Drug Discovery & Development

At a time when companies are grappling with declining R&D productivity, Singapore's integrated research network enables companies to access multidisciplinary capabilities in a single location, thereby improving R&D decision-making and accelerating drug discovery and development.

Excellence in discovery science

Singapore has an established research community that includes seven A*STAR public-sector biomedical research institutes, six disease/technology platform-focused consortiums, two leading universities and two academic medical campuses. Singapore's intellectual output has ranged from publications in high-impact journals and approved and filed patents, to partnerships with industry players and spin-off companies. As of 2008, A*STAR had achieved more than 1,900 publications in biomedical journals. A*STAR research highlights can be accessed at www.research.a-star.edu.sg

Key capabilities in discovery science include:
- Cancer genetics
- Epigenetics, genome-wide association studies
- Computational biology
- Systems immunology
- Stem cells for assays & therapy
- Pre-clinical to clinical imaging
- Biomarker discovery
- Animal model development
- Biologics process optimisation
- Bioengineering & nanotechnology

Access to scientific talent

Singapore's exciting research environment, high quality of life and open immigration policies have been a draw for global and regional talent. Today, more than 4,300 researchers carry out biomedical sciences R&D, and companies can tap the annual pool of more than 8,500 science and engineering graduates from local universities.

Biopolis: Plug-and-play infrastructure

This 2.8 million square-foot research campus co-locates public- and private-sector labs and allows them to rapidly establish operations with minimal up-front capital outlay. Scientists and researchers can tap onto shared services ranging from basic glassware washing to high-end scientific services such as confocal microscopy, mass spectrometry and customised proteomics. Companies can also access cutting-edge scientific research equipment and Specific Pathogen Free containment facilities.

Discovery science at a glance

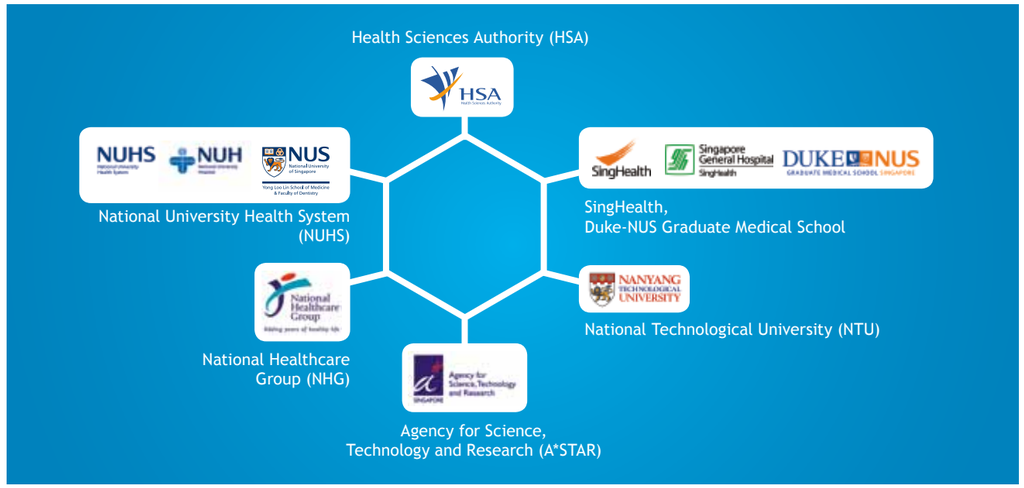
For the year 2008,
- GERD: 2.8% of GDP
- 103 researchers per 10,000 labour force
- 1,581 patents applied; 730 patents awarded
- A*STAR's research units are staffed by 2,620 researchers
- Tertiary institutes (including National University of Singapore, Nanyang Technological University, Duke-NUS Graduate Medical School Singapore) were staffed by 5,511 researchers
- 1.41 papers published per 1,000 people (Wiley-Blackwell, 2007)
- World's no. 1 in intellectual property protection (WEF Global Competitiveness Report, 2009-2010)

Public-Private Partnerships

Leading pharmaceutical companies are co-located with A*STAR research institutes at the Biopolis, and engage in regular public-private partnerships. In recent years, the growing base of biotech companies in Singapore have also tapped onto this integrated research network to accelerate drug discovery and development. Recent announcements include:
- Humalys SAS and Cytos Biotechnology are working with the Singapore Immunology Network to develop antibody-based therapies for infectious diseases that are prevalent in Asia.
- Siena Biotech is partnering A*STAR's Experimental Therapeutics Centre to develop molecular inhibitors of a major signalling pathway in oncology to target difficult-to-treat forms of cancer such as gastric cancer, leukaemia and brain tumours.

Companies with R&D bases in Singapore include
- Abbott — stability studies on API and novel formulations
- CellResearch Corp — stem cell research
- GlaxoSmithKline — neurodegenerative diseases research
- Inviragen — vaccine development for infectious diseases
- Lilly — cancer and diabetes drug/biomarker discovery
- MerLion Pharma — natural product research
- Novartis — dengue fever, tuberculosis and malaria research
- PharmaLogicals — biomarker discovery, cancer research
- Merck Sharp & Dohme — biomarker discovery, non-invasive imaging
- S*BIO — drug development for oncology
- Takeda – target validation and pharmacology

Global scientific leaders who are heading Singapore's research institutes at the Biopolis include Prof Edward Holmes, Executive Chairman, National Medical Research Council and Deputy Chairman, Biomedical Sciences Research Council, A*STAR (centre); Prof Edison Liu, Executive Director, Genome Institute of Singapore, A*STAR (right); and Prof Jackie Ying, Executive Director, Institute of Bioengineering and Nanotechnology, A*STAR (left).



Singapore's integrated research network provides easy access to multidisciplinary capabilities and facilitates coordination amongst partners—all in one location.

Facilitating translational and clinical research

The tight linkages amongst Singapore's 30 research and medical institutes have created an ecosystem where research data and information can be efficiently generated, shared and analysed between clinical and discovery science teams. This integrated network further facilitates pharmacovigilance, healthcare outcomes and data monitoring.

In addition, Singapore's location in the heart of Asia and its pan-Asian population make the city-state a natural location to carry out studies and evaluate ethnic differences (between Chinese, Malays and Indians) in diseases that have a distinct Asian phenotype. Data gleaned from these research efforts can be used to pinpoint new targets relevant to global markets, while developing future therapies customised for Asian patients.

In 2006, Singapore introduced the Translational & Clinical Research (TCR) Flagship Programme, which presents a platform for researchers and clinician-scientists to collaborate in solving scientific problems and translate their research into quality healthcare solutions for patients. Five TCR flagship programmes with a five-year budget of S$25 million each have been launched; they focus on five key disease areas where Singapore has unique strengths and healthcare relevance: cancer, eye diseases, neuroscience, metabolic diseases and infectious diseases.

Cutting-edge capabilities and infrastructure

Singapore has established cutting-edge capabilities and infrastructure to handle complex bench-to-bed and bed-to-bench translational and clinical research projects. This helps companies to move promising candidates more rapidly to the proof-of-concept stage.

These core resources include:

- Dedicated clinical bio-imaging research and early-stage research trial facilities
- Platform technologies in genomics and bio-imaging
- Capabilities in creating unique pre-clinical predictive disease models

Growing base of clinician scientists

Singapore has built up a core of clinician scientists through initiatives such as the Singapore Translational Research (STaR) Investigator Award, which is designed to recruit and nurture world-class clinician scientists to undertake translational and clinical research in Singapore, as well as the Clinician Scientist Award (CSA), which provides research funding and salary support to enable medical researchers to devote more time to research.

At the institutional level, the National University of Singapore (NUS) has partnered Duke University to establish the Duke-NUS Graduate Medical School, Singapore's first graduate medical school. In 2010, Harvard's Beth Israel Deaconess Medical Center announced its collaboration with NUHS in education, research and clinical care. In addition, Singapore is investing in integrated facilities that will house research, education and training in one location. They include the Centre for Translational Medicine at NUHS and the new Khoo Teck Puat Building at the SGH Campus, where Duke-NUS Graduate Medical School Singapore is co-located with the Singapore General Hospital.

Pro-innovation environment

Singapore seeks to provide a regulatory framework that facilitates the development of innovative therapies, while ensuring global standards of safety, quality and efficacy. The Singapore's Health Sciences Authority (HSA) is actively involved in defining new regulatory frameworks and pursuing new areas of research in regulatory science. HSA hosted the 3rd Summit of Heads of Medicines Regulatory Agencies in December 2008 and will co-host the 14th International Conference of Drug Regulatory Authorities with World Health Organisation (WHO) in November/December 2010.

HSA has also forged MOUs with world's leading regulatory agencies such as the U.S. Food and Drug Administration, China's State Food and Drug Administration and UK's Medicines and Healthcare Products Regulatory Agency. In October 2009, Singapore was accepted into OECD's Mutual Acceptance of Data framework that enables data from GLP-compliant preclinical trials conducted in Singapore to be accepted by 30 OECD and non-OECD members that include the U.S., EU and Japan.

Managing clinical research across Asia

Companies can tap into Singapore's growing base of discovery, niche and clinical CROs to facilitate their drug discovery activities. Today, Singapore has established a core base of leading CROs (e.g. Quintiles, Covance, PPD, ICON) that manage regional clinical trials from the city-state. These international CROs offer a wide range of services, ranging from Phase I to pharmacovigilance studies. Some are also setting up innovative biomarker discovery and validation services to support their clients. Besides CROs, companies can also tap on Singapore Clinical Research Institute's capabilities in biostatistics, epidemiology, study design and evidence synthesis as well as full study execution in single and multi-centre studies from proof-of-concept to Phase 4 studies. SCRI is also engaged in implementing clinical research networks across Singapore and in the Asia-Pacific region.

Companies that have set up translational labs include:

- Lilly — oncology biomarker research, genomic data analysis
- PharmaLogicals — biomarker discovery and cancer research
- Takeda — pre-clinical disease model development

Companies/resources supporting translational research include:

- Investigational Medicine Units at National University Health System, SGH Campus, Changi General Hospital, Institute of Mental Health, National Neuroscience Institute
- SingHealth Experimental Medicine Centre — AAALAC-accredited facility
- Albany Molecular Research Inc — chemistry research services
- Maccine — pre-clinical research (model development and bio-imaging; AAALAC- and GLP-accredited)
- Translational Interface — sample collection, tissue preparation, biomarker analysis

Accelerating drug discovery & development

The world's leading companies are leveraging Singapore as a key home-base to drive innovation in Asia. Key examples include:

- Roche's Hub for Translational Medicine — Roche entered into a strategic alliance with Singapore's scientific and medical institutions to set up a major new translational research hub in Singapore in January 2010. Bringing together world-class expertise from Singapore's scientific and medical research institutions with Roche's significant capability in translational medicine and clinical development, this new centre will focus on expanding knowledge of disease biology to develop new personalised treatment approaches.
- Lilly-Singapore Centre for Drug Discovery (LSCDD) — As part of its efforts to fuel drug discovery and research efforts in Asia, Lilly launched an expanded LSCDD in 2007 that conducts drug discovery through an integrated approach of discovery research, integrated informatics and bioinformatics. Located at the Biopolis, LSCDD has established the Fully Integrated Pharmaceutical Network (FIPNet) model that enables the company to partner industry and institutes at the research campus and throughout the region. In 2009, LSCDD partnered with the National Neuroscience Institute (NNI) and the Singapore Institute for Clinical Sciences (SICS) to advance drug discovery, using adult brain tumour stem cells. LSCDD is also part of the Asian Cancer Research Group, which was jointly established by Lilly, Pfizer and Merck & Co, Inc. in 2010 to accelerate research and improve treatment of cancers (e.g. gastric cancer, lung cancer) that are commonly diagnosed in Asia.