

Biomedical Sciences Singapore: The next lap

Keeping an eye on the prize in biomed journey

S'pore has achieved goal of being regional hub, but it must not lose steam, say those in the industry

Amelia Teng
and Samantha Boh

In many ways, molecular and cell biologist Ong Siew Hwa's professional journey, which led her to become founder and chief scientist of a successful start-up, mirrors Singapore's progression into becoming a biomedical sciences hub.

Both stories started in 1991, with the path to success marked by road blocks and snags. The road ahead is no less challenging – major breakthroughs are elusive, and the authorities appear unsure where the research dollars should be directed.

Singapore has become a regional biomedical powerhouse, but those in the scientific community warn that researchers cannot take their foot off the pedal.

Policymakers also should not lose patience, or take their eye off the end goal. While discoveries in the sector can take years, they will reap tremendous payouts.

THE EARLY DAYS

In 1991, Dr Ong, then a wide-eyed teenager, had just enrolled in National University of Singapore (NUS) to study chemistry and biology.

The National Science and Technology Board (NSTB), the predecessor of the Agency for Science, Technology and Research (A*Star), was set up with a mission to advance knowledge-intensive fields like the biomedical sciences and engineering.

They were ahead of the curve and stepping into unfamiliar territory.

At the time, research at the universities focused on traditional sciences like botany and zoology. But by her second year at NUS, Dr Ong, then 20, knew her interest was in the genesis of cancer – by understanding why the abnormality occurs, the genetics of the disease and the cellular pathways involved in its growth. This was a nascent field of study, with the treatment of cancer dependent on chemotherapy.

Around her, new engines of growth were emerging in Singapore. For one, the country had become the world's leading producer of hard disk drives.

NSTB opened the door a crack to the biomedical sector, laying the foundation for what would become the economy's fourth pillar, alongside chemicals, electronics and engineering.

When Singapore set its eye on the biomedical industry in 2000, its vision was clear: to invest in basic science, develop drugs and find cures for diseases. Its goal was to be an Asian hub for biomedical sciences.

But there were setbacks.

In the early days, shipments of enzymes and antibodies needed for experiments took months to arrive. By the time they were here, ice packs meant to keep them cold were warm to the touch, rendering the shipments useless, Dr Ong said.

Some suppliers from the United States and Europe would also ignore orders from Singapore because they had never heard of the country.

And there was a shortage of experts in cutting-edge research, such as in cell signalling in cancer and how cancer responses like growth, spread and inability to die are triggered.

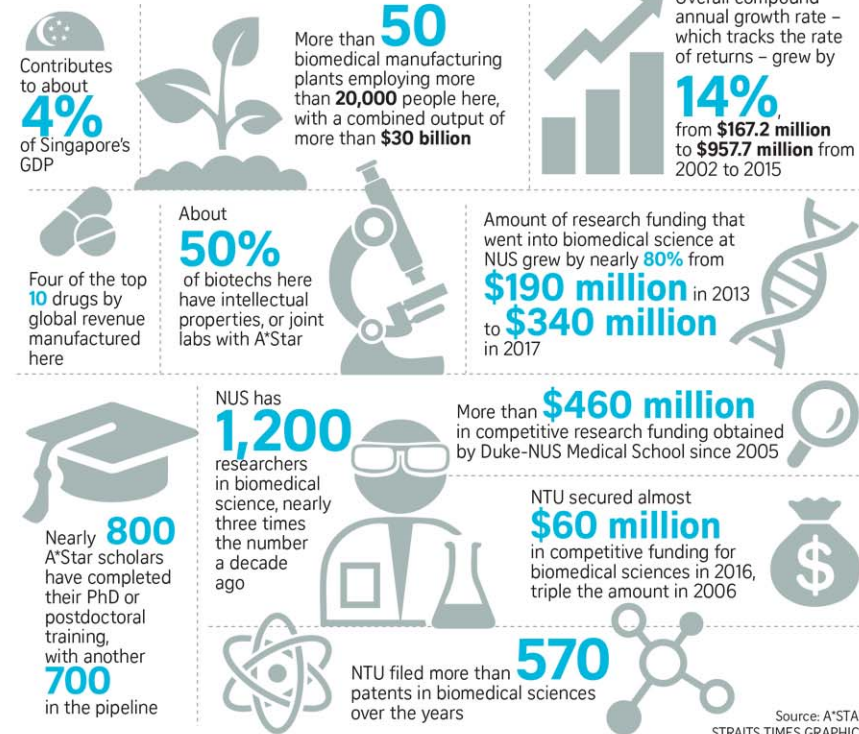
"For people like me, who studied molecular biology and modern cell biology, there wasn't much once we



Although Singapore has built a reputation as the place for biomedical science in Asia, it will have to do more to stay ahead of regional competition, say those in the scientific community. One positive, say researchers, is that the Government is beginning to see the value of encouraging a culture of biotech start-ups. PHOTO: BLOOMBERG

Biomedical feats

THE SECTOR



SINGAPORE'S ADVANTAGE

I think Singapore has the potential to be much more agile in funding specific areas of national interest. It can leverage its multi-ethnic population for studying multiracial disease predispositions.

PROFESSOR GENE YEO, who is with the University of California, San Diego.

PURPOSE AND PASSION

You need to have a purpose and passion to stay in this field. Many of us come into the life sciences hoping that what we discover will be of use to the community. It would be nice for us to build (the start-up) here and contribute to the ecosystem.

DR SARAH HO, an NUS senior research fellow working on a biomedical start-up to be launched in the next two years.

graduated," said the 46-year-old, who in 2000 obtained her PhD from the Institute of Molecular and Cell Biology, which is today an institute under A*Star.

BECOMING A BIOMED HUB

Eighteen years on, the sector has grown significantly, and Singapore has made a name for itself as a place for science.

In 2016, biomedical sciences manufacturing accounted for around 4 per cent of Singapore's gross domestic product and employed over 20,000 workers. Monies spent on biomedical science and research and development hit \$918.6 million in 2016, a fivefold rise from 2002.

"We went from feeling like we needed to go overseas to seek out opportunities, to feeling that the sector here was built-up enough to want to come back," said Dr Ong of how she and her peers felt. She worked for four years in Canada before returning home to take up a position at A*Star in 2004.

She joined global pharmaceutical firm Eli Lilly and Company three years later, before striking out on her own with Acumen Research Laboratories – a contract research organisation that provides services in drug target discovery and pre-clinical drug development – in 2010.

But the industry is in a state of flux as the Republic seems to be increasingly shifting towards growing other segments of research, beyond the basic sciences. It has branched out into areas such as medical technology, food and nutrition, skin and consumer care.

Skin research, which addresses issues such as diabetic skin ulcers, eczema and skin cancer tumours – has attracted over 30 new projects, worth a total of \$11 million, from 2013 to 2016, from industries.

After billions of dollars spent in the biomedical research sector, observers are beginning to ask if Singapore's bold experiment has paid off.

The sector is also facing mounting competition from other countries in the region, including China.

Conflict between researchers and administrators continues to plague the industry, as reflected by the unease in the scientific community over fixed funding cuts at A*Star's research institutes, for instance.

Once an attraction for "whales", Biopolis at one-north in Buona Vista – the biomedical sciences hub – has lost a good number of these star scientists from across the world in the last decade, partly because of frustration with red tape and regulations.

FUNDING

While the amount of money pumped into biomedical research by the Government has grown overall, there is tension over how it

should be distributed.

Singapore allocated \$4 billion to biomedical research for 2016 to 2020, 8 per cent more than the previous five-year period, although 40 per cent was earmarked for competitive funding, up from 20 per cent before. As opposed to guaranteed funding, competitive funding requires scientists to slug it out to receive a slice of the pie.

And in the biggest shake-up in its 16-year history, A*Star announced in March that those who hold hands with industry or provide technologies that support R&D will be guaranteed funding.

Those doing purely basic science research – which fills gaps in knowledge we do not have but is not always immediately applicable or useful – must work even harder to ensure they survive. There is debate on whether it is fair for basic science to be left to open competition.

Professor Pierce Chow, senior consultant surgeon at the National Cancer Centre Singapore, noted: "The overall amount of money hasn't decreased. And as a system matures, it's not inappropriate for principal investigators to compete on the basis of their ideas."

"It can of course be quite stressful for those used to almost guaranteed funding."

But Dr Ong pointed out: "A lot of important discoveries came from

earlier research, which we could not have predicted would have resulted in that sort of pragmatic use in the future."

She is supportive of being more targeted in disbursing funding to the very best basic science research projects, though she remains unconvinced that projects with industrial links should be highly favoured. "Industry links do not automatically mean it will become a product that will make revenue in the market and drive the economy," she said.

"That whole process looks only at the industry link but the practical utility by the end user should be very clear, strong and validated. Does the end user want to pay for it?"

Competition for funding is fierce, and the universities have enjoyed increasing success in getting a slice of the pie. NUS, for one, clinched \$340 million for biomedical research last year, up from \$190 million in 2013.

And Nanyang Technological University said the amount of competitive funding it received in the biomedical sciences nearly tripled from \$20 million in 2006 to almost \$60 million a decade later.

Over the years, Duke-NUS Medical School has secured more than \$460 million in competitive research funding from local and international sources.

HONING TALENT continued on B10-11

Call for S'pore to stay ahead of regional competition

FROM B12

HOME-GROWN TALENT

Singapore is no longer short on talent, with the pool of home-grown scientists growing significantly since the early years.

Since 2001, the A*Star scholarship programme has groomed close to 800 scholars who have completed their PhD or postdoctoral training, with another 700 in the pipeline. It takes about \$1 million to train each one from the undergraduate level.

About 40 per cent remain with A*Star, 15 per cent go on to academia at other institutes and about 15 per cent take on industry research roles. The remaining 30 per cent move on to careers ranging from publishing to polytechnic education.

Meanwhile, the universities are also recruiting more biomedical researchers. There are 1,200 of them at NUS, nearly three times the number from about a decade ago.

But observers say there is less excitement about the sector's prospects than before, amid cuts in postdoctoral places and lab positions for PhD graduates.

Professor Gene Yeo, who completed his PhD in neuroscience at the Massachusetts Institute of Technology in 2005, said: "A decade ago, many postdoctoral graduates were enamoured by the potential to do science and change health outcomes. Now, young scientists are not so sure of their path forward in terms of career progression."

The 41-year-old, who is the son of

former A*Star chairman Philip Yeo, is a professor of cellular and molecular medicine at the University of California, San Diego. He is also a visiting professor at NUS.

"In contrast, demand is still high in the US for PhD holders, most of whom stay in research, though not necessarily in academia," he pointed out. "There's a growing number of biotech and pharma companies in San Diego and Boston, many eager to absorb PhD-level trainees, but since there aren't enough biotech companies in Singapore yet, many life science PhDs go on to administration and middle management."

"This is a good thing since we could always do with well-trained folks in other areas, but we lose many who could have gone on to solve cancer, neurodegeneration and other diseases. We need more life sciences start-ups in Singapore. People are key."

Dr Sarah Ho, who completed her PhD in biomedical sciences in 2014, feels fortunate to have found her niche in gene delivery while studying at NUS. The 32-year-old, a senior research fellow at NUS, said: "I know some of my peers couldn't see how their work could be applied, and were not very motivated to go on."

"Some have left the labs to join other areas such as project management, marketing or sales."

It takes about a decade to complete undergraduate and PhD studies, and those who do typically lose out in financial returns compared to peers in other fields, because of the

headstart they had in their careers.

"For me it's not about money. You need to have a purpose and passion to stay in this field," said Dr Ho, who is working on a biomedical start-up to be launched in the next two years.

"Many of us come into the life sciences hoping that what we discover will be of use to the community. It would be nice for us to build (the start-up) here and contribute to the ecosystem."

THE ROAD AHEAD

Although Singapore has built a reputation as the place to do work in biomedical science in Asia, it will have to do more to stay ahead of regional competition, say those in the scientific community.

Researchers cannot run of steam, they add, and policymakers should not lose patience. Discoveries in the field may take time but they also have a longer runway than other sectors such as engineering.

Professor Lee Eng Hin of NUS' Yong Loo Lin School of Medicine said: "We have to realise that biomedical research takes as many as 20 to 30 years to have outcomes."

Prof Lee, former head of A*Star's Biomedical Research Council, added: "We are doing well but still in our infancy... Our research is not as developed as countries which have done this for a long time."

One positive, said researchers, is that the Government is beginning to see the value of encouraging a culture of biotech start-ups.

Associate Professor Too Heng-



Dr Ong Siew Hwa is founder and chief scientist of Acumen Research Laboratories, a contract research organisation that provides services in drug target discovery and pre-clinical drug development.
ST PHOTO: SYAMIL SAPARI

Phon of NUS' Yong Loo Lin School of Medicine's biochemistry department said while things are moving in the right direction, more support is needed for biotech firms to grow to become global companies that will create value and, of course, jobs.

"The spin-offs have to be encouraged to grow in Singapore and form the base to serve the global market, and not value add to others," he said.

"Singapore still has a reputation and has built some infrastructure. We need to develop an ecosystem of start-ups to create the buzz, so that they attract the multinational corporations, just like how the MNCs want to be in Boston so that they don't

miss out on new developments."

Researchers also point out that Singapore needs to find its own niche to stay ahead of its competitors. Prof Yeo said: "I think Singapore has the potential to be much more agile in funding specific areas of national interest. It can leverage its multi-ethnic population for studying multi-racial disease predispositions."

Others, like Prof Chow, who is also a course director at Duke-NUS Medical School, said more needs to be done to bridge the divide between doctors and scientists. Duke-NUS has just started a PhD programme to train clinicians in high-level research.

"Most doctors don't do research and there is difficulty in translating research into something hospitals can use," he said, adding that the push for more multidisciplinary research into liver cancer and diabetes is on the right track.

Some observers said that while the Republic has changed tack by branching out into skin research, for instance, it must continue to persist in certain core research.

Dr Juliana Chan, editor-in-chief of Asian Scientist Magazine, who was among the first batch of A*Star scholars in 2001, said: "If we are looking for quicker returns on investment in the biomed sector, we should focus

The universities' key achievements

NATIONAL UNIVERSITY OF SINGAPORE

- Amount of research funding that went into biomedical science at NUS grew by nearly 80 per cent from \$190 million in 2013 to \$340 million last year.
- Has 1,200 researchers specialising in biomedical science, nearly three times the number from a decade ago.
- Filed 2,614 publications and 66 primary patents in biomedical sciences last year.
- Between 2013 and 2017, 22 spin-off companies based on technologies borne out of NUS.
- Had 4,475 undergraduates and 1,828 graduate students in biomedical science-related courses last year.

DUKE-NUS MEDICAL SCHOOL

- Has graduated more than 300 Doctor of Medicine and 28 PhD students.
- More than 300 journal articles

- published by students.
- More than 3,700 peer-reviewed journal articles published by researchers.
- Secured more than \$460 million in research funding since it started in 2005.
- Seen more than 74 patents filed and 12 licences awarded, and 11 spin-offs.

NANYANG TECHNOLOGICAL UNIVERSITY

- Published 1,390 research papers in biomedical sciences last year, triple the number in 2007.
- Secured almost \$60 million in competitive funding for biomedical sciences in 2016, triple the \$20 million in 2006.
- Filed more than 570 patents in biomedical sciences.
- Has at least five spin-offs with products and services that are commercially available, and at least eight more that are still developing their products.

on developing products that don't require clinical trials or that have shorter development cycles, such as medical devices, disease biomarkers and laboratory consumables.

"But if we are prepared to play the long game, then it is my hope that Singapore will one day contribute a blockbuster drug with an unambiguous benefit to humanity. This type of research takes time, so stability in core funding and five-year road maps will help."

Prof Yeo added: "There is always a need for biomedical and biotech research, and nations that want to get ahead recognise that. We all get sick, old and die – and the point of this sec-

tor is to understand this process and improve healthcare.

"It's good to branch out, but don't lose sight of the bigger vision. If you keep changing course, like an ocean liner, it's hard to go back to the more difficult but correct trajectory."

Even as Singapore shifts its attention to low-hanging fruit that can be commercialised faster, it should not stray too far from the original goal of drug discovery, said scientists.

As Dr Ong noted: "There is a saying by Confucius that the man who chases two rabbits catches neither."

ateng@sph.com.sg
sambob@sph.com.sg