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Expert Opinion - VL Ramprasad

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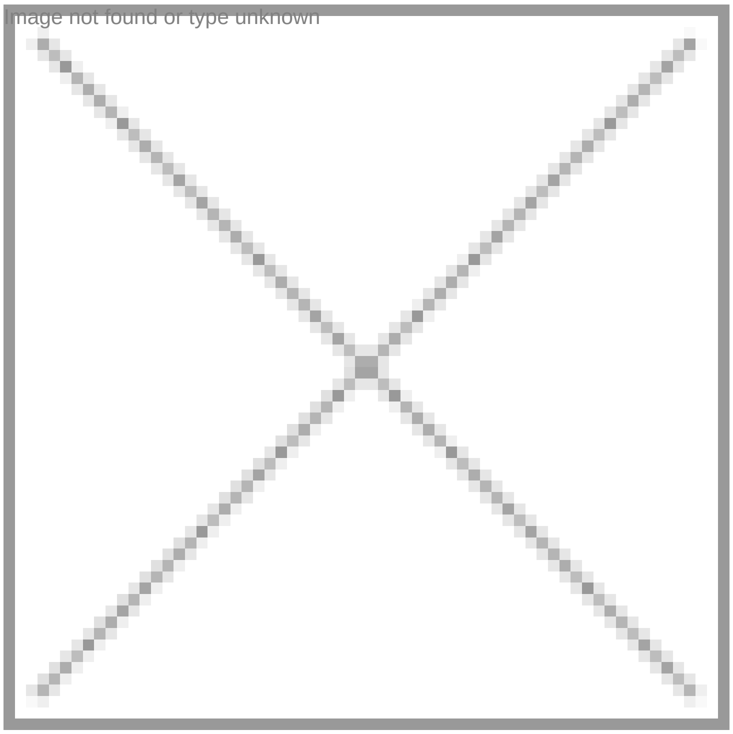

HIGH THROUGHPUT GENOMICS

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NGS penetrating different segments

Though the NGS market in India is encouraging, it is yet to take stride because of long funding cycles and slow adaptability of the researchers to this technology

Decoding the DNA is imperative for all the branches of biology. Discovery of capillary electrophoresis (CE) based Sanger sequencing made scientists to unravel the genetic information from any biological system. This technology has been widely adopted in many laboratories around the world, but was always hindered by the inherent limitations in throughput, scalability, speed, resolution and most importantly the cost. To overcome these barriers an entirely new technology was evolved and was called â€“ Next Generation Sequencing (NGS).

Market overview
Next generation sequencers are penetrating into the services providing sector to become the critical tools in Biomedical and BioAgri research. Recent scientific discoveries that are an outcome of next generation sequencing technology show the impact of massively parallel platforms. The declining cost of genomic sequencing has shown a way for the clinical application of this technology.

The tremendous growth in drug discovery and molecular diagnostics will promote the uptake of this

technology. BioAgri industry is also bullish on NGS. The worldwide market for sequencing products will grow from an estimated $1.3 billion in 2010 to more than $3.3 billion by 2015, a compound annual growth rate (CAGR) of 20.5 percent over the next five years.

Even though the NGS market in India is encouraging, it is yet to take the similar growth stride that other APAC countries such as Australia, China, and Korea have taken, and this could be because of long- funding cycles and slow-adaptability of the researchers to this technology.

The current Indian NGS market is valued at ₹70-75 crore that includes instruments (including the desktop NGS), reagents, and services. The three main players in the Indian market are Illumina (GAIIx, Hiseq), Life Technologies (SOLiD/Ion Torrent) and Roche-454 (FLX/FLX junior). Illumina Hiseq systems deliver the highest data output (300Gb on Hiseq 1000 and 600Gb on Hiseq 2000) among all the available technologies. There are about 42-45 NGS installations (excluding the desktop next gen sequencers) in India.

Illumina is the market leader with more than 40 percent market share and also dominates North and South India with more than 60 percent market share. Roche and Life Technologies share equal market share in East and West India. Scientific publications from India using NGS technology has been slowly increasing, so far there are about 10-15 publications and most of them have used Illumina GAIIx or Roche 454 to generate the published data.

The major factors driving the NGS market include the decrease in the cost of sequencing with increase in the number of applications of sequencing, in various fields of science such as cancer research, agricultural, biofuels, marine sciences, livestock research, and veterinary research. Thus, there is more demand for the equipment to understand the genome sequencing and utilize it further for human and environmental benefits.

The high pace of NGS research is likely to boost the market for personal genome sequencing in the coming years. Manufacturers predominantly have an inclination towards diagnostic applications both as a supplier and manufacturer.

Personal (desktop) NGS market

There have been more interesting developments from the established NGS technologies such as the launch of personal benchtop NGS instruments like the new MiSeq from Illumina, which generates 2-7GB of data and is a direct challenge to Ion Torrent (10MB-1GB), as well as the Roche 454 Jr (35-40MB).

These desktop sequencers require less financial commitment and usually require only one grant to fund. In contrast, the big boxes require a massive financial commitment to purchase and operate.The best analogy would be the personal computer (PC) revolution largely replacing the need for mainframes.

Life Technologies' Ion Torrent and Roche 454 Jr had the early mover advantage as they entered the market (shipping) beginning from 2011, whereas Illumina started shipping Miseq systems at the end of 2011. Accounting for the free or reagent rental installations, the desktop NGS market is dominated by Ion Torrent, followed by Illumina and Roche systems.

While Ion Torrent gives formidable competition to Illumina, as per Goldman Sachs business report, by next year Illumina MiSeq system will begin exerting its dominance. By placements, MiSeq will have an estimated 57 percent market share, compared to 43 percent for PGM, and by revenue Illumina's platform will generate three times as much as Ion Torrent's.

This neck-to-neck competition and affordable costs of all three Desktop sequencer technologies will push the biotech industry to be more innovative and cost effective and the users will enjoy the benefits of this healthy competition.

Drivers for NGS market

The decrease of price of the tests being conducted results in increased reagent usage. Similarly, this technology is replacing the microarray technology and currently many institutes prefer NGS platforms over microarrays.

Future of sequencing

Certainly, one of the complications arising from the deluge of the sequencing data is managing, analyzing, validating, and interpreting the data. The future of sequencing depends a lot on the informatics solutions that

reduce the bioinformatic costs, facilitate the data analysis, and makes it simple for the users to interpret the results. The highest capacity instruments currently available require 8â€“14 days to produce nearly 300-600 GB of data.

Apart from the current market leaders, few other interesting technologies like the single molecule realtime sequencing (SMRT) from Pacific Biosciences that is being tested in early access sites, monitors each one of an array of individual polymerases while DNA synthesis is occurring, in order to obtain the single molecule sequences in less than 30 minutes.

Other instruments in development, including those by Oxford Nanopore, use nanopore technology to identify individual DNA nucleotides as the DNA fragment passes through the nanopore, by non-fluorescent detection approaches. Although the current capacities of realtime sequencers are not enough for whole genome sequencing of large genomes in a single run, the near-term application of these instruments could be on focused evaluation of specific genes or small genomes.

High Throughput NGS installations in India

Technology/Vendor	Installations in 2011	Total installations
Illumina (GAIIx, Hiseq, HiScanSQ)	5	17
Roche (Roche 454)	3	16
Life Technologies (SOLid)	4	10
Pacific Biosystems	0	0

Next Generation Sequencing market has a value of $16million

- Dr VL Ramprasad, chief scientist, Spinco Biotech
Dr Ramprasad was previously working as senior scientist at Vision Research Foundation, Sankara Nethralaya, Chennai. He holds a Masters and PhD degree in Human Genetics from Birla Institute of Technology and Science, Pilani and has 16 international peer reviewed publications.