



Patenting Trends in Global Healthcare Start-ups

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Start-up companies represent a powerful engine of the innovation process. The current study aims to establish a better understanding of the Start-up ecosystem in providing innovative healthcare solutions through the lens of intellectual property and relate it to policy gaps for supporting the Start-up ecosystem in India. This study found that about 397 healthcare Start-up companies have been established after 1 January 2010. The Questel Orbit database was used to conduct a patent search for the patents filed by these Start-ups from 1 January 2010 to 1 May 2020. A total of 3527 patents were retrieved and analyzed thoroughly to generate insights on the year-wise patent filing trend, geographical patent filing density, top aggressive patent filers, sector-wise filing density and a glimpse of the patent filing culture of healthcare Start-ups in India. The result shows that major filing has been done in the field of pharmaceuticals and biotechnology; and major healthcare market is the USA. Despite the Start-up culture being relatively new in India, the country's healthcare Start-ups are among the top 10 patent filers globally. It is observed that *Verily Life Sciences* is the top healthcare patent filer globally and *SigTuple* is the top patent filer from India.

Keywords: Startup, Healthcare, Intellectual property, Patent, Landscape

A Start-up is a young company involved in developing innovative product or services. In India, an entity is called a Start-up if it is incorporated within a period of last ten years as a private limited company or a partnership firm or a limited liability partnership. In addition, it should work towards innovation, development or improvement of products or processes or services; and the turnover of the entity in any financial year should not exceed one hundred crore rupees.¹ Start-ups are engines of growth—they disrupt the economy of a country and forces it to evolve through innovations.²

According to a study conducted by University of California, the top five most popular Start-up sectors are Business-to-Business (B2B) Software and services, Healthcare, Consumer goods and services, Financial technology and Consumer Media.³ Start-up ecosystems are capable of innovating and creating jobs. *Nasscom* reported that India continues to be the third largest start-up ecosystem after China and US.⁴ The Indian Start-up ecosystem is rapidly expanding, and the country's entrepreneurial spirit is gaining momentum. Increased government backing, as well as increased investor confidence and technology breakthroughs, are transforming India's Start-up scene.⁵

With government support, Indian Start-ups will undoubtedly have a huge impact on the country's transformation and economic progress as the country heals itself after the COVID 19 pandemic.⁶

Intellectual property is considered an important priority for any Start-up that wants to cement its success. In short, the certain way for a Start-up to succeed against rivals is by patenting its inventions and innovations.⁷ When a Start-up patents its ideas, its valuation increases. A quality patent portfolio can attract large MNCs that can further provide financial assistance to R&D or can acquire the company leading to a large payday for the founders. Patents are also considered as an asset and can be used as leverage to obtain monetary assistance from financial institutions.⁸

The current study focuses on healthcare Start-ups. As Covid-19 keeps on devastating the world, it is even more important today to have a quality healthcare system in place. The current crisis has exposed the lack of medical infrastructure in India. According to WHO, the ratio of doctors to a number of patients should be 1:1000. However, in India, this ratio is 1:1445.⁹ The aim of the study is to understand the global patent landscape, i.e., the patenting scenario in the healthcare Start-up. Patent landscape reports provide a snapshot of the patent situation of a specific technology. They can help in policy

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discussions, strategic research planning and technology transfer. The study first focuses on the global healthcare Start-up and their patent filing trends. Then it zooms into the scenario in India. Apart from the patenting trend in India, the study also deals with the Start-up ecosystem status in India, various Government initiatives, and the future of healthcare sector in India.

There is no globally accepted definition for a Start-up. In India, A Start-up is defined as an entity that is headquartered in India and opened less than 10 years ago. Therefore, a comprehensive search was carried out by populating a list of all the companies which were labeled as a Start-up in various forums. Initially, a sample list of 882 healthcare Start-ups was compiled. However, several of them were more than 10 years old but still being labeled as a Start-up. Hence, we selected the companies established in between 1st January 2010 to 1st May 2020. The final list contained 397 Start-ups. Next, the Questel Orbit database was used to find patent filed or owned by these Start-ups.¹⁰ This resulted in 3527 patent families.

Bibliographic Data Analysis

Priority country is the country where the first filing of a patent family occurs. This gives a general idea about the jurisdiction where maximum R&D is taking place. Result shows that the USA has the maximum number of patent filings (2679) followed by United Kingdom (415), European patent office (253), China (125), Australia (77), and India (65). Countries like South Korea (47), Japan (24), and Germany (68) also saw patent filings in the field of healthcare.

Figure 1 shows the markets where the inventor/ assignee was interested in protecting their invention. It can be observed that the USA again leads with 1933 patents being filed. It has also surpassed the European Patent Office (1845) filing which is noteworthy; considering EP provides the option to file in multiple countries at one go. Canada (675) which was not present in the top 10 patent filings based on priority country has

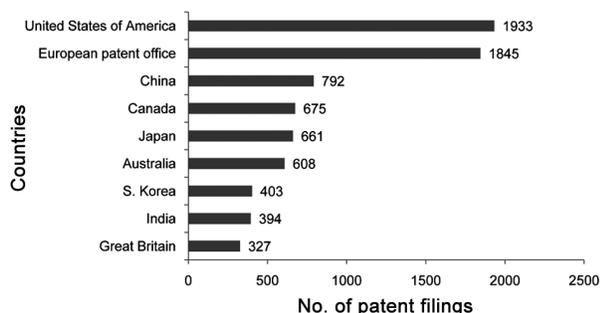


Fig.1 — Global distribution of patent filings in healthcare sector

outnumbered Japan (661), Australia (608), South Korea (403), and India (394). United Kingdom (327) which was second based on priority year comes last.

Figure 2 depicts the priority year of the patent applications. An exponential increase can be seen till 2017. The decrease in 2019-20 can be attributed to the lack of data as the patent applications might not have been published yet.

Based on the technology domain, the patents have been classified into ten broad categories. Table 1 shows the total number of patents in the respective categories.

Verily Life Sciences emerged as the top patent filer with a total of 565 patent filings followed by *ADC Therapeutics* with 98 patent filings. It is evident from Table 2 that *Verily Life Sciences* have dominated most of the sectors in patent filings. This can be attributed to the fact that it is a subsidiary of *Alphabet Inc*, owner of *Google*. This provides the company access to much more capital for R&D expenditure and despite having founded only in 2015 it has raced far ahead of its peers. It is to be noted that the terms ‘Medical technology’ and ‘Healthcare’ are often used interchangeably. However, ‘Medical technology’ specifically refers to medical devices for treatment, monitoring, or diagnostic purposes whereas ‘Healthcare’ is a general term that

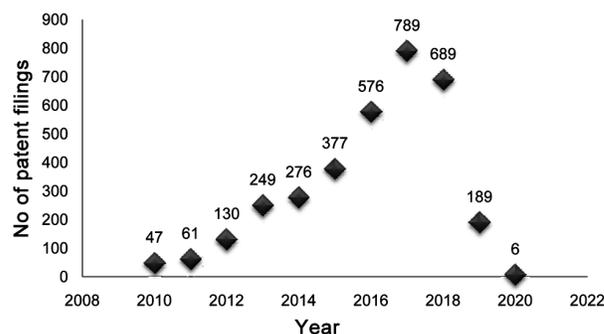


Fig. 2 —Number of patents filings corresponding to priority year

Table 1 — No. of patents filed by different healthcare Start-up sectors

Healthcare sector	Number of patents filed
Pharmaceuticals	1255
Medical technology	1148
Biotechnology	693
Computer technology	494
Measurement	244
Analysis of biological materials	234
Optics	186
Organic fine chemistry	161
Telecommunications	93
Control	75

Table 2 — Top assignees in respective categories

Healthcare sector	Top assignee	Number of patents
Pharmaceuticals	Cellularity	72
	Pharmaceuticals	
Medical technology	Verily Life Sciences	390
Biotechnology	Editas Medicine	53
	Biotechnology	
Computer Technology	Verily Life Sciences	111
Measurement	Verily Life Sciences	106
Analysis of biological materials	Verily Life Sciences	40
Optics	Verily Life Sciences	150
Organic fine chemistry	Translate Bio	12
Telecommunications	Verily Life Sciences	48
Control	Verily Life Sciences	37

Table 3 — Number of patents filed based on their functional area

Function	Number of patents filed
Prevention (Exercise monitoring, Fit bit devices)	221
Diagnosis (Diagnostic kit, Techniques, Image processing)	605
Monitor (Disease monitoring, Medicine effect monitoring)	225
Treatment (Medicines, Injectable devices, Gene editing/therapy, etc.)	2078
Care (Implants, Telemedicine, Database management systems, Prosthetics)	295
Others (Communication devices/ protocols for implants or emergency SOS systems)	103

encompasses medical technology along with prevention of lifestyle diseases, post-injury/ surgery care, etc. It can be seen that several patents have been filed in the field of telecommunications. This is done by assignees like *RAPIDSOS*, *Verily Life Sciences*, *Bigfoot Medical*, etc. The patents are about medical alert systems, communication systems for wearable devices, Communication methods, and systems for medical implants. Table 3 shows the patents classifications based on their functions.

Legal Status Analysis

Although the field of pharmaceuticals has the maximum number of patent filings but it has a smaller number of patents granted (320) compared to medical technology (602). This figure will change overtime as the pharmaceutical category has the maximum number of patents pending (855). Medical technology is leading with lapsed patents (89) and has an insignificant number of patents been revoked by the patent offices. This indicates that most of the Start-ups rely on their patent portfolios and hence the number of lapsed or revoked patents is comparatively less with respect to the number

Table 4 — Legal status analysis of top five assignees

Assignee	Granted	Pending	Dead
Verily Life Sciences	371	169	25
ADC Therapeutics	8	22	68
Autolus	3	72	19
Bigfoot Biomedical	61	26	0
Tosense	29	15	43

of patents pending or granted.

As can be seen from Table 4, *ADC Therapeutics* and *Tosense* both have the higher number of dead patents i.e., they are either revoked or lapsed. This shows an incompetent and weak patent portfolio of these Start-ups or it can be attributed to the poor patent search conducted which has led to patent filings of non-novel research findings. *Bigfoot Medical* has an impressive track record with 61 patents granted and none dead. *Verily Life Sciences* have the maximum number of patents granted (371).

It is noteworthy that the patents of *Editas Medicine*, *Juno Therapeutics*, *Caribou Biosciences*, *CRISPR Therapeutics*, *Zymergen*, and *Poseida Therapeutics* all cite each other. The patents of *Editas Medicine* cite *CRISPR Therapeutics* patents nine times and *CRISPR* patents cite *Editas* patents seven times. Similarly, *Caribou Biosciences Patents* cite *Editas* patents three times and *Editas* cites *Caribou* patents four times. *Voyager Therapeutics* has also cited *Translate Bio* and *UniqoreIP* patents five times and sixteen times, respectively. This shows that the above-mentioned Start-ups are all working in the same functional area and hence so many inter-citations appear. As the Covid-19 crisis develops, the economic scenario has become gloomier and investors might be wary of further investment in these Start-up companies. Therefore, this citation analysis can also provide a potential opportunity for these companies to collaborate or merge in the future based on common technological interests.

Indian Scenario

Healthcare Sector in India

The Healthcare Sector in India recorded a total funding of US\$ 586.93 million in 2019, an increase of over 10% from the previous year.¹¹ Therefore, it can be said that apart from the stumbling block provided by the Covid-19 crisis, the Indian Healthcare Sector is growing at a healthy pace. The Medical Device Industry alone is expected to be worth US\$ 50 billion by 2025 in India.¹² The Covid-19 crisis also gave India a unique opportunity to rectify some of the laws regarding medical equipment and drug testing.

Earlier, the permission had to be taken from the Drugs Controller General of India (DCGI) for testing the prototype of a medical device and the permission used to be granted within 30 days. However, the crisis forced the DCGI to reduce the time to 7 days.¹³

Start-up Culture in India

With around 210 incubation centers at present and approximately 15 Start-up exchange missions in place, India is taking a strong step towards developing a Start-up culture.¹⁴ Importantly, the entrepreneurs that had founded the first generation of Start-ups in India have now become angel investors and serial entrepreneurs for the next generation of Start-ups and entrepreneurs.¹⁵ These entrepreneurs can not only offer seed funding but also advice upcoming Start-ups on policies that may bring success.

Healthcare Start-ups in India

The 'Start-up India' scheme was started in 2016 by the government of India to support grassroots companies. In India, several telemedicine and online pharmacies have mushroomed in Start-up space where *Practo*, *Img*, *Curefit*, *Pharmeasy*, etc. are emerging as leaders. These Start-ups can help India during a crisis like Covid-19 when going to the hospitals for regular ailments itself brings risk. Online pharmacies have helped to reduce unnecessary travel and risk of infection. In India, Healthcare Start-ups grew at a CAGR of 50% between 2014-19 amounting to 14% of 9200 start-ups established between this period. Approximately, 65-67% of these healthcare Start-ups are using Artificial Intelligence (AI) and 45-46% are making use of Internet of Things (IoT) technologies as the backbone of their products and solutions.¹⁶ An Indian Start-up called *Fastsense Diagnostics* developed a rapid detection kit for Covid-19 that can analyze a sample in 15 minutes and a confirmatory PCR-based test that can analyze 50 samples in an hour.¹⁷ The company has also filed a patent for detecting stages of cancer, the possibility of cancer onset, and patient treatment monitoring using a single drop of blood.¹⁸

Patents Filed in India

A total of 65 patents were filed with India as the priority country. It is noteworthy that despite the Start-up culture being relatively new in India, the country is among the top 10 patent filers globally. More patents are being filed in India in the field of medical technology and then in South Korea, Australia, and Japan. In India, *Sigtuple* technology has emerged as the largest patent filer with 19 patents and most of the patents focus on the analysis of

biological materials. *Forus healthPrivate Limited* has emerged as the second-largest assignee with 15 patents. The patents filed are mainly focusing on eye care. *Sigtuple* has filed maximum patents between the periods of 2016-18 whereas *Vyome Therapeutics* has been consistently filing patents since 2011. In terms of protection countries, Europe followed by the USA has emerged as the regions of interest for these assignees. *Bugworks Research* and *Vyome Therapeutics* have emerged as stand-out patent filers with filings in EP, USA, Japan, China, South Korea, Mexico, Brazil jurisdictions. The number of diverse jurisdictions where patents have been filed shows that assignees consider these jurisdictions as potential markets where they will be launching their products in the future. The strategy can also be considered as a mature move where assignees have considered filing patents in foreign jurisdictions and thus bearing the cost of filing in these territories. The patent filing trend obtained from the data showed that the number of patents being filed increased gradually since 2016. Most of the assignees are registered with the Start-up India scheme. The data reflects that Start-ups are recognizing the importance of protecting their intellectual property. Some of the Start-ups have filed only one patent but have chosen multiple jurisdictions to protect their invention.

Government Schemes for Start-ups in India

Some of the benefits provided by the Start-up India scheme are i) fast tracking of the patent applications, 80% Rebate on patent filing fees, ii) relaxed norms for participating in government tenders, iii) self-certification under Labour and Environment Laws, iv) insolvency process to be completed in 90 days, and v) tax exemption for 3 years.

Funding Source for Start-ups and Few Suggestions for India

According to a survey by the *Reserve Bank of India* for Start-ups, healthcare has emerged as the secondlargest sector in India where Start-ups have mushroomed.¹⁹ While this is a positive sign for this sector, it was also reported that for approximately 43% of the Start-ups, the main source of funding remained friends and families. It is quite disappointing that despite best efforts of the government and monetary provisions available by various government agencies for Start-ups, the innovators are not aware of them. There might be various reasons including lack of information or procedural roadblocks which might be discouraging entrepreneurs from approaching the government agencies for the funds. India can also take inspiration

from some of its fellow ASEAN countries who have taken some innovative steps for developing Start-ups. For example, Japan provides Start-up Visa for one year to attract foreign investment in the country.²⁰ South Korea encourages employees to develop their start-ups and promises to re-absorb them in the organization if the venture fails.²¹ China has around 2300 mass entrepreneurship spaces and 3000 technology incubators.²² Australia provides special fund for indigenous tribes to develop start-ups.²³ The *Global Innovation Alliance* in Singapore provides an entrepreneurial network through which people from Singapore can build their network across the globe.²⁴

Conclusion

The current study dealt with the patent information of healthcare Start-ups around the world. Further, it paid attention to the Indian scenario. It is interesting to see that the maximum number of patents have been filed in the field of pharmaceuticals worldwide although there are several approval hurdles for products in this area. *Verily Life Sciences* emerged as a giant amongst all the assignees with maximum patent filings. It was only possible because it had the absolute support of *Google*. The field of biotechnology also showed tremendous growth with multiple patent filings across the globe. An interesting point is that Canada is a major market for most of these companies. Although, Canada is not among top ten priority countries, it stands 5th based on the publishing data. Several Start-ups like *CRISPR Therapeutics*, *Editas Medicine* and *Caribou Biosciences*, involved in the patent dispute over *CRISPR/ cas9* technology, are working extensively in this field and have filed several patents on this subject. The Indian healthcare sector is booming since 2014. Despite, the Start-up culture being relatively new in India, the country is among the top 10 patent filers globally. More patents are being filed in India in the field of medical technology than in South Korea, Australia, and Japan. *Sigtuple Technology* has emerged as the largest patent filer in India, combining artificial intelligence, robotics and data science. Sadly enough, most of the entrepreneurs still depend on their family and friends for finances. Therefore, some of the practices from ASEAN countries have been shared that India can follow to strengthen the Start-up culture.

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