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Overview of the
UK National
Stem Cell Network
Patent Watch Landscape

April 2010

Patent informatics project report:
Overview of the UKNSCN patent watch landscape

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Executive Summary

The UK National Stem Cell Network provides the stem cell community with regular digests of both published and granted patents in the field of stem cells. The reports are provided by the IPO every two months and this report analyses the patents published and granted during the period 1 November 2008 – 31 October 2009.

The dataset of published and granted patent applications provided to the UKNSCN was analysed to give an overview of the types of activity/organisations present in the stem cell patent landscape. It should be noted that the more recent research areas/organisations will be reflected in the published patent applications.

In general, corporations hold the main share of both published and granted patent applications, closely followed by academic institutions. It is interesting to note, however, that the top holder of published patent applications is Kyoto University and that of granted patents is Wisconsin Alumni. In the UK, the University of Edinburgh not only has the most published patent applications but also the most number of granted patents.

Recent research is focussed in mesenchymal stem cells, pluripotent cells e.g. embryonic stem cells and haematopoietic stem cells/uncommitted or multipotent progenitors.

For granted patents, the top three areas are pluripotent cells e.g. embryonic stem cells, stem cells/progenitor cells/precursor cells of the nervous system and haematopoietic stem cells/uncommitted or multipotent progenitors.

In the broader fields of cardiovascular, ophthalmic and antineoplastic patenting, both the academic and corporate sectors have a similar share of published patent applications, with the edge just going to the academic sector. Corporations, however, own the bulk of patent applications in the neurological field.

In cardiovascular, ophthalmic and neurological areas, corporations have at least half the share of granted patents. The exception to this is in the antineoplastic area in which academic institutions are the main granted patent holders.

In order to place the results of the UK patent watch in a more global context and to give a fuller picture of the activity in relation to stem cells, an overview of the complete global dataset is recommended. This is particularly important with patent applications from countries such as China rising very rapidly.

Further more detailed analysis is also possible for specific companies or technology areas. A particular university or company's patent holdings could be analysed, for example, to identify any potential technology cross-over.

It would also be useful to repeat this work at a later date in order to keep on top of the activity in the stem cell technology space. For example, the patent landscape maps could be regenerated and time-sliced in order to graphically view how the patenting activity varies from year to year.

Contents

1	Introduction	5
1.1	Overview	5
1.2	Patent documents analysed	5
1.3	Objectives	5
2	Discussion	6
2.1	General overview of data set.....	6
2.2	Filing trends.....	6
2.3	Organisation breakdown	13
2.4	Organisation breakdown by technology sector.....	14
2.5	Collaborations	16
3	Patent landscape	19
4	Conclusions and recommendations.....	25
4.1	Conclusions.....	25
4.2	Recommendations	25
	Appendix	28
	Basis for report.....	28
	Priority year, application year and publication year	28
	WO and EP filings.....	28
	Data cleaning	29

1 Introduction

1.1 Overview

The UK National Stem Cell Network (UKNSCN) provides the stem cell community with regular digests of both published and granted patents in the field of stem cells¹. The reports are provided by the IPO every two months and this report analyses the patents published and granted during the period 1 November 2008 – 31 October 2009.

1.2 Patent documents analysed

The dataset was provided in full so no further searching was necessary. The UKNSCN patent digests also contain details of the search strategy used and so for completeness, an exemplar search strategy is reproduced here:

Search area (ECLA):

1: /EC/ECNO OR C12N5/06B2P, C12N5/06B3, C12N5/06B6P, C12N5/06B8P, C12N5/06B11P, C12N5/06B12P, C12N5/06B14P, C12N5/06B18P, C12N5/06B20P, C12N5/06B21P, C12N5/06B22P, C12N5/06B26P, C12N5/06B28P, C12N5/06B30P, C12N5/06B3A

Key words:

10: * AND (STEM? OR PLURIPOTEN+ OR PROGENITOR? OR EMBRYO+ OR HBS OR BLASTOCYST? OR RE_PROGRAM+ OR DE_DIFFERENTIAT+ OR RETRO_DIFFERENTIAT+ OR ?ESC?)

11: ((STEM? OR PLURIPOTEN+ OR EMBRYONIC+ OR PROGENITOR? OR EMBRYONAL+ OR HBS OR BLASTOCYST? OR DE_DIFFERENTIAT+ OR RETRO_DIFFERENTIAT+ OR ?ES OR RE_PROGRAM+) 3D CELL?) OR (HESC? OR (HUMAN W ESC?) OR (PRIMATE W ESC?))

12: 1 OR 10 OR 11

13: ..LIM 12

14 PD<=2009-10-31 AND PD>2008-10-31 *– provides worldwide dataset of A publications*

15: /PN B? w (OR 200811, 200812, 20090+, 200910) *– provides worldwide dataset of B publications*

16: /PN C? w (OR 200811, 200812, 20090+, 200910) *– provides worldwide dataset of C publications*

1.3 Objectives

In order to provide the macroscopic overview of the dataset provided to the UKNSCN, this report analyses the patent data by considering the following areas:

- Breakdown by the type of applicant (Corporate / Academic / Government)
- Collaboration maps for the top applicants
- Breakdown by certain technological groupings
- Landscape maps for the data set have also been generated

Section 2 gives a detailed overview of the data set, section 3 provides some patent landscape maps and section 4 provides a summary and offers recommendations for future work. The appendix gives details of general technical issues/definitions which may be of use when interpreting the results of this report.

¹ http://www.uknscn.org/downloads/patent_digests.html [accessed 23 March 2010]

2 Discussion

2.1 General overview of data set

Summary data representing the published and granted patents in the UK patent stem cell dataset is shown in Table 1 below.

Number of Patents (Applications/Grants)	847 (744/103)	
Date	Nov 08 – Oct 09	
Top Country	United States (US)	
Top Organisation type	Academic	
Field Choices	Field Name	Field Coverage
Countries	Priority Countries	100%
Years	Priority Years	100%
Technology	International Classifications (Advanced)	100%
	European Classifications	96%

Table 1 Summary of patent data set

The dataset is limited to patent applications published having WO, US, EP and GB designations, along with the granted US, EP and GB patents. It should be noted that WO patent applications are those filed using the international Patent Cooperation Treaty (PCT) route; these patent applications lead to national or regional applications at the relevant national offices. Thus there will be no granted WO patents.

Given the relatively small size of the dataset, the results have been summarised together for clarity. However, the analysis which follows is based on a first dataset containing patents published between November 08 and October 09 and a second dataset containing only patents granted within this time frame.

The one minor issue that should be noted is the lack of full coverage of European classifications. This is likely to be due to the delays at the EPO in applying the classifications.

2.2 Filing trends

It is interesting to break the dataset down by earliest priority date as that gives an indication as to when the work relating to the patents was being carried out. It can be seen in Figure 1 below that even though we are only looking at a dataset comprising patents published between Nov08 and Oct 09, the earliest dates go back to 1989. One reason for this is the continuation-in-part procedure in the United States which allows for a patent application to (potentially) continually claim priority from earlier applications. A similar trend is therefore seen in the granted dataset, as shown in Figure 2.

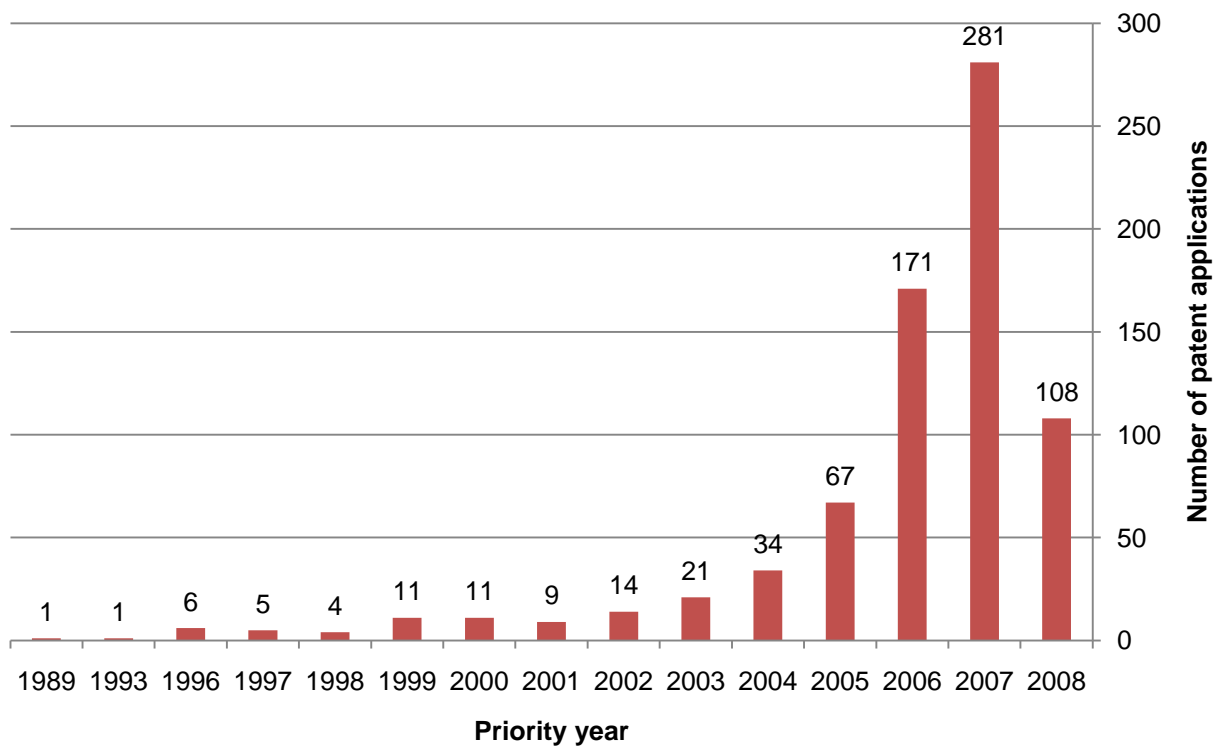


Figure 1 Published patents in the published dataset by priority year

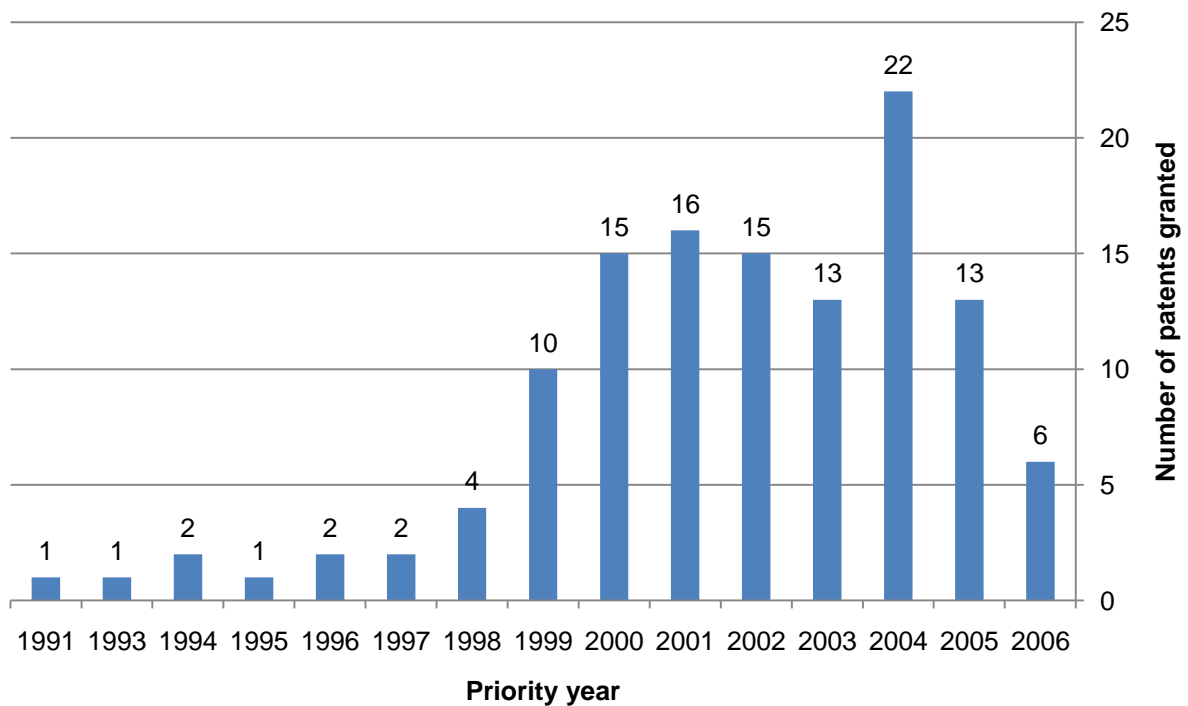


Figure 2 Granted patents by priority year

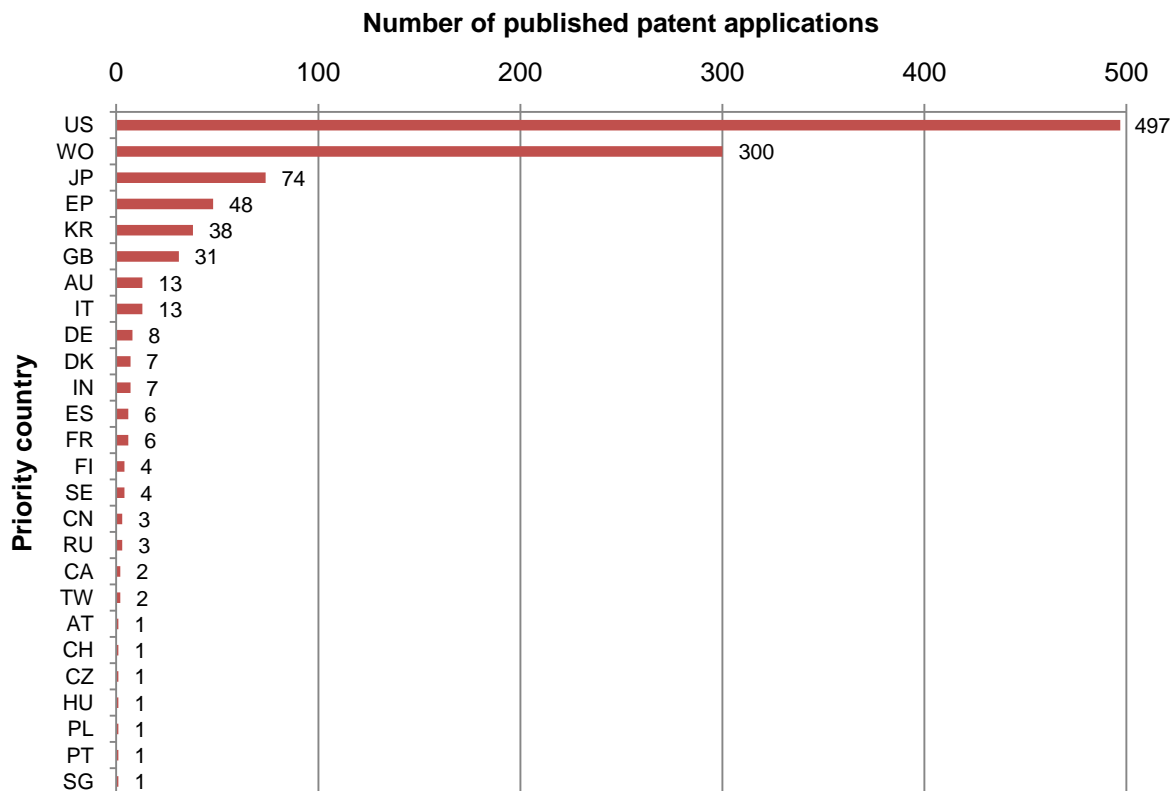


Figure 3 Patent applications in the published dataset by country of priority

Given that the dataset is necessarily limited to WO, US, GB and EP patent publications, it is not surprising that the US and WO patents dominate the country of priority graphs, shown in Figure 3 above and Figure 4 below.

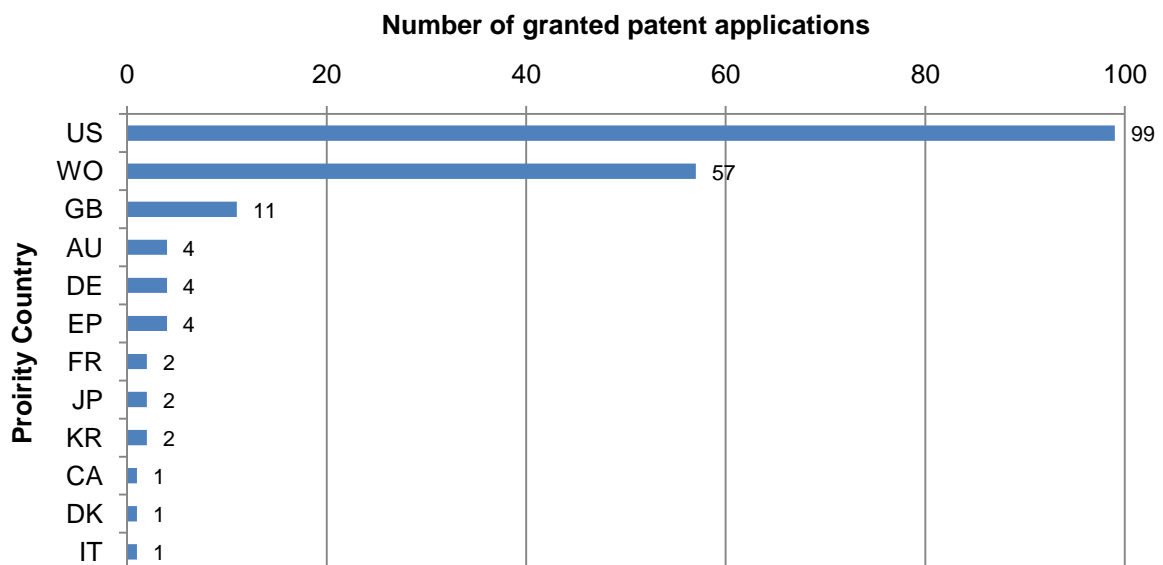


Figure 4 Granted patents by country of priority

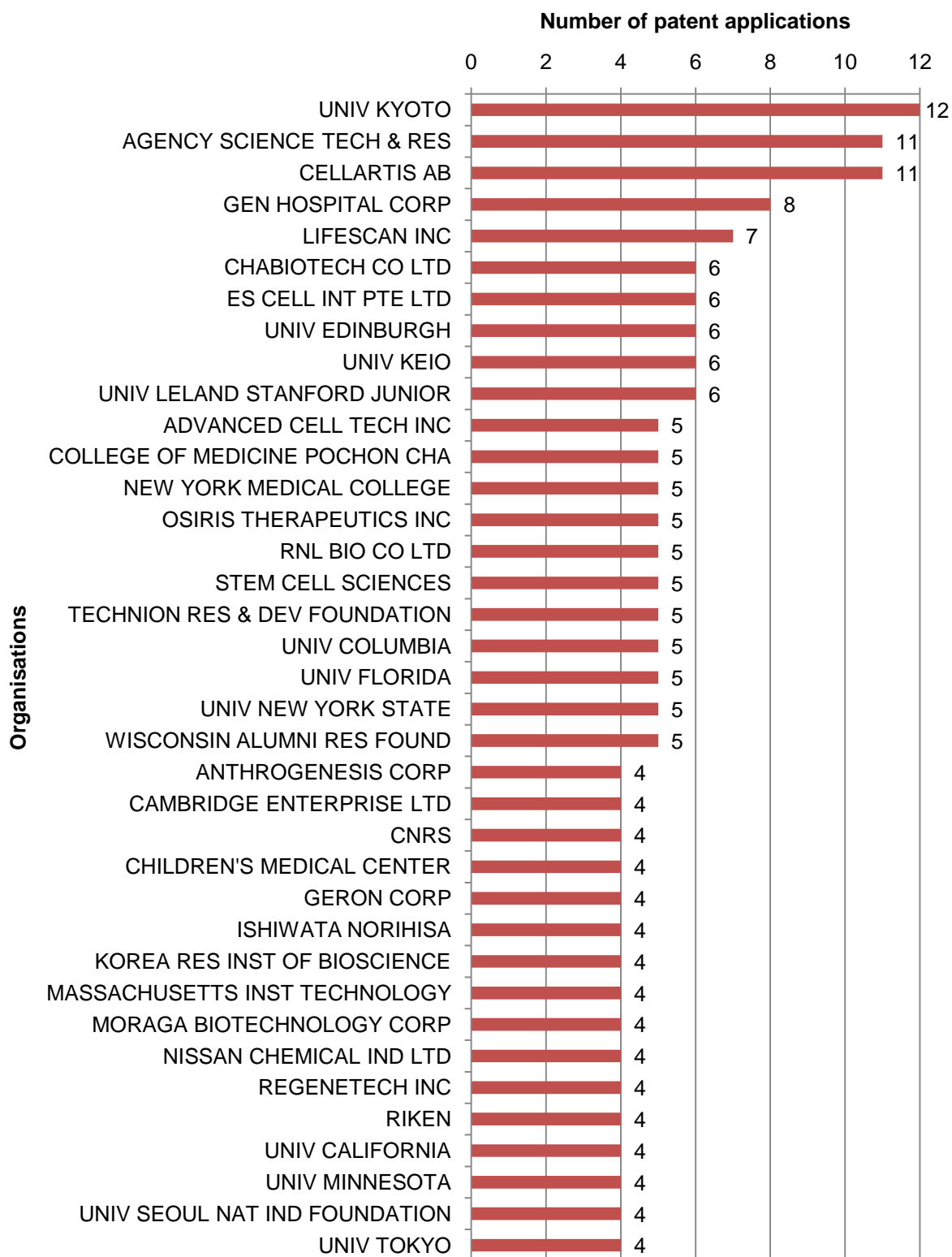


Figure 5 Top applicants having more than 4 published patent applications

Figure 5 and Figure 6 show the number of published patent applications/granted patents for the top organisations. Unlike the general trend seen in many other technology areas in which large corporations dominate patent filings, the top

organisation having published patent applications is Kyoto University. Similarly, a university dominates the granted patents list, Wisconsin Alumni. Edinburgh University leads the way for not only UK universities, but UK organisations in general for both published applications and granted patents.

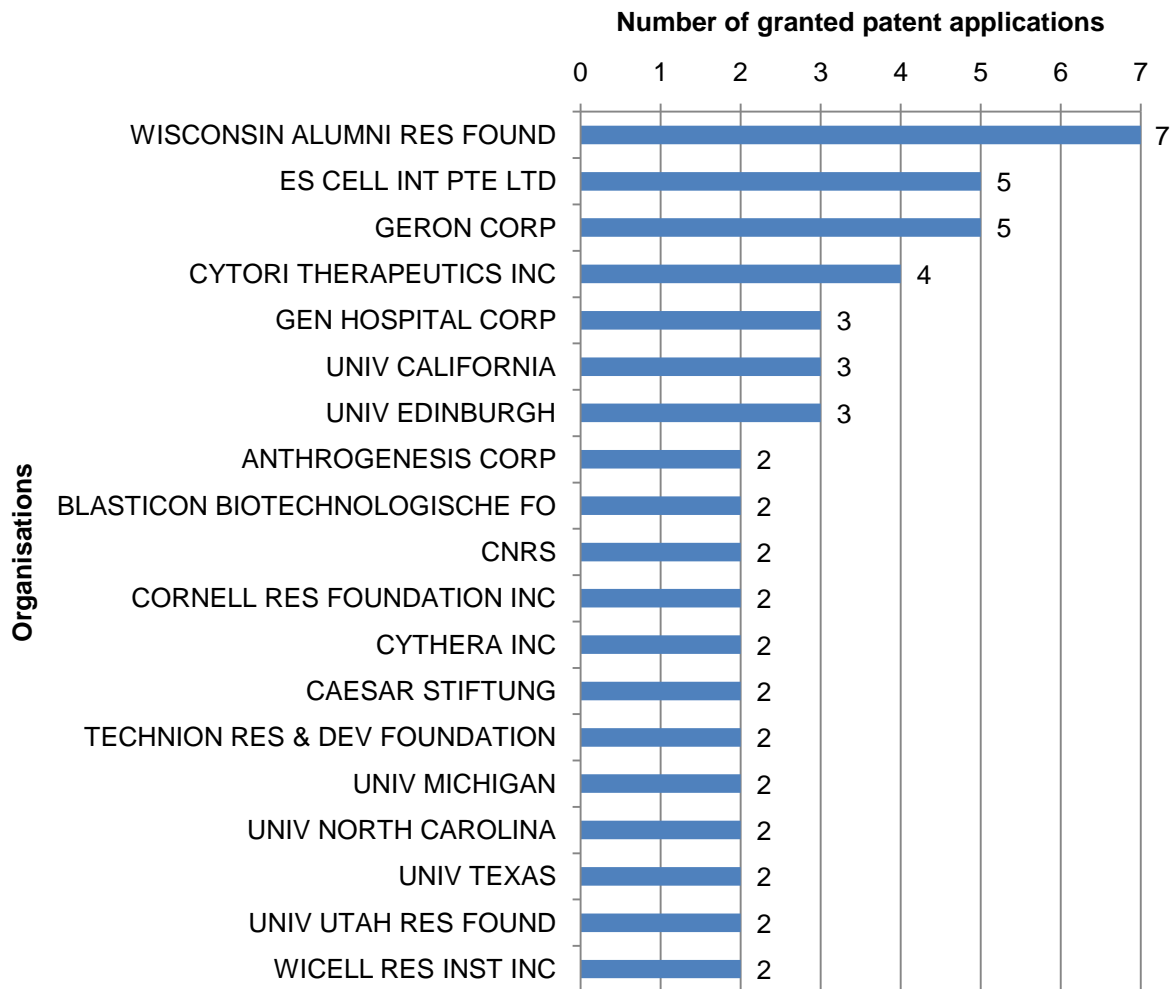


Figure 6 Top applicants (having more than 2 granted patent applications)

For completeness, the UK based organisations (as categorised by the EPO in their EPODOC patent database) are summarised in Table 2 on the next page.

UK Organisation	Published Applications	Granted Patents
UNIV EDINBURGH	6	3
CAMBRIDGE ENTERPRISE LTD	4	
STEM CELL SCIENCES	3	
ROSLIN INST	2	
UNIV SHEFFIELD	2	
IMPERIAL INNOVATIONS	1	1
ISIS INNOVATION		1
AXORDIA LTD		1
UNIV NEWCASTLE		1
NOVATHERA LTD		1
ODONTIS LTD		1
REINNERVATE LTD	1	
ANTOXIS LTD	1	
SMITH & NEPHEW	1	
ITI SCOTLAND LTD	1	
UCL BUSINESS PLC	1	
UNIV BRIGHTON	1	
UNIV CARDIFF	1	
OMNICYTE LTD	1	
PROCURE THERAPEUTICS LTD	1	
CHRIS MASON	1	
PETER DUNNILL	1	

Table 2 Summary of patent filings from UK-based organisations

Given the focus of the patent watch service to identify relevant stem cell patents, it is not surprising to see the top technology areas, as defined by the top European Classification (ECLA) subgroups, being stem cell related². The top three subgroups for published patents, as shown in Figure 7, are mesenchymal stem cells (C12N5/06B21P), pluripotent cells e.g. embryonic stem cells (C12N5/06B2P) and haematopoietic stem cells/uncommitted or multipotent progenitors (C12N5/06B11P).

For granted patents, the top three subgroups, as shown in Figure 8, are pluripotent cells e.g. embryonic stem cells (C12N5/06B2P), stem cells/progenitor cells/precursor cells of the nervous system (C12N5/06B8P) and haematopoietic stem cells/uncommitted or multipotent progenitors (C12N5/06B11P).

² The meaning of specific ECLA terminology can be viewed online at http://v3.espacenet.com/eclasrch?locale=en_V3&classification=ecla [accessed 23 March 2010]

Given the timescales involved in granting patents (as shown in Figure 2), it follows that the ECLA subgroups applied to the *published patents* give an indication of where more recent activity is taking place.

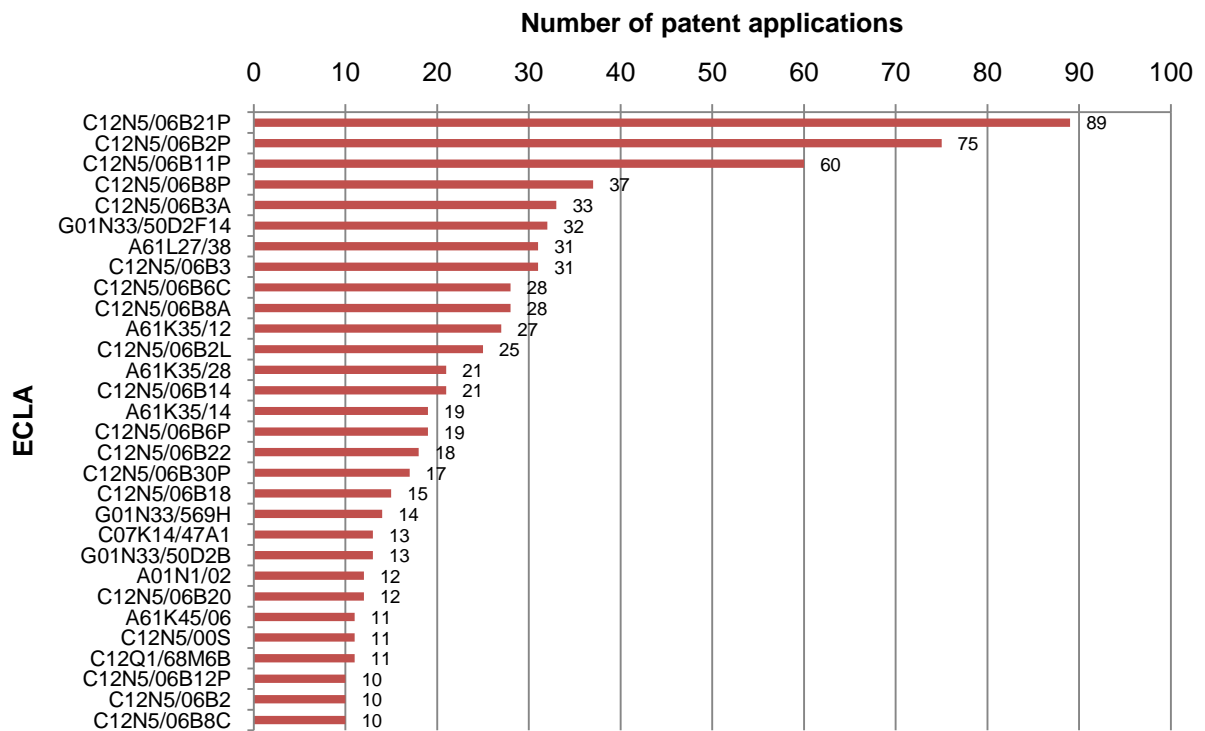


Figure 7 Top 30 ECLA subgroups in published patent dataset

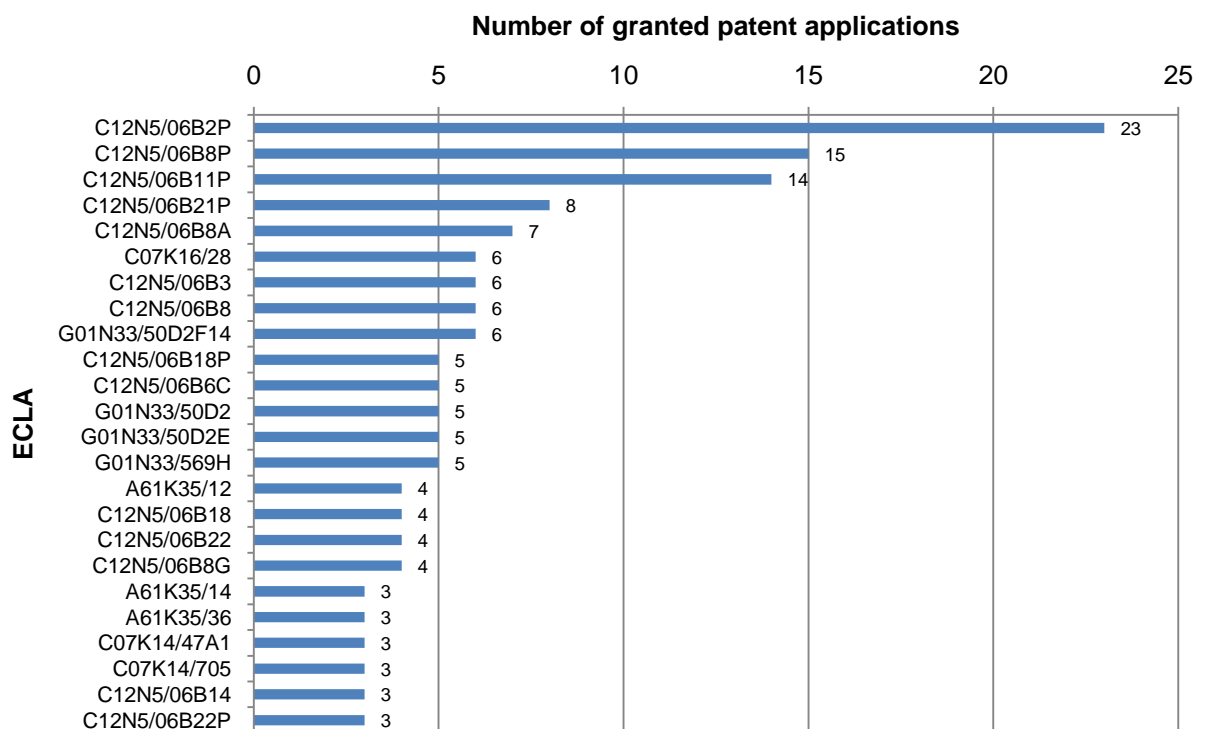


Figure 8 Top ECLA subgroups (applied 3 or more times) for granted patents

2.3 Organisation breakdown

In order to provide a breakdown of the types of organisations applying for or holding stem cell related patents, the applicants were categorised as corporate, academic, hospital, government and people. It should be noted that for this report, the academic category includes universities, research foundations and other institutions. The category people was used where no obvious link to an organisation could be found. These patents may legitimately be patents applied for by individual people or the assignment to an organisation may not have yet been entered on to the patent databases through statutory-related delays in certain jurisdictions.

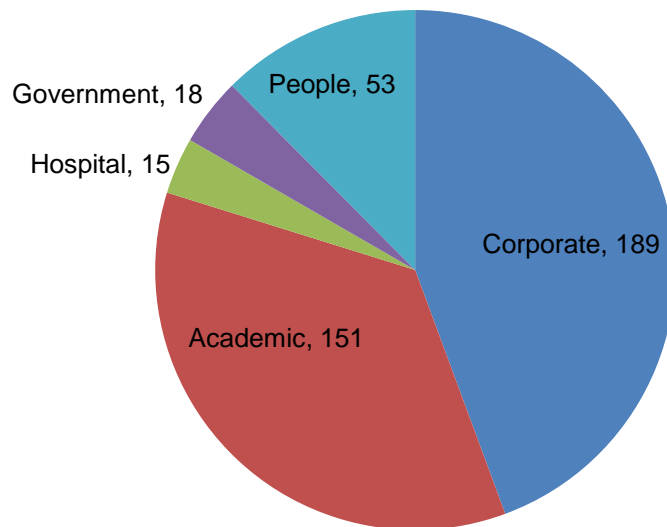


Figure 9 Breakdown of published patent data by organisation type

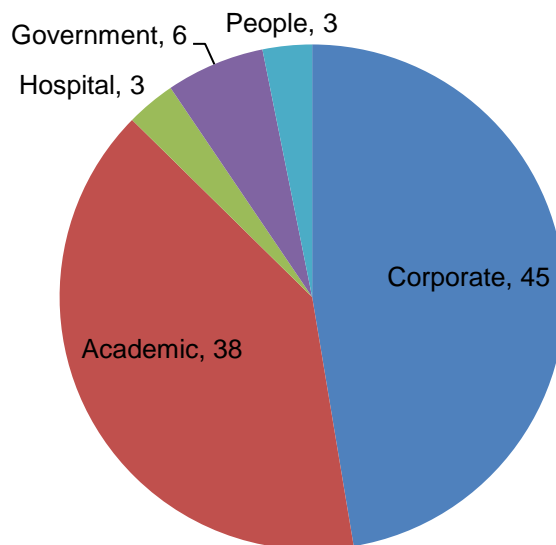


Figure 10 Breakdown of granted patents by organisation type

It is clear to see from Figure 9 and Figure 10 that most activity is dominated by the corporate and academic sectors, with the corporate sector just leading the way. This is perhaps a reflection of the type of research and funding required in the area of stem cells.

2.4 Organisation breakdown by technology sector

The datasets were also sub-divided into four areas of interest using specific International Patent Classification (IPC) subgroups in the heading A61P as shown in Table 3 below. These areas were chosen as they currently appear to encompass the most clinically relevant applications and uses of stem cells.

Technology area	IPC subgroups
Cardiovascular	A61P9/00-14
Neurological	A61P25/00-36
Ophthalmic	A61P27/02-14
Antineoplastic	A61P35/00-04

Table 3 Concordance of technology area with IPC

The datasets were then analysed further by the type of organisation, with the results shown in the figures below.

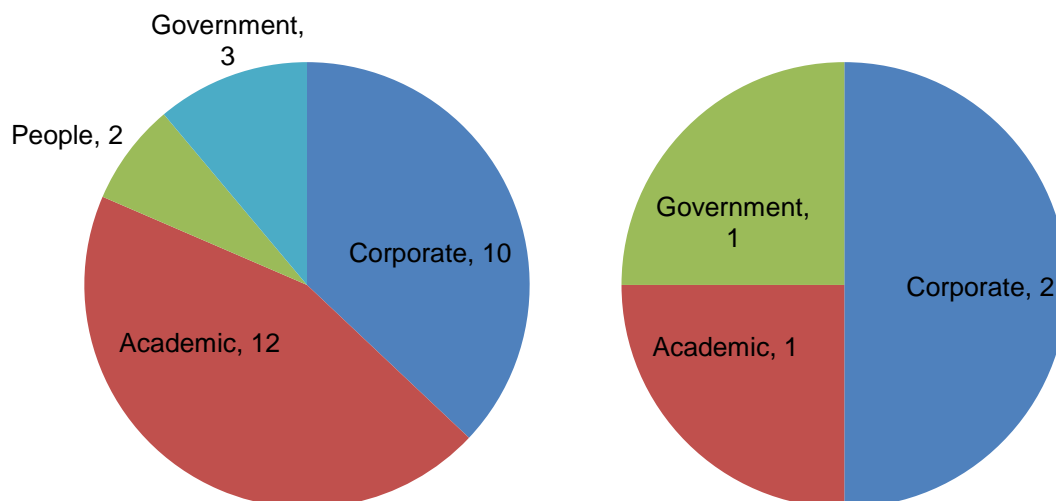


Figure 11 Breakdown of published (left) and granted (right) cardiovascular patents

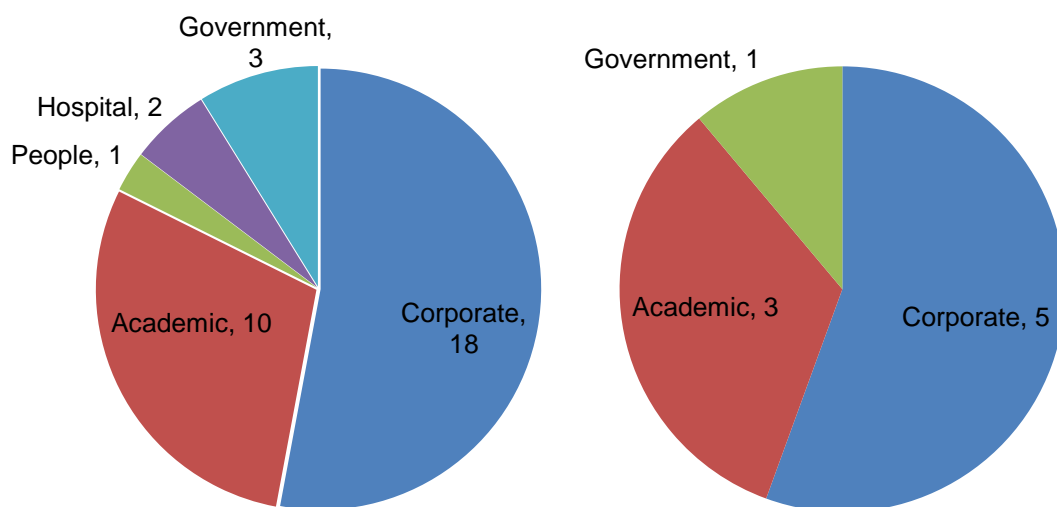


Figure 12 Breakdown of published (left) and granted (right) neurological patents

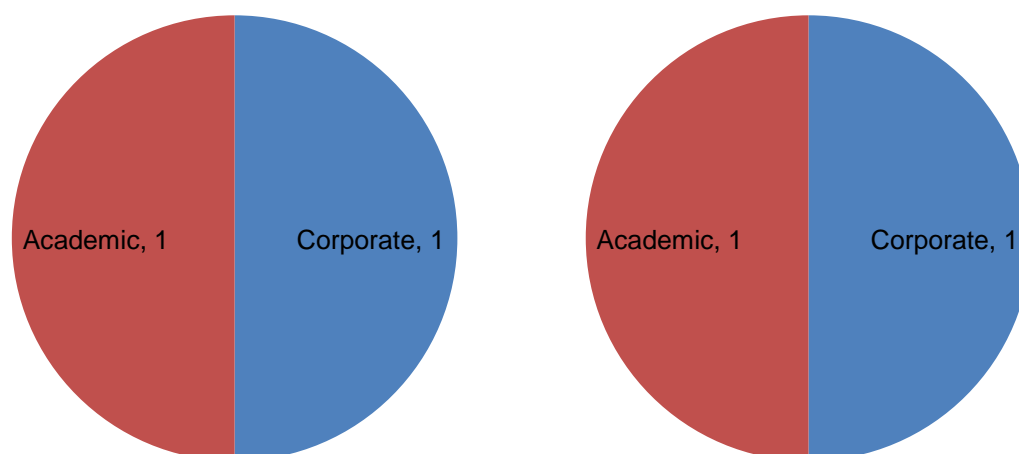


Figure 13 Breakdown of published (left) and granted (right) ophthalmic patents

With the exception of neurological related patents, the other three areas show a similar proportion of published patent applications from academic and corporate backgrounds, with the edge just going to the academic institutions. In the neurological field, corporations own the bulk of the published patent applications.

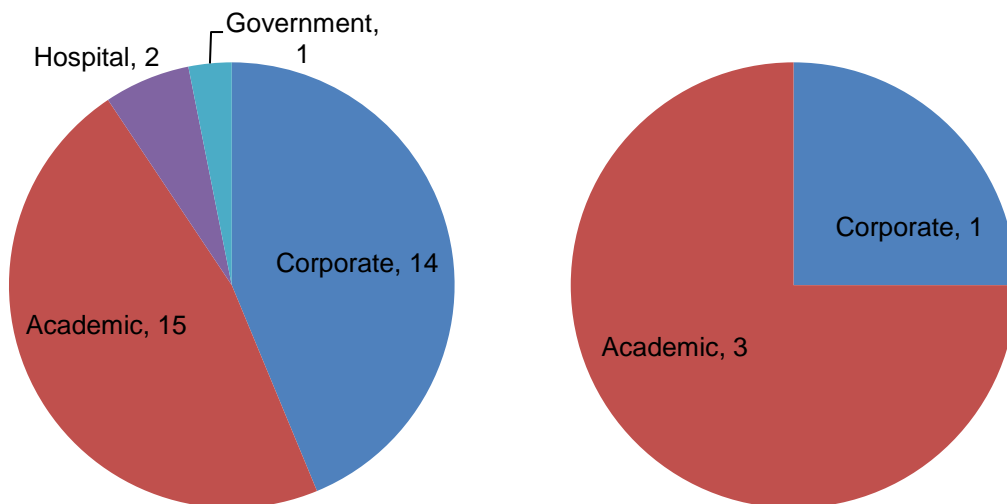


Figure 14 Breakdown of published (left) and granted (right) antineoplastic patents

The breakdown for granted patents is, however, different to that observed at the published application stage. In cardiovascular, ophthalmic and neurological areas, corporations have at least half the share of granted patents. However, in the very small dataset of antineoplastic patents, academic institutions are the main holders of granted patents.

2.5 Collaborations

The top filing organisations in both datasets were analysed and the resultant collaborations were plotted on a map. Each of the top organisations is plotted along with any of their collaborators (i.e. not just the top organisations); the larger the dot, the higher the number of patents in their portfolio. The spacing between organisations is arbitrary and the lines indicate which organisations work together. The more solid and thick the join between dots, the more frequently collaboration occurs.

Figure 15 shows the collaborations between the organisations who have published the most patents and Figure 16 shows the collaborations between those who have the most granted patents.

As well as having the most published patent applications, the University of Kyoto collaborates both with other universities (Keio and Tokyo) as well as the private sector (Oriental Yeast). Several other collaborations also occur, as can be seen in Figure 15, including the University of Edinburgh with Canada's Hospital for Sick Children (otherwise known as SickKids).

The main collaborators having granted patents are Wisconsin (with the Van Andel Res Inst), Caesar Stiftung (with Bonn University) and CNRS (with Oreal).

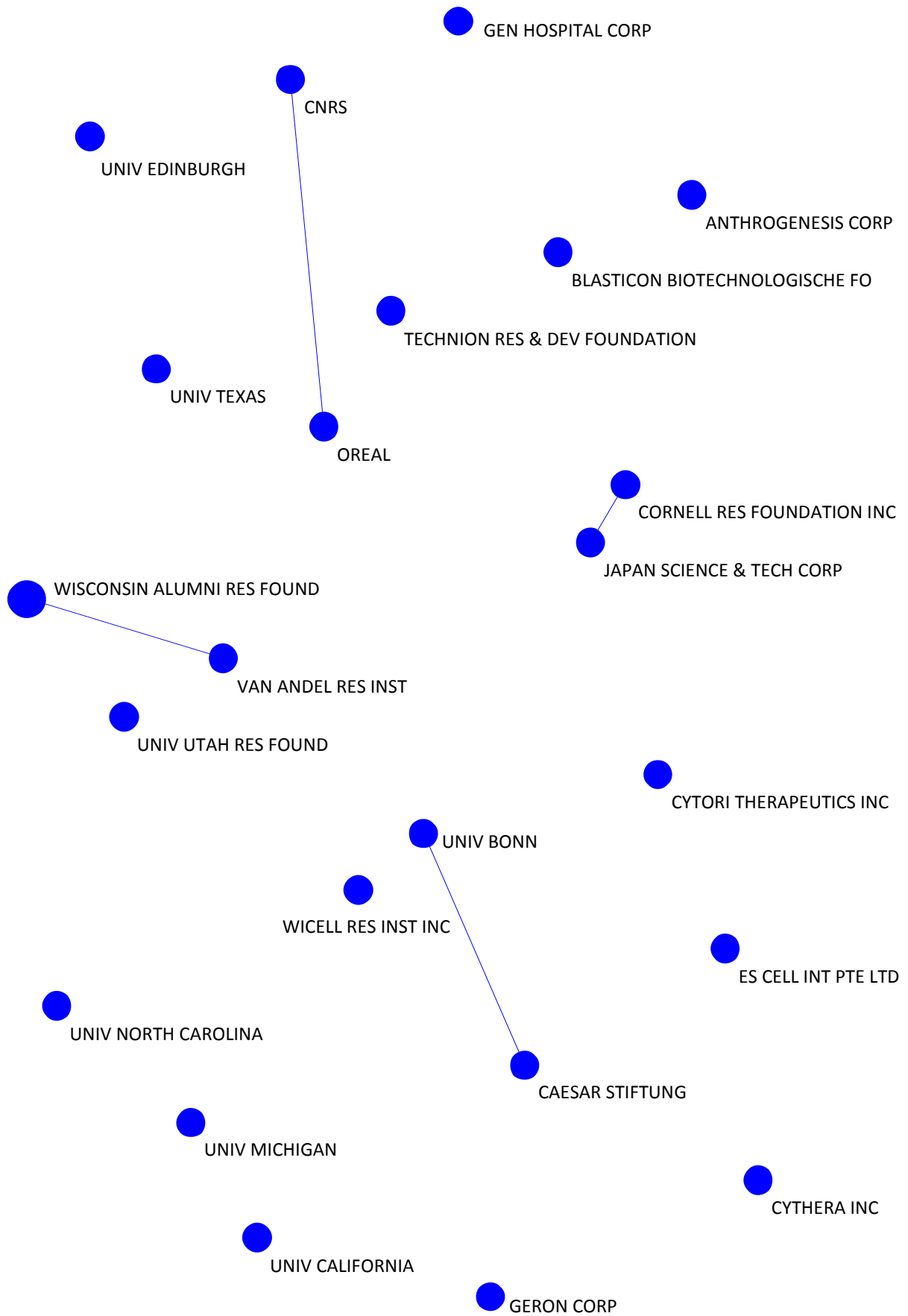


Figure 16 Collaborations between top applicants (granted patents)

3 Patent landscape

The patent landscape can be represented visually, as shown in Figure 17 below. The titles and abstracts of the patents are analysed and patents are placed on the map according to the occurrence of automatically selected words and phrases. The patents are represented on the map by dots (not all patents are shown in this view) and the more intense the concentration of patents (i.e. the more closely related they are) the higher the topography, as shown by contour lines. For this landscape map, the published patent dataset has been combined with the granted patent dataset to give a dataset of a reasonable size.

Figures 18-21 show the patents relating to the four technology sectors discussed above and Figure 22 shows where the granted patents are. It can be seen that even though the majority of the map is made up of the published patent data, the spread of granted patents is fairly broad.

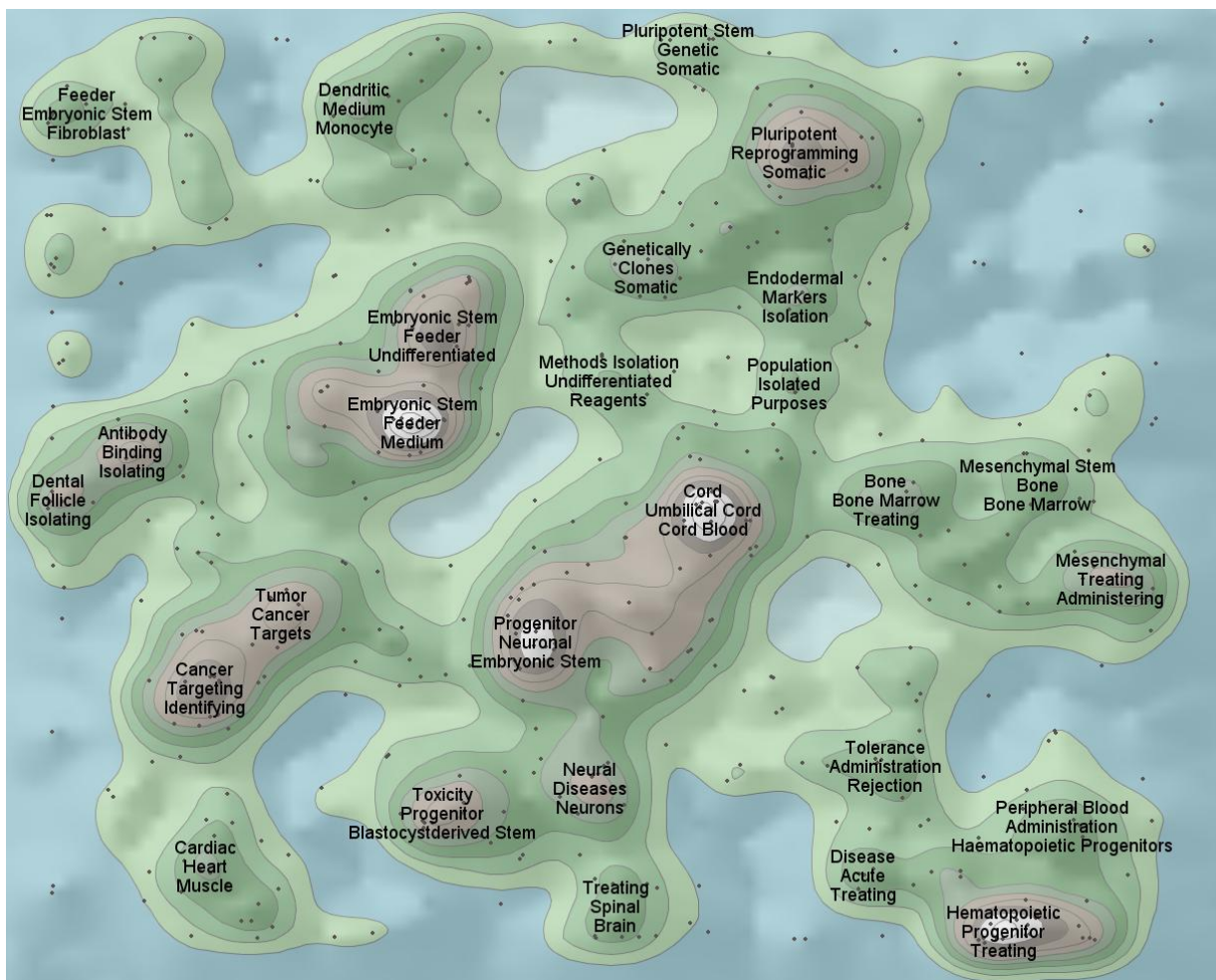


Figure 17 Patent landscape map of all patent watch data © Thomson Reuters

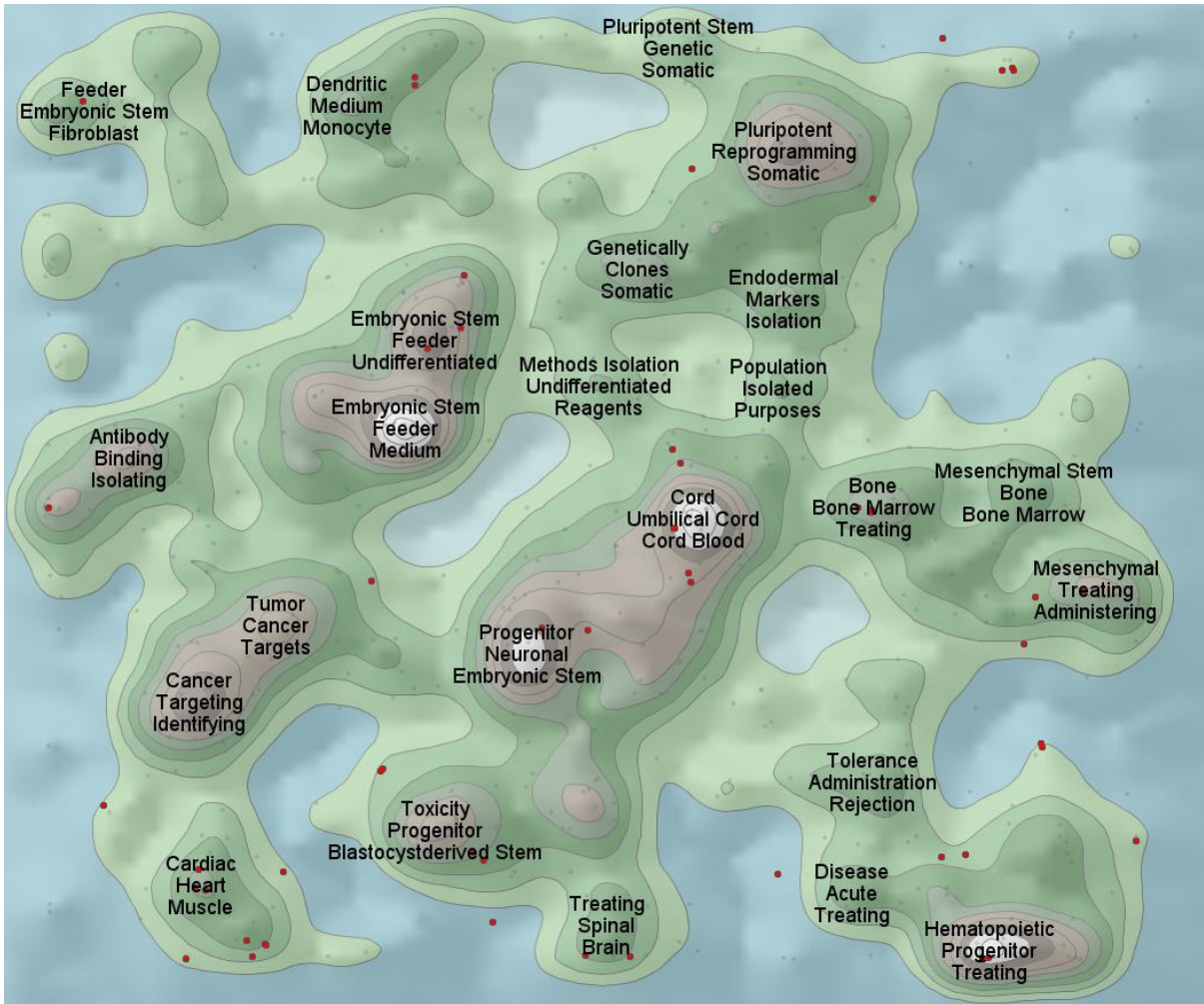


Figure 18 Patent landscape map showing cardiovascular patents (red) © Thomson Reuters

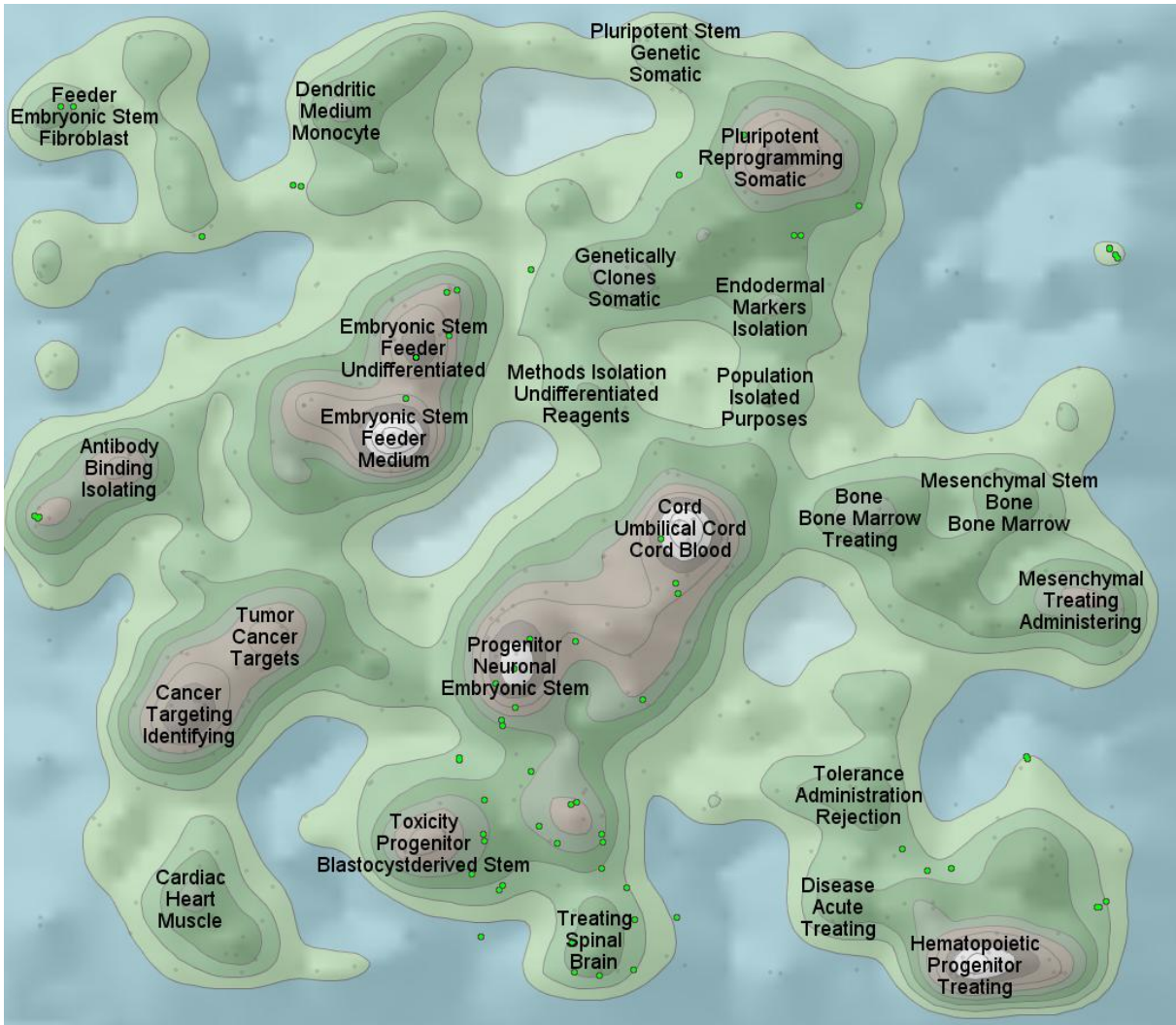


Figure 19 Patent landscape map showing neurological patents (green)

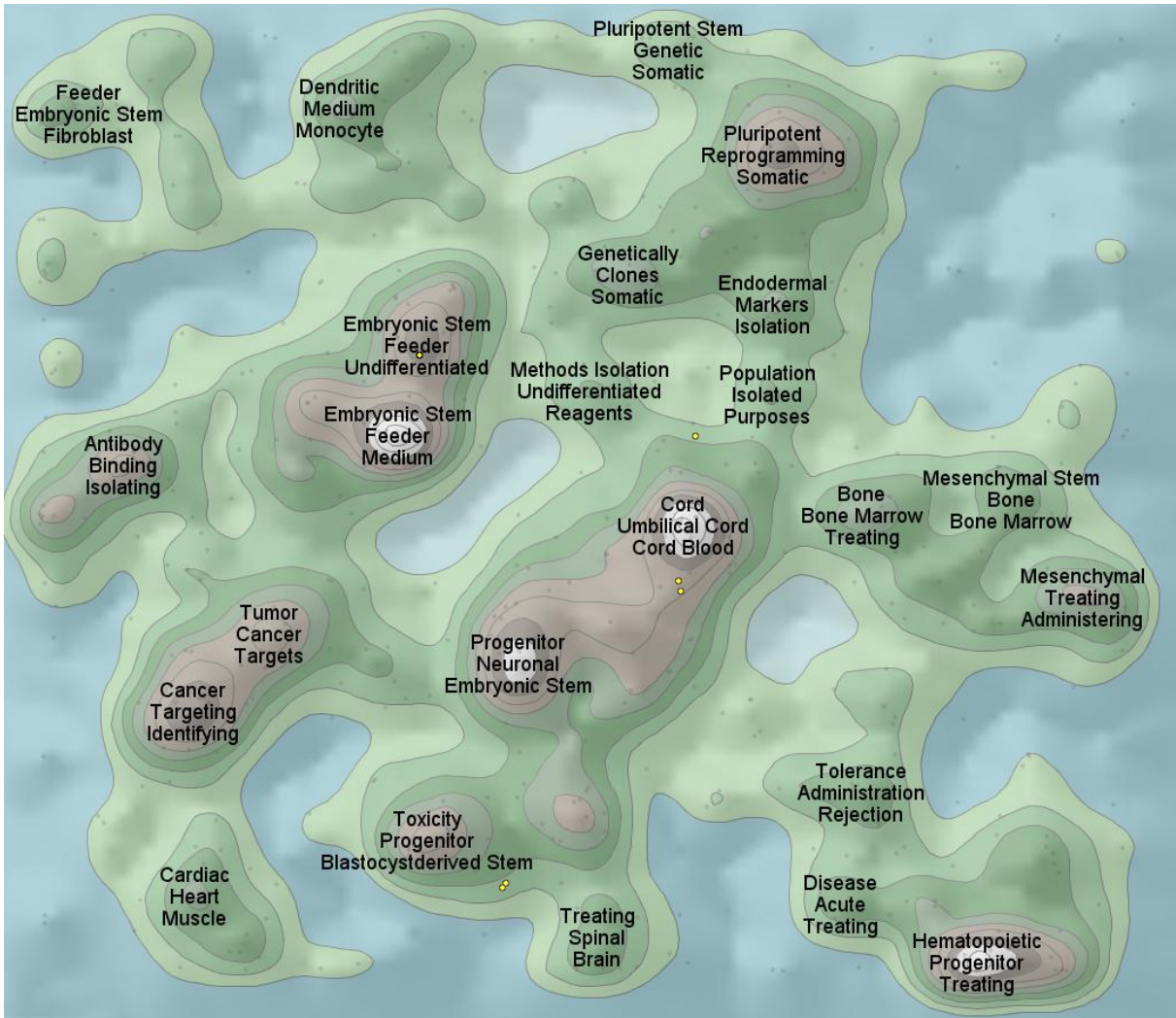


Figure 20 Patent landscape map showing ophthalmic patents (yellow)

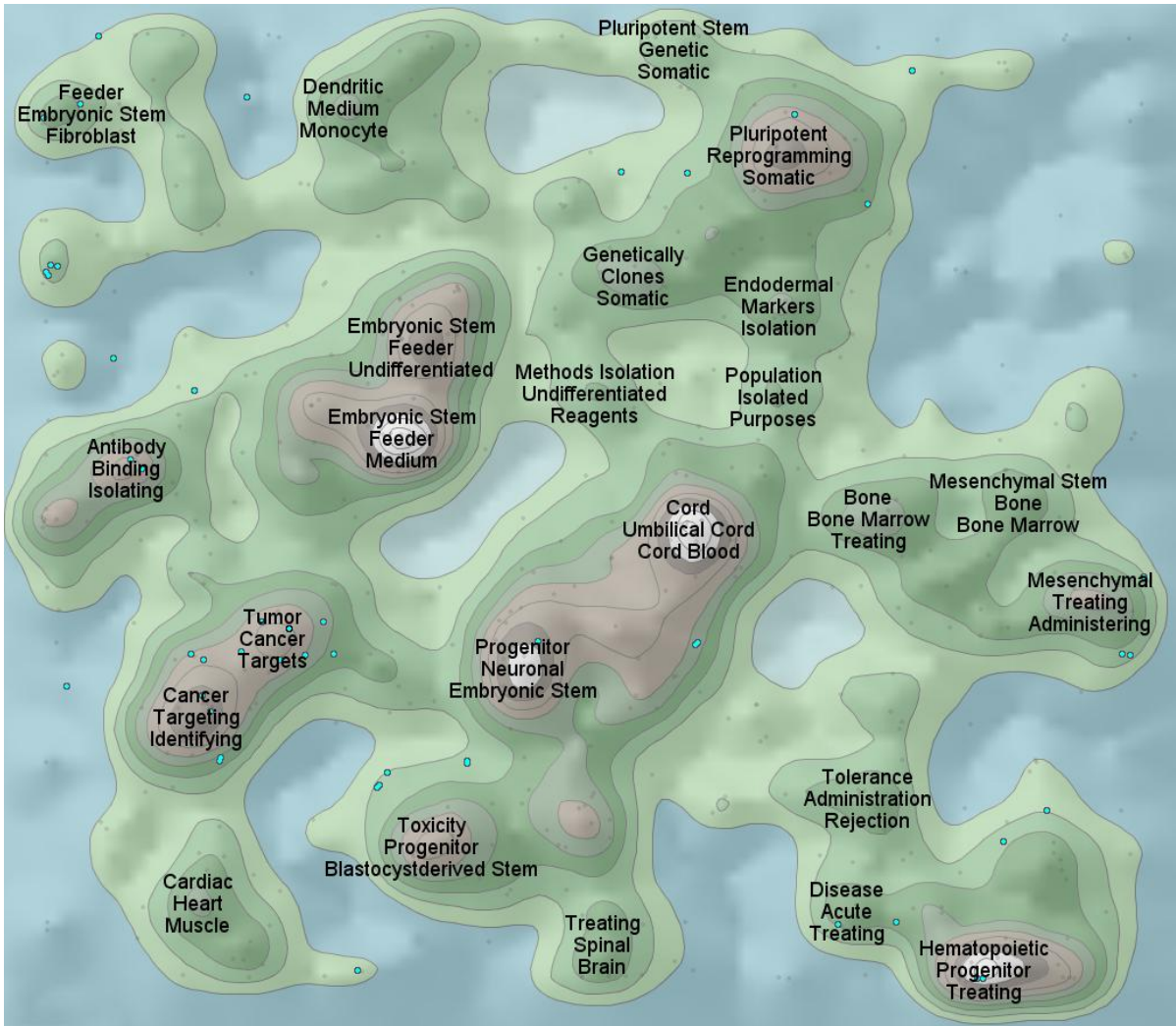


Figure 21 Patent landscape map showing antineoplastic patents (cyan)

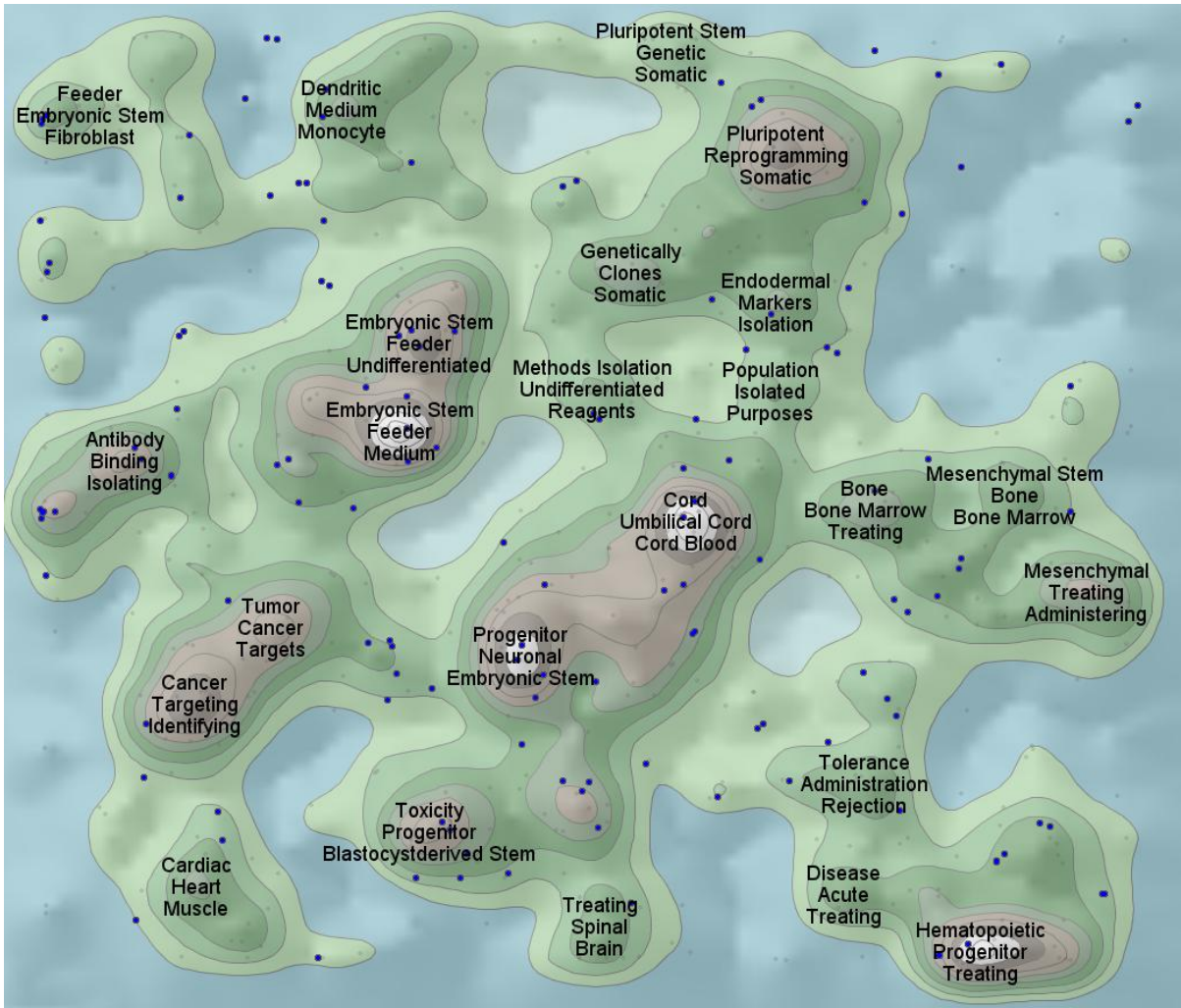


Figure 22 Patent landscape map showing granted patents (blue) © Thomson Reuters

4 Conclusions and recommendations

4.1 Conclusions

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In general, corporations hold the main share of both published and granted patent applications, closely followed by academic institutions. It is interesting to note, however, that the top holder of published patent applications is Kyoto University and that of granted patents is Wisconsin Alumni. In the UK, the University of Edinburgh not only has the most published patent applications but also the most number of granted patents.

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In cardiovascular, ophthalmic and neurological areas, corporations have at least half the share of granted patents. The exception to this is in the antineoplastic area in which academic institutions are the main granted patent holders.

4.2 Recommendations

In order to place the results of the UK patent watch in a more global context and to give a fuller picture of the activity in relation to stem cells, an overview of the complete global dataset is recommended. This is particularly important with patent applications from countries such as China rising very rapidly.

Further more detailed analysis is also possible for specific companies or technology areas. A particular university or company's patent holdings could be analysed, for example, to identify any potential technology cross-over

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Appendix

Basis for report

For this project the European Patent Office (EPO) database EPODOC was interrogated, which encompasses published patent documents derived from the majority of leading industrialised countries and patent organisations, for example the World Intellectual Property Organisation (WIPO), EPO and the African Regional Industry Property Organisation (ARIPO). It should be noted that since by convention patents are usually published eighteen months after filing, the patent record set covering Sept 2008 – present may not be complete. This should be borne in mind when considering recent patent trends.

Priority year, application year and publication year

There are generally three dates which can be associated with a patent application as follows:

Application date: The date on which a physical application was made for a patent. This enables an accurate temporal reflection of the technical content of a patent application.

Priority date: A patent can claim priority from an earlier application. This usually happens for two reasons: a) when an application is filed in one country, international convention dictates that the applicant then has 12 months to file a corresponding application abroad. Thus the patent application would then have a priority date, which indicates the earliest date attributed to the invention; b) an earlier application may contain part of an invention so a subsequent application, made within 12 months of filing, may claim priority from the earlier application. However, in the new application, this date is only valid for that part of the invention which appears in the earlier application. Care should therefore be taken when analysing the priority date of an invention.

Publication date: The date when the patent application was published. This is normally 18 months after the priority date or the application date, whichever is earlier.

The analysis presented in this report is primarily based on priority year to give the earliest indication of innovative activity.

WO and EP filings

As well as filing in separate national countries, patents can also be filed as International patents (WO) and European patents (EP). WO patents may designate in which national states protection is sought; these patents are then processed in the respective national states and will then be included in the other figures for FR, GB, DE etc. WO patents may themselves designate EP, and these patents will go on to

become European patents which may have validity in one or more European states. European patents can also be obtained in their own right. The country of validity cannot be easily determined except on a patent-by-patent basis. Figures for patent families with WO and EP priorities have been included for completeness though no single attributable country is immediately apparent.

Data cleaning

It is also important to note that prior to analysis, the applicant field data is “cleaned” to de-duplicate database entries, which relate to the same applicant, but where a different form of applicant name is used, for example arising from spelling error, international variation (e.g. Ltd, Pty, GmbH etc.) or equivalence (e.g. Ltd., Limited). This avoids erroneous apparition of apparent multiple applicants which are in fact one and the same. However, this can also mean that some subsidiary companies might potentially be obscured by larger parent companies.