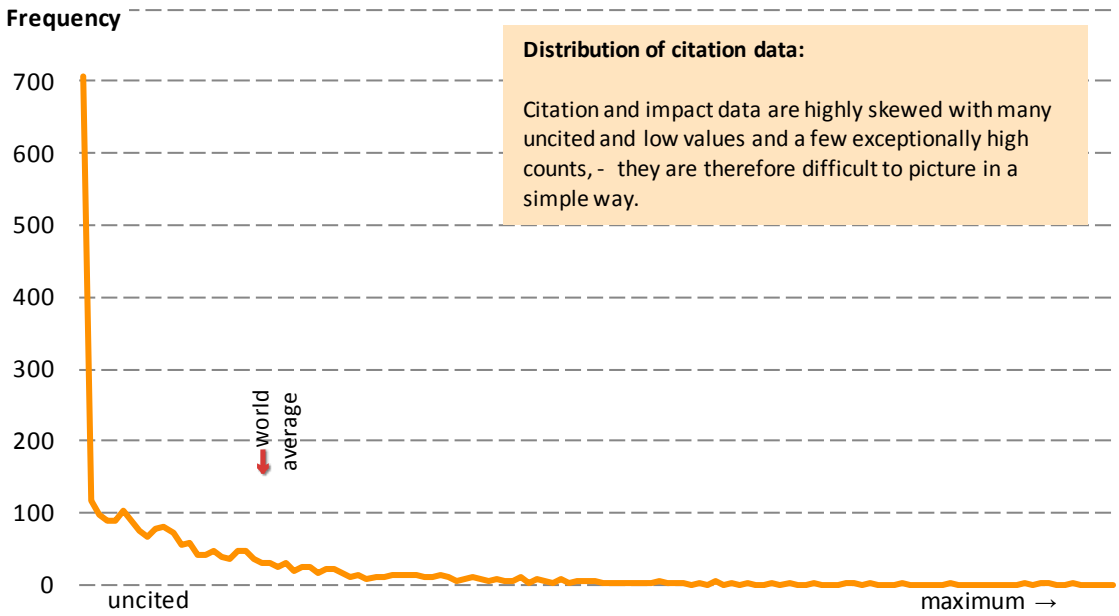
Unlike other databases, the Thomson Reuters Web of Science and underlying databases are selective, that is, the journals abstracted are selected using rigorous editorial and quality criteria. The authoritative, multidisciplinary content covers over 10,000 of the highest impact journals worldwide, including Open Access journals and over 110,000 conference proceedings. The abstracted journals actually encompass the majority of significant 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 relatively stable in given research fields and do not fluctuate widely from year to year, which increases the usability of such data for performance evaluation.

Evidence, now as part of Thomson Reuters, 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.

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.



citation count at end-2009 for UK cell biology papers published in 2005

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 that 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 with the quality of the research.

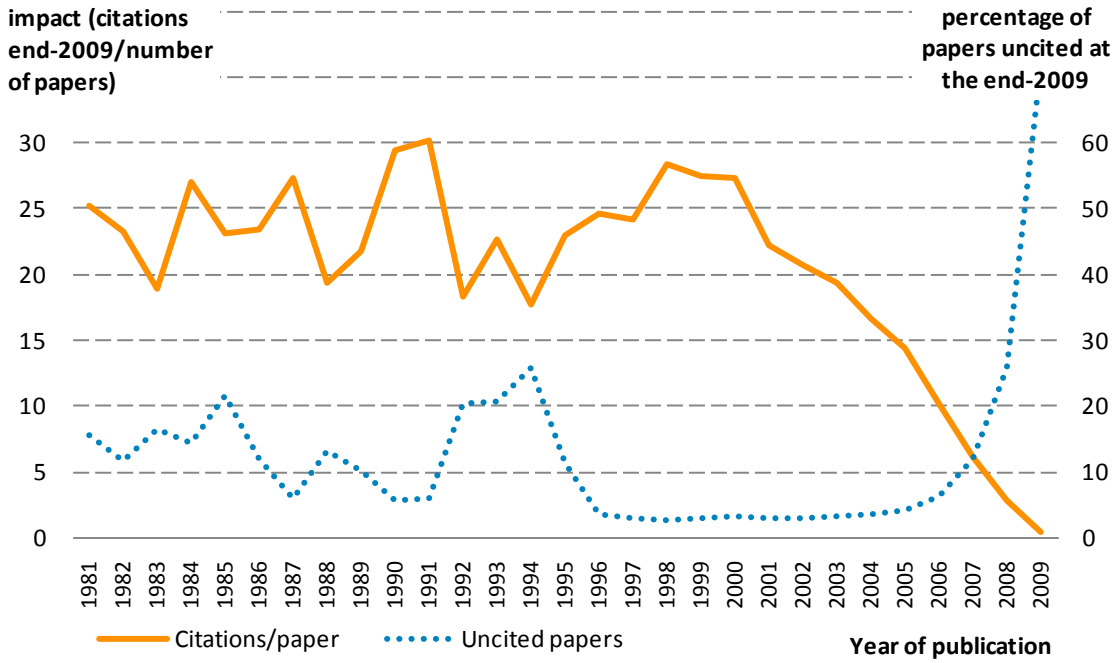
The figure shows the skewed distribution of more or less frequently cited papers from a sample of UK authored publications in cell biology. The skew in the distribution varies from field to field. It is to compensate for such factors that actual citation counts must be normalised, or normalised, against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

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. Normalisation accounts for differences in citation accumulation rates in rapidly moving fields and in slower moving fields by using the year appropriate world average though care should still be taken with data based on the most recent year as this can be very volatile. This is principally due to raw citation counts necessarily being an integer, typically 1, whereas the world average will be a fraction.

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 Thomson Reuters, 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 that were informed by extensive work by Thomson and with the research community since the early 1960s. This scheme has been superseded by the 251 Web of Science journal categories that allow for greater disaggregation for the growing volume of research that 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 Biomedical Engineering.

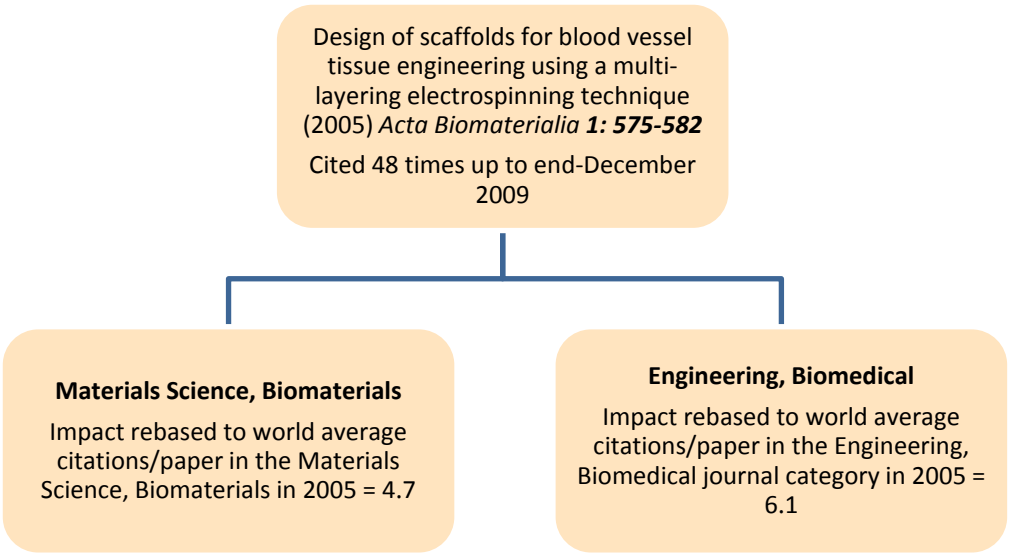
Very few papers are not assigned to any research field and as such will not be included in specific analyses using normalised impact data. The journals included in the Thomson Reuters databases and how they are selected are detailed here http://scientific.thomsonreuters.com/mjl/.

Some journals with a very diverse content, including the prestigious journals Nature and Science were classified as Multidisciplinary before 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

For the reasons given above, 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. In addition, the type of publication will influence the citation count. For example, a review will typically be cited more frequently than an article, and both of these types will tend to be cited more than editorials or meeting abstracts. Consequently, only citation counts from reviews and articles are used in calculations of impact. The most common normalisation factors are the average citations per paper for the year and either the field or 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 citation impact', or nci. The following schematic illustrates how the normalised 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 Biomedical Engineering. 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 impact (in the above example the category-specific nci for Materials Science, Biomaterials is 2.66 and the category-specific nci for Biomedical Engineering is higher at 3.63). 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 Thomson Reuters 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 have been sourced from the Thomson Reuters National Science Indicators baseline data for 2008.

Average impact

As noted above, the distribution of citations amongst papers is highly skewed, many papers are uncited and a very few papers accumulate extensive citation counts. Historically, research performance has been indexed using average impact (normalised as described to a world average that accounts for time and discipline).

An average may be misleading, however, if assumptions are made about the distribution of the data beneath it. Almost all research activity metrics are skewed: many low performance values and a few exceptionally high values. In reality, therefore, the average impact tends to be significantly different from either the median or mode in the underlying distribution.

The average (normalised) 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.

Thus, in the example above, the average nci of the *Acta Biomaterialia* paper can be given as 3.15.

Impact Profiles®

Evidence has developed a bibliometric methodology which shows the proportion of papers that are uncited and the proportion that lie in each of eight categories of relative citation rates, normalised (normalised) to world average. An Impact Profile® enables an examination and analysis of the strengths and weaknesses of published outputs relative to world average and relative to a reference profile. This provides much more information about the basis and structure of research performance than conventionally reported averages in citation indices.

Impact Profiles® enable an examination and analysis of the balance of published outputs relative to world average and relative to a reference profile. This provides much more information about the basis and structure of research performance than conventionally reported averages in citation indices.

An Impact Profile® shows what proportion of papers are uncited and what proportion are in each of eight categories of relative citation rates, normalised (normalised) to world average (which becomes 1.0 in this graph). Normalised citation rates above 1.0 indicate papers cited more often than world average for the field in which that journal is categorised and in their year of publication.

Attention should be paid to:

- The proportion of uncited papers on the left of the chart
- The proportion of cited papers either side of world average (1.0)
- The location of the most common (modal) group near the centre
- The proportion of papers in the most highly cited categories to the right, (≥4 x world, ≥8 x world).

What are uncited papers?

It may be a surprise that some journal articles 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 that 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. There is also an obvious increase in the likelihood of citation over time but most papers that are going to be cited will be cited within a few years of publication.

What is the threshold for 'highly cited'?

Thomson Reuters has traditionally used the term 'Highly Cited Paper' to refer to the world's 1% of most frequently cited papers, taking into account year of publication and field. In rough terms, UK papers cited more than eight times as often as relevant world average would fall into the Thomson Highly Cited category. About 1-2% of papers (all papers, cited or uncited) typically pass this hurdle. Such a threshold certainly delimits exceptional papers for international comparisons but, in practice, is an onerous marker for more general management purposes.

After reviewing the outcomes of a number of analyses, we have chosen a more relaxed definition for our descriptive and analytical work.

> We deem papers that are cited more often than four times the relevant world average to be relatively highly cited for many national comparisons. This covers the two most highly cited categories in our graphical analyses.
>
> Because of variations between subject categories we also use the top decile (top 10% most highly cited). This usually covers UK papers cited more often than three times world average.

Annex 3. MeSH term – Stem Cells

Table 3.1 Papers published per year in the Stem Cells MeSH category

	2005	2006	2007	2008	2009	Total
UK	**414**	**493**	**587**	**674**	**674**	**2,842**
EU-27	1786	2136	2456	2947	3000	12,325
UN Macroregions						
Europe	1,896	2,272	2,605	3,104	3,164	13,041
Africa	14	13	16	15	28	86
Asia	1,120	1,403	1,770	2,275	2,454	9,022
Latin America	60	73	79	121	151	484
Northern America	2,286	2,728	3,046	3,584	3,745	15,389
Oceania	127	156	196	223	272	974
Countries						
Brazil	35	34	47	66	85	267
Canada	251	272	298	375	434	1,630
China	194	298	452	650	785	2,379
France	286	307	336	383	369	1,681
Germany	471	548	654	790	816	3,279
India	33	30	45	72	92	272
Israel	68	103	119	122	118	530
Italy	248	311	383	459	489	1,890
Japan	603	676	791	913	857	3,840
Netherlands	125	150	170	229	246	920
South Korea	127	152	206	292	315	1,092
Spain	78	128	166	194	239	805
Sweden	130	153	170	163	176	792
Switzerland	107	125	135	164	179	710
USA	2,102	2,531	2,828	3,316	3,443	14,220
US States						
California	362	468	568	678	749	2,825
Illinois	90	111	129	151	149	630
Maryland	217	297	321	305	324	1,464
Massachusetts	278	376	428	531	490	2,103
Michigan	80	117	119	137	151	604
Minnesota	69	67	91	101	90	418
New York	256	273	315	391	414	1,649
North Carolina	80	108	127	137	143	595
Ohio	105	116	171	154	195	741
Pennsylvania	193	208	224	250	265	1,140
Texas	140	155	211	225	284	1,015
Washington	74	86	106	96	107	469
Wisconsin	47	71	61	73	84	336
World	**4,778**	**5,759**	**6,583**	**7,947**	**8,240**	**33,307**

Table 3.2 Citation impact in the Stem Cells MeSH category

	2005	2006	2007	2008	2009	Average
UK	**1.78**	**1.71**	**1.88**	**1.79**	**2.02**	**1.85**
EU-27	1.74	1.69	1.72	1.69	1.76	1.72
UN Macroregions						
Europe	1.74	1.67	1.70	1.69	1.75	1.71
Africa	0.96	0.71	0.86	1.47	1.37	1.13
Asia	1.42	1.43	1.34	1.46	1.33	1.39
Latin America	0.73	0.81	1.21	0.93	1.29	1.04
Northern America	2.06	2.08	2.04	2.39	2.24	2.18
Oceania	1.68	2.13	1.87	1.94	1.71	1.86
Countries						
Brazil	0.64	0.56	1.45	1.04	1.47	1.13
Canada	1.84	1.99	1.94	1.85	1.91	1.91
China	1.01	1.12	1.07	1.20	1.15	1.13
France	1.53	1.51	1.77	1.62	1.78	1.65
Germany	2.06	1.77	1.77	1.85	1.91	1.86
India	0.74	0.91	0.85	1.08	1.17	1.01
Israel	2.11	1.93	1.68	1.68	2.20	1.90
Italy	1.61	1.94	2.08	1.72	1.65	1.80
Japan	1.44	1.51	1.48	1.72	1.38	1.51
Netherlands	2.14	2.45	2.39	2.32	2.33	2.33
South Korea	1.63	1.49	1.24	1.21	1.34	1.34
Spain	1.49	1.82	1.48	1.79	2.38	1.88
Sweden	1.99	2.54	1.97	1.74	1.93	2.03
Switzerland	2.56	2.07	2.37	2.38	2.25	2.32
USA	2.10	2.11	2.07	2.44	2.30	2.22
US States						
California	2.39	2.16	2.42	3.05	2.87	2.64
Illinois	1.83	1.64	1.78	1.89	2.22	1.89
Maryland	2.58	2.34	2.59	2.14	2.36	2.39
Massachusetts	2.77	2.78	3.15	3.80	3.30	3.23
Michigan	2.15	2.60	2.77	2.37	2.26	2.44
Minnesota	1.40	1.73	1.89	1.54	2.34	1.80
New York	2.50	2.27	2.15	2.53	2.29	2.35
North Carolina	2.81	2.73	2.02	1.93	2.81	2.42
Ohio	1.92	2.21	1.75	1.88	2.29	2.01
Pennsylvania	2.02	2.17	2.04	2.00	1.99	2.04
Texas	2.42	2.09	2.04	2.10	2.38	2.21
Washington	2.14	1.99	2.45	2.12	2.35	2.23
Wisconsin	2.60	2.40	2.07	5.62	3.96	3.46
World	**1.71**	**1.70**	**1.68**	**1.80**	**1.72**	**1.72**

Table 3.3 Uncited papers in the Stem Cells MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**2.2%**	**1.8%**	**1.9%**	**3.4%**	**9.1%**	**4.0%**
EU-27	2.2%	2.4%	3.1%	4.7%	12.6%	5.5%
UN Macroregions						
Europe	3.4%	3.5%	3.5%	5.3%	13.2%	6.3%
Africa	7.1%	15.4%	0.0%	6.7%	7.1%	7.0%
Asia	2.4%	2.6%	3.1%	6.2%	18.6%	7.9%
Latin America	8.3%	6.8%	5.1%	13.2%	22.5%	13.2%
Northern America	1.1%	1.4%	1.4%	3.2%	9.8%	3.8%
Oceania	0.0%	3.2%	1.5%	4.9%	10.7%	4.9%
Countries						
Brazil	5.7%	8.8%	4.3%	10.6%	20.0%	11.6%
Canada	0.4%	1.8%	1.0%	2.9%	13.1%	4.7%
China	3.1%	2.7%	3.5%	7.5%	21.8%	10.5%
France	4.2%	4.2%	4.5%	5.7%	15.7%	7.1%
Germany	0.6%	2.9%	2.9%	5.3%	11.0%	5.2%
India	6.1%	0.0%	2.2%	11.1%	23.9%	12.1%
Israel	0.0%	3.9%	1.7%	3.3%	10.2%	4.2%
Italy	2.0%	2.3%	2.9%	3.9%	11.0%	5.0%
Japan	2.3%	2.8%	3.3%	4.7%	17.6%	6.6%
Netherlands	1.6%	1.3%	2.4%	3.9%	9.3%	4.3%
South Korea	3.1%	1.3%	2.4%	8.9%	15.2%	7.8%
Spain	2.6%	0.8%	4.2%	5.2%	10.5%	5.6%
Sweden	2.3%	0.7%	1.8%	2.5%	13.6%	4.4%
Switzerland	0.9%	4.0%	2.2%	3.0%	9.5%	4.4%
USA	1.1%	1.4%	1.4%	3.3%	9.2%	3.7%
US States						
California	0.8%	1.1%	0.7%	2.7%	7.5%	3.0%
Illinois	1.1%	0.0%	0.0%	2.0%	9.4%	2.9%
Maryland	0.9%	1.3%	1.9%	2.6%	7.7%	3.1%
Massachusetts	1.8%	1.3%	1.9%	2.8%	4.9%	2.7%
Michigan	1.3%	0.9%	0.8%	1.5%	8.6%	3.0%
Minnesota	0.0%	0.0%	3.3%	11.9%	12.2%	6.2%
New York	0.4%	0.7%	0.3%	2.6%	8.0%	2.9%
North Carolina	2.5%	3.7%	1.6%	0.7%	7.7%	3.4%
Ohio	1.0%	0.9%	0.6%	5.2%	10.8%	4.3%
Pennsylvania	0.5%	1.4%	1.3%	2.4%	9.8%	3.4%
Texas	0.7%	1.3%	1.4%	3.6%	9.5%	4.0%
Washington	0.0%	0.0%	0.9%	3.1%	10.3%	3.2%
Wisconsin	0.0%	0.0%	0.0%	4.1%	11.9%	3.9%
World	**2.6%**	**2.7%**	**2.8%**	**5.2%**	**14.2%**	**5.5%**

Table 3.4 Highly-cited papers in the Stem Cells MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**25.4%**	**25.4%**	**29.5%**	**27.0%**	**23.0%**	**26.0%**
EU-27	23.6%	24.6%	26.7%	22.6%	20.8%	23.5%
UN Macroregions						
Europe	23.5%	24.2%	26.2%	22.6%	20.7%	23.2%
Africa	7.1%	0.0%	12.5%	13.3%	10.7%	9.3%
Asia	20.2%	18.1%	17.7%	16.8%	14.6%	17.0%
Latin America	8.3%	11.0%	16.5%	9.9%	17.9%	13.4%
Northern America	29.4%	30.8%	30.3%	30.7%	26.3%	29.4%
Oceania	26.0%	28.2%	23.0%	27.4%	19.5%	24.2%
Countries						
Brazil	8.6%	2.9%	19.1%	9.1%	18.8%	13.1%
Canada	28.3%	27.2%	30.5%	24.8%	20.7%	25.7%
China	13.4%	14.4%	11.9%	14.3%	11.5%	12.9%
France	22.0%	21.2%	26.8%	21.1%	22.5%	22.7%
Germany	29.1%	28.1%	27.4%	23.7%	22.9%	25.7%
India	3.0%	6.7%	8.9%	9.7%	14.1%	9.9%
Israel	32.4%	27.2%	19.3%	26.2%	20.3%	24.3%
Italy	18.5%	25.4%	30.0%	21.1%	17.6%	22.4%
Japan	19.9%	17.3%	19.7%	17.4%	16.2%	18.0%
Netherlands	26.4%	31.3%	37.1%	32.8%	30.5%	31.8%
South Korea	27.6%	22.4%	17.0%	15.1%	13.3%	17.4%
Spain	17.9%	27.3%	18.7%	24.7%	23.4%	22.9%
Sweden	26.2%	29.4%	27.6%	23.3%	26.7%	26.6%
Switzerland	35.5%	33.6%	34.1%	32.3%	25.1%	31.5%
USA	29.6%	31.3%	30.6%	31.4%	27.1%	29.9%
US States						
California	35.4%	33.8%	35.0%	37.5%	32.8%	34.9%
Illinois	32.2%	33.3%	29.5%	29.1%	28.9%	30.3%
Maryland	31.8%	36.4%	35.8%	32.5%	25.6%	32.4%
Massachusetts	37.8%	40.7%	41.1%	41.8%	35.1%	39.4%
Michigan	32.5%	33.3%	30.3%	37.2%	29.1%	32.5%
Minnesota	18.8%	37.3%	26.4%	30.7%	28.9%	28.5%
New York	36.3%	30.4%	32.1%	35.8%	28.7%	32.5%
North Carolina	28.8%	38.0%	28.3%	28.5%	36.4%	32.1%
Ohio	27.6%	23.3%	27.5%	27.9%	28.2%	27.1%
Pennsylvania	28.5%	30.3%	30.4%	31.6%	26.4%	29.4%
Texas	28.6%	27.1%	33.6%	32.0%	31.3%	30.9%
Washington	28.4%	27.9%	38.7%	33.3%	29.0%	31.8%
Wisconsin	34.0%	33.8%	34.4%	42.5%	26.2%	33.9%
World	**13.4%**	**14.3%**	**14.4%**	**13.8%**	**12.5%**	**13.7%**

Annex 4. MeSH term – Tumour Stem Cells

Table 4.1 Papers published per year in the Tumour Stem Cells MeSH category

	2005	2006	2007	2008	2009	Total
UK	**22**	**17**	**18**	**46**	**42**	**145**
EU-27	44	58	97	182	209	590
UN Macroregions						
Europe	46	61	102	187	218	614
Africa	1	0	0	0	1	2
Asia	15	26	55	112	118	326
Latin America	1	2	1	6	4	14
Northern America	59	93	141	250	273	816
Oceania	0	4	5	9	16	34
Countries						
Brazil	1	1	1	5	0	8
Canada	5	15	14	33	31	98
China	3	5	23	52	42	125
France	1	6	10	13	21	51
Germany	6	12	30	51	46	145
India	1	4	5	2	3	15
Israel	0	3	3	5	6	17
Italy	5	12	17	34	46	114
Japan	6	12	18	34	40	110
Netherlands	3	3	7	12	20	45
South Korea	3	1	4	13	10	31
Spain	2	2	3	12	25	44
Sweden	2	1	6	5	10	24
Switzerland	1	4	2	8	11	26
USA	54	81	131	228	250	744
US States						
California	10	17	27	53	53	160
Illinois	1	5	4	12	7	29
Maryland	7	11	22	34	37	111
Massachusetts	5	9	17	38	42	111
Michigan	4	8	13	17	15	57
Minnesota	0	1	6	4	4	15
New York	11	9	11	28	26	85
North Carolina	1	3	3	12	11	30
Ohio	1	0	1	8	17	27
Pennsylvania	4	4	7	21	21	57
Texas	7	10	12	12	34	75
Washington	1	4	6	6	7	24
Wisconsin	1	5	3	5	2	16
World	**105**	**170**	**263**	**487**	**523**	**1,548**

Table 4.2 Citation impact in the Tumour Stem Cells MeSH category

	2005	2006	2007	2008	2009	Average
UK	**2.63**	**1.57**	**1.78**	**2.21**	**3.48**	**2.51**
EU-27	1.68	1.72	2.04	2.12	2.76	2.26
UN Macroregions						
Europe	1.65	1.73	2.27	2.32	2.81	2.38
Africa	0.12	0.00	0.00	0.00	1.89	1.01
Asia	1.48	1.44	2.34	2.31	1.95	2.08
Latin America	0.38	0.35	1.19	0.86	1.64	1.00
Northern America	2.61	2.89	3.53	2.96	3.08	3.07
Oceania	0.00	5.92	5.09	4.14	2.79	3.85
Countries						
Brazil	0.38	0.28	1.19	0.98	0.00	0.84
Canada	2.03	1.56	2.76	2.26	2.65	2.34
China	0.15	0.67	2.16	2.47	1.36	1.91
France	0.37	2.07	2.87	2.28	2.47	2.41
Germany	0.93	0.96	2.56	2.75	2.66	2.46
India	3.94	0.39	1.10	0.31	1.80	1.13
Israel	0.00	1.36	0.76	3.70	1.28	1.92
Italy	0.46	2.77	1.74	2.33	2.64	2.33
Japan	1.46	2.26	2.58	1.65	1.74	1.89
Netherlands	1.18	0.69	2.76	2.39	5.25	3.52
South Korea	1.37	0.82	5.01	1.87	1.54	2.09
Spain	6.48	0.52	1.36	2.09	4.40	3.48
Sweden	0.82	4.41	2.52	1.55	3.95	2.85
Switzerland	1.15	0.35	7.74	8.32	3.67	4.81
USA	2.67	3.10	3.67	3.00	3.16	3.16
US States						
California	3.11	2.32	5.33	3.83	3.36	3.72
Illinois	2.48	2.41	2.32	1.57	6.22	2.97
Maryland	4.58	5.19	4.08	2.22	3.08	3.32
Massachusetts	2.45	4.12	6.01	5.25	4.39	4.82
Michigan	0.97	7.43	6.86	4.40	2.19	4.57
Minnesota	0.00	0.28	1.88	1.37	7.55	3.15
New York	2.48	1.92	2.66	3.05	4.02	3.10
North Carolina	1.76	5.66	5.23	3.59	7.06	5.17
Ohio	1.41	0.00	2.85	3.19	4.98	4.24
Pennsylvania	4.78	2.53	2.93	2.13	2.40	2.54
Texas	2.96	2.25	2.86	5.03	3.90	3.61
Washington	1.76	2.43	1.17	3.76	1.49	2.15
Wisconsin	0.18	2.54	1.76	1.84	1.20	1.86
World	**2.23**	**2.23**	**2.81**	**2.42**	**2.66**	**2.47**

Table 4.3 Uncited papers in the Tumour Stem Cells MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**4.8%**	**1.4%**
EU-27	2.3%	3.4%	8.2%	2.7%	8.6%	5.8%
UN Macroregions						
Europe	2.2%	4.9%	7.8%	2.7%	8.3%	5.7%
Africa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Asia	6.7%	0.0%	0.0%	5.4%	11.9%	6.4%
Latin America	0.0%	0.0%	0.0%	0.0%	50.0%	14.3%
Northern America	0.0%	1.1%	0.7%	2.0%	7.3%	3.3%
Oceania	0.0%	0.0%	0.0%	0.0%	6.3%	2.9%
Countries						
Brazil	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canada	0.0%	6.7%	0.0%	3.0%	9.7%	5.1%
China	0.0%	0.0%	0.0%	5.8%	11.9%	6.4%
France	0.0%	16.7%	0.0%	0.0%	28.6%	13.7%
Germany	0.0%	0.0%	10.0%	5.9%	8.7%	6.9%
India	0.0%	0.0%	0.0%	0.0%	33.3%	6.7%
Israel	0.0%	0.0%	0.0%	0.0%	16.7%	5.9%
Italy	0.0%	0.0%	17.6%	0.0%	4.3%	4.4%
Japan	16.7%	0.0%	0.0%	5.9%	7.5%	5.5%
Netherlands	0.0%	0.0%	0.0%	0.0%	5.0%	2.2%
South Korea	0.0%	0.0%	0.0%	7.7%	10.0%	6.5%
Spain	50.0%	0.0%	33.3%	0.0%	0.0%	4.5%
Sweden	0.0%	0.0%	0.0%	0.0%	30.0%	12.5%
Switzerland	0.0%	25.0%	0.0%	0.0%	0.0%	3.8%
USA	0.0%	0.0%	0.8%	2.2%	7.2%	3.2%
US States						
California	0.0%	0.0%	0.0%	0.0%	9.4%	3.1%
Illinois	0.0%	0.0%	0.0%	0.0%	14.3%	3.4%
Maryland	0.0%	0.0%	0.0%	2.9%	2.7%	1.8%
Massachusetts	0.0%	0.0%	0.0%	0.0%	2.4%	0.9%
Michigan	0.0%	0.0%	0.0%	0.0%	13.3%	3.5%
Minnesota	0.0%	0.0%	0.0%	0.0%	25.0%	6.7%
New York	0.0%	0.0%	0.0%	3.6%	3.8%	2.4%
North Carolina	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ohio	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pennsylvania	0.0%	0.0%	14.3%	0.0%	14.3%	7.0%
Texas	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Washington	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wisconsin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
World	**1.9%**	**2.4%**	**3.0%**	**3.1%**	**9.4%**	**3.9%**

Table 4.4 Highly-cited papers in the Tumour Stem Cells MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**22.7%**	**23.5%**	**33.3%**	**32.6%**	**31.0%**	**29.7%**
EU-27	13.6%	22.4%	28.9%	26.9%	32.1%	27.6%
UN Macroregions						
Europe	13.0%	23.0%	29.4%	27.8%	32.1%	28.0%
Africa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Asia	26.7%	11.5%	32.7%	27.7%	22.0%	25.2%
Latin America	0.0%	0.0%	0.0%	0.0%	25.0%	7.1%
Northern America	32.2%	31.2%	43.3%	40.4%	37.0%	38.1%
Oceania	0.0%	50.0%	60.0%	33.3%	25.0%	35.3%
Countries						
Brazil	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canada	20.0%	20.0%	42.9%	39.4%	41.9%	36.7%
China	0.0%	0.0%	21.7%	26.9%	11.9%	19.2%
France	0.0%	16.7%	30.0%	46.2%	19.0%	27.5%
Germany	0.0%	8.3%	40.0%	37.3%	37.0%	33.8%
India	100.0%	0.0%	20.0%	0.0%	33.3%	20.0%
Israel	0.0%	0.0%	0.0%	60.0%	16.7%	23.5%
Italy	0.0%	33.3%	29.4%	23.5%	41.3%	31.6%
Japan	16.7%	25.0%	50.0%	26.5%	25.0%	29.1%
Netherlands	0.0%	0.0%	28.6%	41.7%	40.0%	33.3%
South Korea	33.3%	0.0%	50.0%	15.4%	30.0%	25.8%
Spain	50.0%	0.0%	33.3%	25.0%	32.0%	29.5%
Sweden	0.0%	100.0%	33.3%	20.0%	50.0%	37.5%
Switzerland	0.0%	0.0%	50.0%	75.0%	36.4%	42.3%
USA	33.3%	33.3%	44.3%	40.4%	36.4%	38.4%
US States						
California	50.0%	17.6%	59.3%	49.1%	41.5%	45.0%
Illinois	100.0%	60.0%	25.0%	25.0%	42.9%	37.9%
Maryland	42.9%	45.5%	36.4%	32.4%	35.1%	36.0%
Massachusetts	20.0%	44.4%	52.9%	55.3%	40.5%	46.8%
Michigan	25.0%	62.5%	53.8%	47.1%	26.7%	43.9%
Minnesota	0.0%	0.0%	16.7%	25.0%	75.0%	33.3%
New York	54.5%	11.1%	45.5%	42.9%	42.3%	41.2%
North Carolina	0.0%	66.7%	66.7%	58.3%	81.8%	66.7%
Ohio	0.0%	0.0%	100.0%	50.0%	58.8%	55.6%
Pennsylvania	50.0%	25.0%	28.6%	47.6%	38.1%	40.4%
Texas	28.6%	30.0%	41.7%	50.0%	44.1%	41.3%
Washington	0.0%	25.0%	16.7%	50.0%	14.3%	25.0%
Wisconsin	0.0%	20.0%	66.7%	20.0%	0.0%	25.0%
World	**18.1%**	**19.4%**	**24.0%**	**21.4%**	**22.2%**	**21.0%**

Annex 5. MeSH term – Stem Cell Transplantation

Table 5.1 Papers published per year in the Stem Cell Transplantation MeSH category

	2005	2006	2007	2008	2009	Total
UK	**174**	**159**	**209**	**221**	**253**	**1,016**
EU-27	1007	952	1069	1216	1248	5,492
UN Macroregions						
Europe	1,055	997	1,100	1,268	1,304	5,724
Africa	12	5	9	15	17	58
Asia	475	516	620	791	762	3,164
Latin America	43	36	51	57	83	270
Northern America	889	1,080	1,114	1,275	1,286	5,644
Oceania	58	72	69	75	103	377
Countries						
Brazil	15	15	29	32	59	150
Canada	77	96	119	147	144	583
China	68	80	137	183	207	675
France	168	126	156	159	206	815
Germany	296	293	296	338	387	1,610
India	12	6	21	24	29	92
Israel	44	52	53	56	50	255
Italy	182	179	213	240	240	1,054
Japan	238	227	242	311	259	1,277
Netherlands	102	74	123	124	107	530
South Korea	58	75	88	80	105	406
Spain	76	72	77	99	123	447
Sweden	62	74	72	81	91	380
Switzerland	49	62	56	77	86	330
USA	833	1,022	1,026	1,169	1,203	5,253
US States						
California	129	162	158	214	223	886
Illinois	47	71	72	78	100	368
Maryland	104	117	128	93	145	587
Massachusetts	101	133	132	151	159	676
Michigan	39	45	43	43	45	215
Minnesota	76	100	88	114	124	502
New York	82	120	106	145	147	600
North Carolina	46	50	56	53	49	254
Ohio	60	62	68	103	94	387
Pennsylvania	58	80	69	95	110	412
Texas	84	104	128	133	164	613
Washington	85	103	99	102	117	506
Wisconsin	26	43	32	64	54	219
World	**2,278**	**2,446**	**2,650**	**3,082**	**3,040**	**13,496**

Table 5.2 Citation impact in the Stem Cell Transplantation MeSH category

	2005	2006	2007	2008	2009	Average
UK	**1.24**	**1.56**	**1.40**	**1.45**	**1.56**	**1.45**
EU-27	1.05	1.36	1.31	1.26	1.37	1.27
UN Macroregions						
Europe	1.04	1.34	1.30	1.24	1.35	1.26
Africa	0.82	0.23	0.93	0.86	1.05	0.87
Asia	1.03	1.05	0.97	1.07	1.03	1.03
Latin America	0.76	0.46	1.53	0.75	1.15	0.98
Northern America	1.62	1.54	1.56	1.72	1.61	1.61
Oceania	0.79	2.17	1.33	1.60	1.95	1.63
Countries						
Brazil	0.88	0.33	2.35	0.70	1.24	1.21
Canada	1.50	1.46	1.67	1.25	1.72	1.52
China	1.08	1.19	0.97	1.10	1.03	1.06
France	1.02	1.81	1.39	1.34	1.79	1.47
Germany	1.26	1.51	1.52	1.30	1.82	1.50
India	0.72	0.53	0.50	0.99	0.69	0.72
Israel	1.57	1.56	1.37	1.32	2.14	1.58
Italy	1.24	1.42	1.82	1.51	1.96	1.61
Japan	0.94	0.99	0.91	1.10	0.88	0.97
Netherlands	1.10	1.28	1.55	1.50	1.53	1.41
South Korea	1.37	0.96	1.17	1.17	1.28	1.19
Spain	0.98	1.73	0.98	1.20	1.68	1.34
Sweden	1.73	1.93	1.71	1.41	1.63	1.67
Switzerland	1.22	2.79	1.91	1.38	2.16	1.91
USA	1.65	1.55	1.59	1.79	1.65	1.65
US States						
California	1.76	1.73	1.82	1.81	1.88	1.81
Illinois	1.73	1.34	1.45	1.58	1.91	1.62
Maryland	2.15	2.31	1.68	1.50	2.09	1.96
Massachusetts	2.28	1.93	2.19	2.46	2.64	2.32
Michigan	1.83	2.43	2.26	1.29	1.96	1.96
Minnesota	1.40	1.38	1.78	1.53	2.23	1.70
New York	2.07	1.78	1.68	1.37	2.28	1.83
North Carolina	1.42	1.73	2.26	1.43	3.54	2.08
Ohio	1.73	1.36	1.92	1.41	1.78	1.63
Pennsylvania	1.82	1.48	1.78	1.27	2.37	1.76
Texas	1.88	1.78	1.56	1.72	1.61	1.69
Washington	1.84	1.81	1.47	1.51	1.65	1.65
Wisconsin	2.01	2.17	2.50	5.42	1.92	3.09
World	**1.16**	**1.27**	**1.22**	**1.33**	**1.25**	**1.25**

Table 5.3 Uncited papers in the Stem Cell Transplantation MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**3.4%**	**3.1%**	**2.9%**	**5.9%**	**13.8%**	**6.4%**
EU-27	3.9%	5.3%	5.4%	9.5%	19.2%	9.1%
UN Macroregions						
Europe	4.4%	6.0%	5.9%	9.8%	19.9%	9.7%
Africa	16.7%	40.0%	0.0%	6.7%	11.8%	12.1%
Asia	4.8%	4.7%	8.4%	12.9%	27.2%	12.9%
Latin America	16.3%	11.1%	9.8%	10.5%	34.9%	18.9%
Northern America	1.8%	2.1%	3.1%	7.1%	16.6%	6.7%
Oceania	0.0%	1.4%	7.2%	5.3%	16.5%	7.2%
Countries						
Brazil	0.0%	6.7%	3.4%	12.5%	28.8%	15.3%
Canada	1.3%	1.0%	2.5%	6.1%	13.9%	5.8%
China	2.9%	5.0%	5.1%	11.5%	17.9%	10.5%
France	4.2%	7.1%	8.3%	12.6%	21.4%	11.4%
Germany	3.0%	7.5%	5.4%	7.1%	16.0%	8.3%
India	25.0%	0.0%	9.5%	0.0%	31.0%	15.2%
Israel	2.3%	3.8%	3.8%	7.1%	16.0%	6.7%
Italy	3.3%	3.9%	4.7%	5.4%	11.7%	6.1%
Japan	4.2%	4.4%	9.1%	12.9%	30.5%	12.6%
Netherlands	1.0%	6.8%	4.1%	6.5%	16.8%	7.0%
South Korea	1.7%	4.0%	6.8%	12.5%	26.7%	11.8%
Spain	6.6%	0.0%	3.9%	13.1%	15.4%	8.9%
Sweden	1.6%	1.4%	2.8%	9.9%	14.3%	6.6%
Switzerland	2.0%	4.8%	3.6%	2.6%	18.6%	7.3%
USA	1.8%	2.2%	3.2%	7.1%	16.5%	6.7%
US States						
California	1.6%	1.2%	1.9%	5.6%	13.0%	5.4%
Illinois	0.0%	1.4%	2.8%	3.8%	15.0%	5.7%
Maryland	1.0%	2.6%	3.1%	3.2%	16.6%	6.0%
Massachusetts	1.0%	0.8%	3.0%	5.3%	15.7%	5.8%
Michigan	7.7%	2.2%	2.3%	7.0%	17.8%	7.4%
Minnesota	1.3%	1.0%	2.3%	10.5%	17.7%	7.6%
New York	0.0%	3.3%	1.9%	4.1%	12.2%	5.0%
North Carolina	2.2%	2.0%	1.8%	5.7%	8.2%	3.9%
Ohio	3.3%	1.6%	2.9%	6.8%	16.0%	7.0%
Pennsylvania	0.0%	1.3%	1.4%	7.4%	10.9%	5.1%
Texas	0.0%	2.9%	3.9%	6.8%	16.5%	7.2%
Washington	3.5%	1.0%	3.0%	10.8%	20.5%	8.3%
Wisconsin	0.0%	0.0%	6.3%	4.7%	18.5%	6.8%
World	**4.1%**	**4.6%**	**5.8%**	**10.3%**	**22.0%**	**9.4%**

Table 5.4 Highly-cited papers in the Stem Cell Transplantation MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**15.5%**	**20.8%**	**16.7%**	**17.6%**	**19.8%**	**18.1%**
EU-27	13.2%	16.5%	17.1%	16.5%	16.4%	16.0%
UN Macroregions						
Europe	13.3%	16.2%	16.9%	16.2%	16.2%	15.8%
Africa	16.7%	0.0%	11.1%	13.3%	11.8%	12.1%
Asia	13.7%	14.7%	12.7%	12.9%	10.5%	12.7%
Latin America	9.3%	5.6%	17.6%	8.8%	14.5%	11.9%
Northern America	21.5%	22.0%	21.9%	22.0%	19.6%	21.4%
Oceania	6.9%	25.0%	11.6%	22.7%	23.3%	18.8%
Countries						
Brazil	6.7%	0.0%	27.6%	3.1%	13.6%	12.0%
Canada	16.9%	20.8%	24.4%	13.6%	19.4%	18.9%
China	19.1%	16.3%	10.2%	13.1%	11.6%	13.0%
France	14.9%	24.6%	18.6%	20.1%	25.2%	20.7%
Germany	18.2%	18.8%	20.6%	17.5%	20.7%	19.2%
India	0.0%	0.0%	0.0%	4.2%	6.9%	3.3%
Israel	20.5%	26.9%	17.0%	21.4%	16.0%	20.4%
Italy	13.7%	19.0%	23.9%	21.3%	21.7%	20.2%
Japan	12.2%	12.3%	12.0%	12.2%	9.7%	11.7%
Netherlands	14.7%	18.9%	17.1%	16.9%	19.6%	17.4%
South Korea	19.0%	16.0%	17.0%	15.0%	13.3%	15.8%
Spain	13.2%	26.4%	10.4%	17.2%	20.3%	17.7%
Sweden	21.0%	16.2%	18.1%	14.8%	22.0%	18.4%
Switzerland	26.5%	33.9%	25.0%	15.6%	22.1%	23.9%
USA	22.0%	22.3%	22.0%	23.1%	20.4%	21.9%
US States						
California	27.9%	26.5%	31.0%	30.8%	22.4%	27.5%
Illinois	25.5%	18.3%	22.2%	24.4%	22.0%	22.3%
Maryland	25.0%	35.0%	25.8%	26.9%	28.3%	28.3%
Massachusetts	32.7%	27.8%	28.0%	33.8%	29.6%	30.3%
Michigan	20.5%	31.1%	27.9%	23.3%	31.1%	27.0%
Minnesota	21.1%	21.0%	25.0%	27.2%	29.8%	25.3%
New York	29.3%	27.5%	33.0%	22.8%	29.9%	28.2%
North Carolina	21.7%	22.0%	35.7%	22.6%	42.9%	29.1%
Ohio	18.3%	17.7%	26.5%	20.4%	23.4%	21.4%
Pennsylvania	31.0%	21.3%	27.5%	16.8%	28.2%	24.5%
Texas	28.6%	22.1%	18.0%	30.1%	23.2%	24.1%
Washington	21.2%	24.3%	20.2%	27.5%	22.2%	23.1%
Wisconsin	26.9%	30.2%	28.1%	29.7%	25.9%	28.3%
World	**7.3%**	**9.3%**	**8.8%**	**9.1%**	**8.2%**	**8.5%**

Annex 6. MeSH term – Tissue Engineering

Table 6.1 Papers published per year in the Tissue Engineering MeSH category

	2005	2006	2007	2008	2009	Total
UK	**116**	**210**	**217**	**212**	**171**	**926**
EU-27	386	663	621	755	742	3,167
UN Macroregions						
Europe	414	704	647	784	777	3,326
Africa	6	4	7	6	12	35
Asia	443	510	593	668	723	2,937
Latin America	9	12	13	14	29	77
Northern America	561	735	709	808	891	3,704
Oceania	25	33	43	50	76	227
Countries						
Brazil	5	6	7	8	15	41
Canada	55	54	76	72	100	357
China	112	134	177	225	262	910
France	36	48	67	53	64	268
Germany	102	182	162	184	181	811
India	5	12	8	28	46	99
Israel	14	28	28	18	21	109
Italy	52	83	80	102	99	416
Japan	194	185	198	224	197	998
Netherlands	50	75	51	74	80	330
South Korea	54	77	71	67	79	348
Spain	10	22	20	32	44	128
Sweden	4	14	19	25	23	85
Switzerland	43	63	45	56	54	261
USA	514	689	644	754	805	3,406
US States						
California	70	87	86	105	103	451
Illinois	32	56	31	36	32	187
Maryland	26	56	44	45	45	216
Massachusetts	101	127	138	129	130	625
Michigan	32	39	29	36	58	194
Minnesota	17	29	9	19	28	102
New York	41	67	69	76	72	325
North Carolina	23	32	40	35	45	175
Ohio	21	26	35	39	44	165
Pennsylvania	58	78	72	91	71	370
Texas	53	59	57	69	62	300
Washington	14	12	19	9	16	70
Wisconsin	7	10	5	19	13	54
World	**1,299**	**1,787**	**1,794**	**2,057**	**2,167**	**9,104**

Table 6.2 Citation impact in the Tissue Engineering MeSH category

	2005	2006	2007	2008	2009	Average
UK	**2.17**	**1.52**	**1.76**	**1.80**	**1.55**	**1.73**
EU-27	1.76	1.50	1.66	1.57	1.40	1.56
UN Macroregions						
Europe	1.89	1.54	1.67	1.58	1.42	1.59
Africa	0.63	2.34	0.81	1.91	2.04	1.56
Asia	1.86	1.49	1.43	1.60	1.29	1.51
Latin America	1.02	0.56	1.34	1.18	1.70	1.28
Northern America	2.36	1.97	1.87	2.07	1.61	1.95
Oceania	2.03	1.72	1.66	2.00	1.95	1.88
Countries						
Brazil	0.67	0.72	1.41	1.01	1.06	1.01
Canada	1.70	1.36	1.45	1.79	1.00	1.42
China	1.51	1.47	1.29	1.36	1.12	1.31
France	1.59	1.29	1.42	1.15	1.28	1.33
Germany	1.31	1.37	1.42	1.39	1.28	1.36
India	5.26	0.90	0.85	1.61	1.54	1.61
Israel	2.90	1.40	1.84	1.39	1.77	1.78
Italy	1.89	1.51	1.55	1.37	1.31	1.48
Japan	1.72	1.33	1.27	1.75	1.20	1.46
Netherlands	2.17	1.54	2.34	1.90	1.34	1.79
South Korea	2.25	2.00	1.61	1.81	1.70	1.85
Spain	0.96	2.29	1.30	1.82	1.51	1.65
Sweden	0.69	2.33	1.24	1.73	0.95	1.46
Switzerland	3.09	2.13	1.84	1.82	1.79	2.10
USA	2.41	2.02	1.93	2.09	1.69	2.00
US States						
California	2.93	2.10	1.67	2.68	2.12	2.29
Illinois	1.95	1.82	1.81	1.51	1.33	1.70
Maryland	2.92	2.34	2.42	2.12	1.64	2.23
Massachusetts	2.35	2.40	2.43	2.39	1.64	2.24
Michigan	3.30	1.88	1.92	2.01	2.46	2.32
Minnesota	1.62	1.37	1.85	2.48	1.25	1.63
New York	2.47	2.02	2.54	1.96	1.47	2.05
North Carolina	1.69	3.06	2.80	1.47	1.74	2.16
Ohio	2.02	1.30	1.58	2.37	1.13	1.66
Pennsylvania	2.31	1.96	2.27	1.86	2.35	2.12
Texas	1.94	2.12	2.36	1.85	1.61	1.97
Washington	4.40	2.45	2.08	1.61	1.53	2.42
Wisconsin	5.70	4.66	2.43	1.05	1.04	2.45
World	**1.99**	**1.67**	**1.64**	**1.72**	**1.44**	**1.69**

Table 6.3 Uncited papers in the Tissue Engineering MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**0.0%**	**1.0%**	**0.9%**	**2.8%**	**17.5%**	**4.3%**
EU-27	1.6%	2.3%	2.9%	4.2%	14.6%	5.7%
UN Macroregions						
Europe	1.4%	2.6%	2.8%	4.3%	14.5%	5.7%
Africa	0.0%	0.0%	0.0%	16.7%	8.3%	5.7%
Asia	0.9%	1.8%	2.5%	3.6%	18.5%	6.3%
Latin America	0.0%	8.3%	7.7%	7.1%	27.6%	14.3%
Northern America	0.9%	1.8%	1.8%	3.6%	13.0%	4.8%
Oceania	0.0%	3.0%	0.0%	6.0%	15.8%	7.0%
Countries						
Brazil	0.0%	0.0%	0.0%	12.5%	40.0%	17.1%
Canada	1.8%	1.9%	0.0%	1.4%	13.0%	4.5%
China	3.6%	0.7%	2.8%	4.4%	21.4%	8.4%
France	2.8%	4.2%	1.5%	7.5%	6.3%	4.5%
Germany	2.9%	3.8%	4.3%	7.1%	14.9%	7.0%
India	0.0%	0.0%	25.0%	0.0%	17.4%	10.1%
Israel	0.0%	7.1%	0.0%	11.1%	4.8%	4.6%
Italy	0.0%	2.4%	7.5%	5.9%	8.1%	5.3%
Japan	0.0%	2.2%	3.0%	2.7%	18.8%	5.3%
Netherlands	2.0%	1.3%	0.0%	0.0%	15.0%	4.2%
South Korea	0.0%	1.3%	1.4%	1.5%	8.9%	2.9%
Spain	0.0%	0.0%	0.0%	0.0%	15.9%	5.5%
Sweden	0.0%	0.0%	0.0%	0.0%	26.1%	7.1%
Switzerland	0.0%	4.8%	2.2%	1.8%	14.8%	5.0%
USA	0.8%	1.7%	2.0%	3.7%	13.0%	4.8%
US States						
California	0.0%	2.3%	2.3%	4.8%	12.6%	4.9%
Illinois	0.0%	3.6%	3.2%	0.0%	15.6%	4.3%
Maryland	0.0%	1.8%	0.0%	4.4%	13.3%	4.2%
Massachusetts	0.0%	1.6%	1.4%	3.1%	10.8%	3.5%
Michigan	0.0%	0.0%	3.4%	11.1%	5.2%	4.1%
Minnesota	0.0%	6.9%	0.0%	5.3%	21.4%	8.8%
New York	0.0%	1.5%	0.0%	3.9%	8.3%	3.1%
North Carolina	4.3%	0.0%	0.0%	0.0%	22.2%	6.3%
Ohio	4.8%	0.0%	5.7%	5.1%	15.9%	7.3%
Pennsylvania	3.4%	2.6%	1.4%	3.3%	5.6%	3.2%
Texas	0.0%	0.0%	0.0%	8.7%	8.1%	3.7%
Washington	0.0%	8.3%	5.3%	0.0%	0.0%	2.9%
Wisconsin	0.0%	0.0%	0.0%	21.1%	7.7%	9.3%
World	**1.2%**	**2.1%**	**2.5%**	**4.2%**	**15.7%**	**5.2%**

Table 6.4 Highly-cited papers in the Tissue Engineering MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**23.3%**	**21.4%**	**25.8%**	**25.5%**	**15.2%**	**22.5%**
EU-27	26.2%	24.4%	25.0%	23.7%	16.7%	22.8%
UN Macroregions						
Europe	27.5%	24.6%	25.3%	24.0%	17.0%	23.2%
Africa	0.0%	50.0%	14.3%	33.3%	16.7%	20.0%
Asia	27.8%	23.5%	19.7%	22.0%	16.0%	21.2%
Latin America	11.1%	0.0%	30.8%	21.4%	20.7%	18.2%
Northern America	38.5%	33.6%	30.7%	30.1%	19.6%	29.7%
Oceania	28.0%	27.3%	32.6%	38.0%	26.3%	30.4%
Countries						
Brazil	0.0%	0.0%	28.6%	12.5%	20.0%	14.6%
Canada	29.1%	27.8%	26.3%	23.6%	5.0%	20.4%
China	20.5%	26.1%	16.9%	19.1%	12.2%	17.9%
France	33.3%	20.8%	22.4%	17.0%	12.5%	20.1%
Germany	17.6%	23.6%	24.1%	19.0%	17.7%	20.6%
India	80.0%	16.7%	12.5%	35.7%	21.7%	27.3%
Israel	28.6%	25.0%	25.0%	27.8%	28.6%	26.6%
Italy	30.8%	28.9%	22.5%	19.6%	16.2%	22.6%
Japan	25.8%	17.8%	17.7%	18.3%	15.2%	18.9%
Netherlands	38.0%	28.0%	39.2%	33.8%	18.8%	30.3%
South Korea	46.3%	32.5%	25.4%	25.4%	21.5%	29.3%
Spain	20.0%	36.4%	10.0%	21.9%	18.2%	21.1%
Sweden	0.0%	42.9%	21.1%	40.0%	13.0%	27.1%
Switzerland	44.2%	31.7%	35.6%	30.4%	20.4%	31.8%
USA	39.5%	34.1%	31.7%	30.8%	21.5%	30.7%
US States						
California	41.4%	35.6%	26.7%	20.0%	26.2%	29.0%
Illinois	50.0%	37.5%	22.6%	25.0%	25.0%	32.6%
Maryland	42.3%	37.5%	38.6%	35.6%	15.6%	33.3%
Massachusetts	41.6%	39.4%	42.0%	41.1%	23.1%	37.3%
Michigan	46.9%	33.3%	41.4%	19.4%	31.0%	33.5%
Minnesota	41.2%	27.6%	55.6%	47.4%	14.3%	32.4%
New York	41.5%	34.3%	47.8%	30.3%	18.1%	33.5%
North Carolina	30.4%	40.6%	40.0%	17.1%	22.2%	29.7%
Ohio	33.3%	19.2%	22.9%	23.1%	13.6%	21.2%
Pennsylvania	36.2%	32.1%	38.9%	36.3%	29.6%	34.6%
Texas	35.8%	33.9%	38.6%	27.5%	22.6%	31.3%
Washington	64.3%	25.0%	36.8%	33.3%	18.8%	35.7%
Wisconsin	57.1%	50.0%	60.0%	15.8%	7.7%	29.6%
World	**18.3%**	**15.1%**	**14.6%**	**13.6%**	**10.0%**	**14.3%**

Annex 7. MeSH term – Regenerative Medicine

Table 7.1 Papers published per year in the Regenerative Medicine MeSH category

	2005	2006	2007	2008	2009	Total
UK	**38**	**50**	**99**	**89**	**90**	**366**
EU-27	77	118	223	251	342	1,011
UN Macroregions						
Europe	80	124	232	258	353	1,047
Africa	0	1	1	2	3	7
Asia	100	98	175	207	238	818
Latin America	0	3	5	3	9	20
Northern America	101	140	234	370	448	1,293
Oceania	2	7	9	8	23	49
Countries						
Brazil	0	1	2	2	5	10
Canada	16	7	17	31	50	121
China	5	9	20	32	57	123
France	4	8	17	14	26	69
Germany	18	18	49	53	83	221
India	0	0	4	11	10	25
Israel	1	3	16	11	13	44
Italy	12	14	24	36	52	138
Japan	81	78	116	123	122	520
Netherlands	0	4	6	11	22	43
South Korea	1	3	9	18	17	48
Spain	1	11	16	20	23	71
Sweden	0	6	9	14	20	49
Switzerland	3	7	6	8	15	39
USA	86	134	224	350	408	1,202
US States						
California	14	19	49	80	114	276
Illinois	2	6	12	17	19	56
Maryland	7	11	10	22	38	88
Massachusetts	14	27	32	68	57	198
Michigan	0	3	2	6	14	25
Minnesota	3	5	4	9	13	34
New York	4	7	19	17	33	80
North Carolina	11	15	28	32	36	122
Ohio	1	4	7	10	14	36
Pennsylvania	24	33	30	46	44	177
Texas	0	2	8	9	18	37
Washington	2	6	16	16	24	64
Wisconsin	2	0	6	3	10	21
World	**253**	**339**	**577**	**742**	**900**	**2,811**

Table 7.2 Citation impact in the Regenerative Medicine MeSH category

	2005	2006	2007	2008	2009	Average
UK	**1.38**	**1.58**	**1.18**	**1.81**	**2.09**	**1.63**
EU-27	1.88	1.78	1.42	1.96	1.74	1.74
UN Macroregions						
Europe	1.90	1.86	1.41	1.96	1.76	1.75
Africa	0.00	0.21	0.27	1.45	3.79	2.11
Asia	1.31	1.48	1.49	1.35	1.41	1.41
Latin America	0.00	1.20	0.81	1.61	1.29	1.21
Northern America	2.73	2.79	2.27	2.62	2.33	2.49
Oceania	1.19	3.64	0.96	0.95	3.81	2.69
Countries						
Brazil	0.00	0.63	0.82	1.12	1.56	1.23
Canada	2.21	0.61	1.43	2.63	2.32	2.16
China	1.24	2.87	0.94	1.32	1.48	1.44
France	1.82	2.69	1.64	2.48	1.73	1.98
Germany	2.76	1.19	1.41	2.48	1.86	1.93
India	0.00	0.00	0.48	1.93	1.81	1.65
Israel	0.83	1.37	2.38	1.45	2.73	2.15
Italy	2.26	1.93	1.13	2.17	1.51	1.72
Japan	1.37	1.43	1.42	1.30	1.19	1.33
Netherlands	0.00	2.68	3.79	3.71	2.92	3.22
South Korea	0.69	3.65	1.41	2.26	1.19	1.78
Spain	0.00	1.39	0.66	3.96	2.42	2.26
Sweden	0.00	2.90	2.05	1.44	1.43	1.73
Switzerland	2.76	2.89	0.95	3.47	2.24	2.45
USA	2.91	2.89	2.30	2.69	2.33	2.53
US States						
California	2.06	2.99	3.12	2.99	2.26	2.66
Illinois	2.72	2.94	2.26	1.87	1.59	2.00
Maryland	3.03	3.69	3.23	2.50	2.00	2.56
Massachusetts	5.60	5.76	3.70	4.36	3.05	4.16
Michigan	0.00	3.35	0.64	5.40	3.15	3.51
Minnesota	0.83	1.05	1.52	1.10	2.61	1.70
New York	3.59	0.98	2.78	1.87	2.40	2.31
North Carolina	1.24	4.62	2.98	1.56	2.07	2.38
Ohio	1.72	0.92	2.43	2.91	1.88	2.16
Pennsylvania	1.97	1.71	1.48	1.93	2.17	1.88
Texas	0.00	1.63	2.87	3.45	1.90	2.47
Washington	12.40	2.55	3.77	2.47	2.23	3.02
Wisconsin	2.73	0.00	1.19	1.53	4.95	3.17
World	**1.83**	**2.09**	**1.66**	**1.99**	**1.83**	**1.88**

Table 7.3 Uncited papers in the Regenerative Medicine MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**0.0%**	**0.0%**	**4.0%**	**2.2%**	**11.1%**	**4.4%**
EU-27	2.6%	0.0%	4.5%	5.6%	12.0%	6.6%
UN Macroregions						
Europe	2.5%	0.8%	4.3%	6.2%	12.2%	6.9%
Africa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Asia	3.0%	4.1%	3.4%	8.2%	16.4%	8.4%
Latin America	0.0%	0.0%	0.0%	0.0%	33.3%	15.0%
Northern America	2.0%	1.4%	2.6%	3.5%	11.2%	5.6%
Oceania	0.0%	0.0%	0.0%	12.5%	13.0%	8.2%
Countries						
Brazil	0.0%	0.0%	0.0%	0.0%	40.0%	20.0%
Canada	0.0%	0.0%	0.0%	0.0%	16.0%	6.6%
China	20.0%	11.1%	5.0%	9.4%	17.5%	13.0%
France	25.0%	0.0%	0.0%	21.4%	11.5%	10.1%
Germany	0.0%	0.0%	2.0%	3.8%	14.5%	6.8%
India	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Israel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Italy	0.0%	0.0%	16.7%	5.6%	5.8%	6.5%
Japan	2.5%	3.8%	4.3%	12.2%	21.3%	9.8%
Netherlands	0.0%	0.0%	0.0%	9.1%	0.0%	2.3%
South Korea	0.0%	0.0%	0.0%	5.6%	17.6%	8.3%
Spain	100.0%	0.0%	6.3%	5.0%	13.0%	8.5%
Sweden	0.0%	0.0%	0.0%	0.0%	5.0%	2.0%
Switzerland	0.0%	14.3%	0.0%	0.0%	6.7%	5.1%
USA	2.3%	1.5%	2.7%	3.7%	10.5%	5.5%
US States						
California	0.0%	0.0%	0.0%	7.5%	10.5%	6.5%
Illinois	0.0%	0.0%	0.0%	5.9%	10.5%	5.4%
Maryland	0.0%	0.0%	0.0%	0.0%	2.6%	1.1%
Massachusetts	0.0%	3.7%	12.5%	2.9%	5.3%	5.1%
Michigan	0.0%	0.0%	0.0%	0.0%	7.1%	4.0%
Minnesota	0.0%	20.0%	0.0%	11.1%	7.7%	8.8%
New York	0.0%	0.0%	0.0%	11.8%	15.2%	8.8%
North Carolina	0.0%	0.0%	0.0%	3.1%	16.7%	5.7%
Ohio	0.0%	0.0%	0.0%	0.0%	21.4%	8.3%
Pennsylvania	8.3%	0.0%	3.3%	2.2%	15.9%	6.2%
Texas	0.0%	0.0%	0.0%	0.0%	11.1%	5.4%
Washington	0.0%	0.0%	0.0%	0.0%	8.3%	3.1%
Wisconsin	0.0%	0.0%	0.0%	33.3%	10.0%	9.5%
World	**2.8%**	**1.8%**	**3.6%**	**6.1%**	**13.7%**	**5.6%**

Table 7.4 Highly-cited papers in the Regenerative Medicine MeSH category

	2005	2006	2007	2008	2009	Overall
UK	**13.2%**	**30.0%**	**13.1%**	**22.5%**	**20.0%**	**19.4%**
EU-27	24.7%	31.4%	22.4%	24.3%	20.5%	23.4%
UN Macroregions						
Europe	26.3%	30.6%	22.8%	24.0%	21.0%	23.7%
Africa	0.0%	0.0%	0.0%	0.0%	33.3%	14.3%
Asia	16.0%	21.4%	22.3%	14.5%	16.8%	17.8%
Latin America	0.0%	33.3%	20.0%	33.3%	33.3%	30.0%
Northern America	34.7%	36.4%	29.5%	36.2%	26.3%	31.5%
Oceania	50.0%	71.4%	0.0%	12.5%	43.5%	34.7%
Countries						
Brazil	0.0%	0.0%	0.0%	0.0%	40.0%	20.0%
Canada	31.3%	14.3%	23.5%	35.5%	24.0%	27.3%
China	20.0%	33.3%	20.0%	18.8%	15.8%	18.7%
France	25.0%	25.0%	41.2%	35.7%	38.5%	36.2%
Germany	27.8%	16.7%	26.5%	26.4%	26.5%	25.8%
India	0.0%	0.0%	0.0%	18.2%	20.0%	16.0%
Israel	0.0%	33.3%	43.8%	18.2%	38.5%	34.1%
Italy	41.7%	28.6%	25.0%	22.2%	19.2%	23.9%
Japan	17.3%	20.5%	17.2%	13.0%	14.8%	16.2%
Netherlands	0.0%	75.0%	50.0%	45.5%	50.0%	51.2%
South Korea	0.0%	66.7%	33.3%	27.8%	11.8%	25.0%
Spain	0.0%	36.4%	6.3%	35.0%	21.7%	23.9%
Sweden	0.0%	33.3%	33.3%	21.4%	30.0%	28.6%
Switzerland	100.0%	14.3%	16.7%	50.0%	33.3%	35.9%
USA	36.0%	37.3%	29.0%	36.9%	26.7%	31.9%
US States						
California	35.7%	57.9%	30.6%	35.0%	26.3%	32.2%
Illinois	100.0%	33.3%	33.3%	35.3%	26.3%	33.9%
Maryland	28.6%	45.5%	50.0%	45.5%	18.4%	33.0%
Massachusetts	64.3%	59.3%	43.8%	52.9%	36.8%	48.5%
Michigan	0.0%	33.3%	0.0%	66.7%	42.9%	44.0%
Minnesota	0.0%	20.0%	0.0%	11.1%	38.5%	20.6%
New York	75.0%	0.0%	47.4%	29.4%	24.2%	31.3%
North Carolina	9.1%	46.7%	42.9%	25.0%	22.2%	29.5%
Ohio	100.0%	0.0%	14.3%	40.0%	28.6%	27.8%
Pennsylvania	25.0%	18.2%	33.3%	37.0%	29.5%	29.4%
Texas	0.0%	0.0%	25.0%	44.4%	22.2%	27.0%
Washington	100.0%	33.3%	43.8%	25.0%	29.2%	34.4%
Wisconsin	50.0%	0.0%	16.7%	33.3%	20.0%	23.8%
World	**13.0%**	**18.0%**	**12.1%**	**15.2%**	**13.8%**	**14.4%**