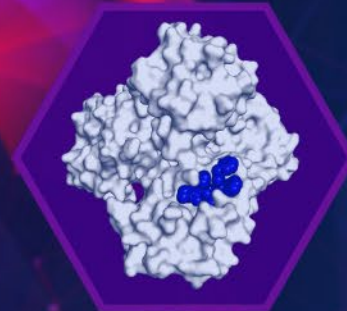


Annual Report

January to December 2021



Great Science
for Great Medicines

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Great Science for

Great Medicines



EDDC - National Centre with Dual Missions

1

Bridge the drug development gap in Singapore

- Engage local entities to translate biomedical research projects into drugs for commercialization
- Bridge the drug developmental gap with expert know-how and innovative drug platforms



2

Attract research investments and catalyse the biopharma ecosystem

- Develop a pipeline of high quality biotherapeutic assets that attract and sustain private investments into Singapore
- Encourage the spin-off of innovative biotech companies to enhance Singapore's biotech ecosystem

As a publicly funded national drug development platform, EDDC's Governing Board comprises members from key public agencies as well as former industry veterans.

"I am very proud of EDDC as it plays a key role in Singapore as a catalyst and an active player in the translation of local ideas into potential therapeutics. It will help accelerate Singapore's emergence into the global biotech ecosystem with much value in return."

Prof William Chin

Bertarelli Professor of Translational Medical
Science Emeritus, Harvard Medical School
Formerly SVP Discovery Research, Eli Lilly

Co-Chairman



"Singapore now has all the ingredients to be a global biotech player: cutting-edge science, great infrastructure, talent and venture capital. EDDC plays a central role to bring all these together to develop new drugs and to create successful partnerships and companies."

Prof Benjamin Seet

Group Chief Research Officer
National Healthcare Group

Co-Chairman



Dear Colleagues & Friends of EDDC,

In 2019 Singapore's national platform for drug discovery and development, the Experimental Drug Development Centre (EDDC), was formed from the integration of the Experimental Therapeutics Centre (ETC), Drug, Discovery and Development (D3), and Experimental Biotherapeutics Centre (EBC). EDDC aims to develop therapeutics that save and improve the lives of patients in Singapore, Asia and around the world. We work collaboratively with public sector and industry partners to translate the great science arising from Singapore's biomedical and clinical sciences R&D into commercial and innovative healthcare solutions, with a focus on Asian-prevalent diseases. The eyes of investigators, investors, biotechs and the pharmaceutical industry have increasingly focused on Singapore and this new model we designed to traverse the Valley of Death.

Two years later, we have much to be proud of. Our scientists are both contributing important knowledge about some of mankind's most serious diseases including colorectal, ovarian and other cancers, COVID-19 and other endemic infectious diseases, pulmonary and related fibrotic diseases and making meaningful contributions toward treatments and cures. Their work shows great promise to advance

standards of care in medicine. Furthermore we have played an important role in supporting the emerging biotech ecosystem in Singapore through strategic partnerships as well as home-grown spin-outs!

The mission of EDDC has been publicly endorsed by way of secured five-year Core and Project funding. With this financial support you will see us further increase our impact in engaging and partnering with the local ecosystem to advance and translate early stage drug discovery projects; we will build new and innovative capabilities and platforms in drug discovery to transform human health; and we will train a new cadre of Drug Discovery and Development scientists and professionals. In this way we will continuously strive to realise our vision of turning great science into great medicines.

Thank you for your continued support of our vision & mission. I'm proud of what we have accomplished together and enthusiastic about what lies ahead; I hope that as you review our inaugural annual publication, you'll feel the same way.

I hope you and yours remain safe.

Sincerely,

Prof Damian O'Connell
Chief Executive Officer



EDDC's Governing Board comprises members from key public agencies and/or who are former industry veterans.

**Governing Board
(GB) Co-Chairs**



Prof William Chin
Bertarelli Professor of Translational Medical Science Emeritus, Harvard Medical School
Formerly SVP Discovery Research, Eli Lilly
Co-Chairman



Prof Benjamin Seet
Group Chief Research Officer
National Healthcare Group
Co-Chairman

Members



Prof Tan Sze Wee
Assistant Chief Executive
Enterprise, A*STAR



Prof Ng Huck Hui
Assistant Chief Executive
BMRC, A*STAR



Mr Beh Kian Teik
Deputy Chief Executive Officer
National Research Foundation



Dr Danny Soon
Chief Executive Officer, CRIS,
MOH
Executive Director, SCRI



Dr Lisa Ooi
Vice-President Strategy
(Health & Wellness)
Economic Development Board



A/Prof Tan Say Beng
Executive Director
National Medical Research Council



Ms Audrey Lok
Director
(Healthcare & Biomedical)
Enterprise Singapore



Dr Andreas Wallnoefer
Chair of EDDC Portfolio
Review Committee
(ex-officio)



Prof Damian O'Connell
Chief Executive Officer
EDDC
(ex-officio)



Damian O'Connell
Chief Executive Officer



Ang Hwee Ching
Deputy CEO

Asset Development Leaders

Chief Scientific Officer

Chief Development Officer

Chief Operation Officer

Chief Of Staff

	Target & Assay Biology I Target & Assay Biology II		Medicinal Chemistry Chemical Biology Peptide Chemistry
	Target & Assay Biology III Antibody Biology Computational Biology		<i>In vivo</i> Pharmacology Biomarker Development
	Project Management		Innovation

	Regulatory Affairs Medical Clinical Operations CMC		Quality Assurance

	Operations Resource Management
	Information Technology Information Systems

	Business Development Alliance Management Strategy Planning
--	--



Snapshots
EDDC in
2021





**A Snapshot
of our
Key Achievements
in 2021**

January to December

Worked on **14** 
Portfolio Projects

Formed **7** 
**New Collaborations
with Public Sector Researchers**




Supported Singapore's Fight Against COVID-19

2 **New Co-development
Projects with Industry**



5 **Other Engagements with
Local Biotech and Industry**

7 
**Patent
Applications**

EDDC Spin-Off



Ligature Therapeutics

**Raised US\$6 Million
in Seed Funding**

Click [here](#) to find out more!

4 
**Innovative
Platforms Initiated**

**Integrated
Target Translation Consortium
(TTC) with the STDR***

**Expanded
EDDC Academic Research Organization
(EARO) Effort**

*STDR: Singapore Therapeutics Development Review

EDDC Portfolio Overview (as of 31 Oct 2021)

14 Ongoing Projects

7 Small Molecules

7 Biologics

7 in Oncology

3 in Infectious Diseases

3 in Fibrosis

1 in Ophthalmology

High priority projects*

ETC-159
EBC-129
Pan-CoV
P201806

*all public collaborations



Significant Projects completed as a National Platform

AOD01
AOD02

7

Discovery

3

Preclinical Dev't

1

Clinical Dev't

4 (prioritized)

Partnering /Out-licensing



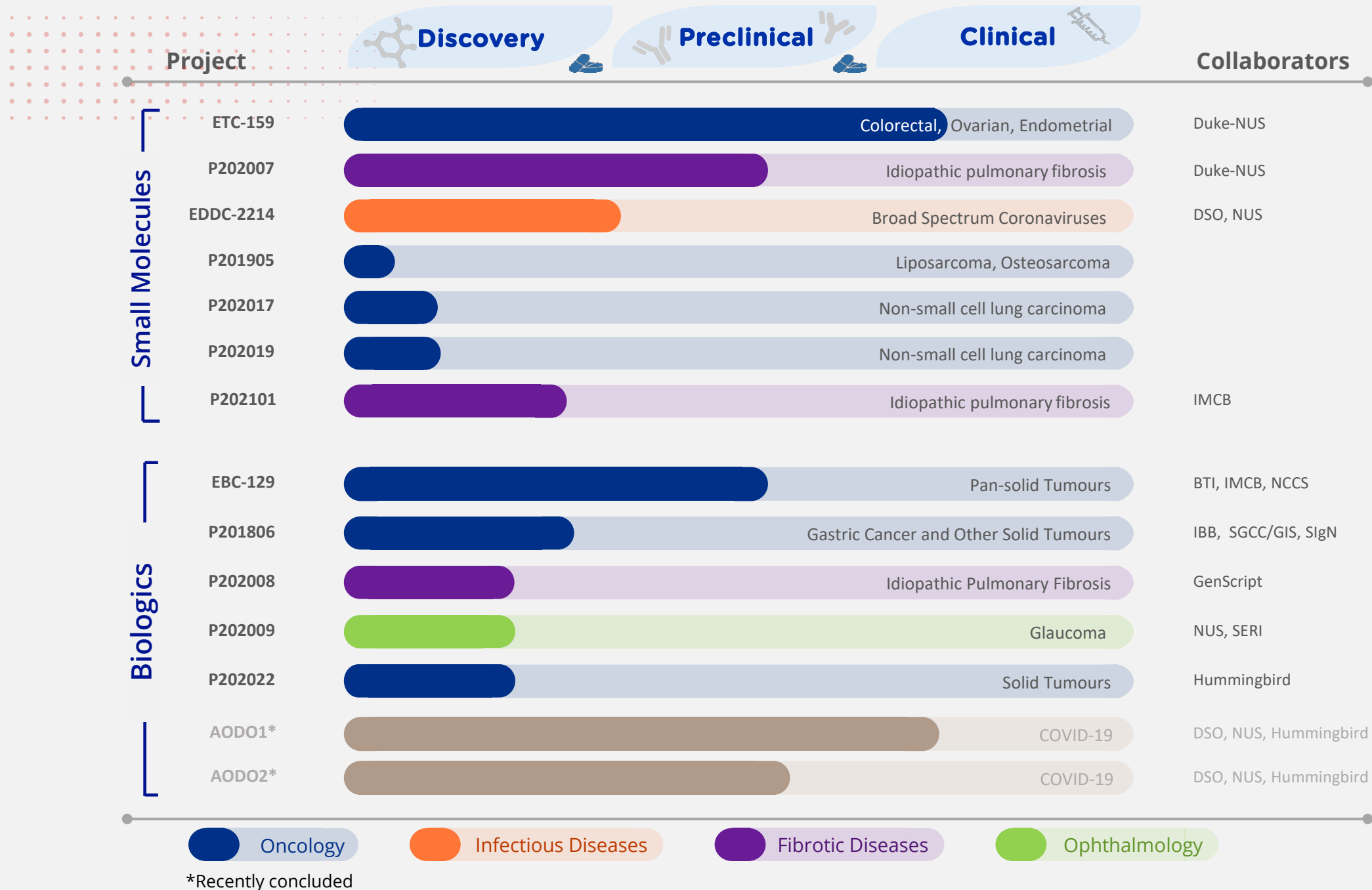
8 Public Collaborations



4 Industry Collaborations



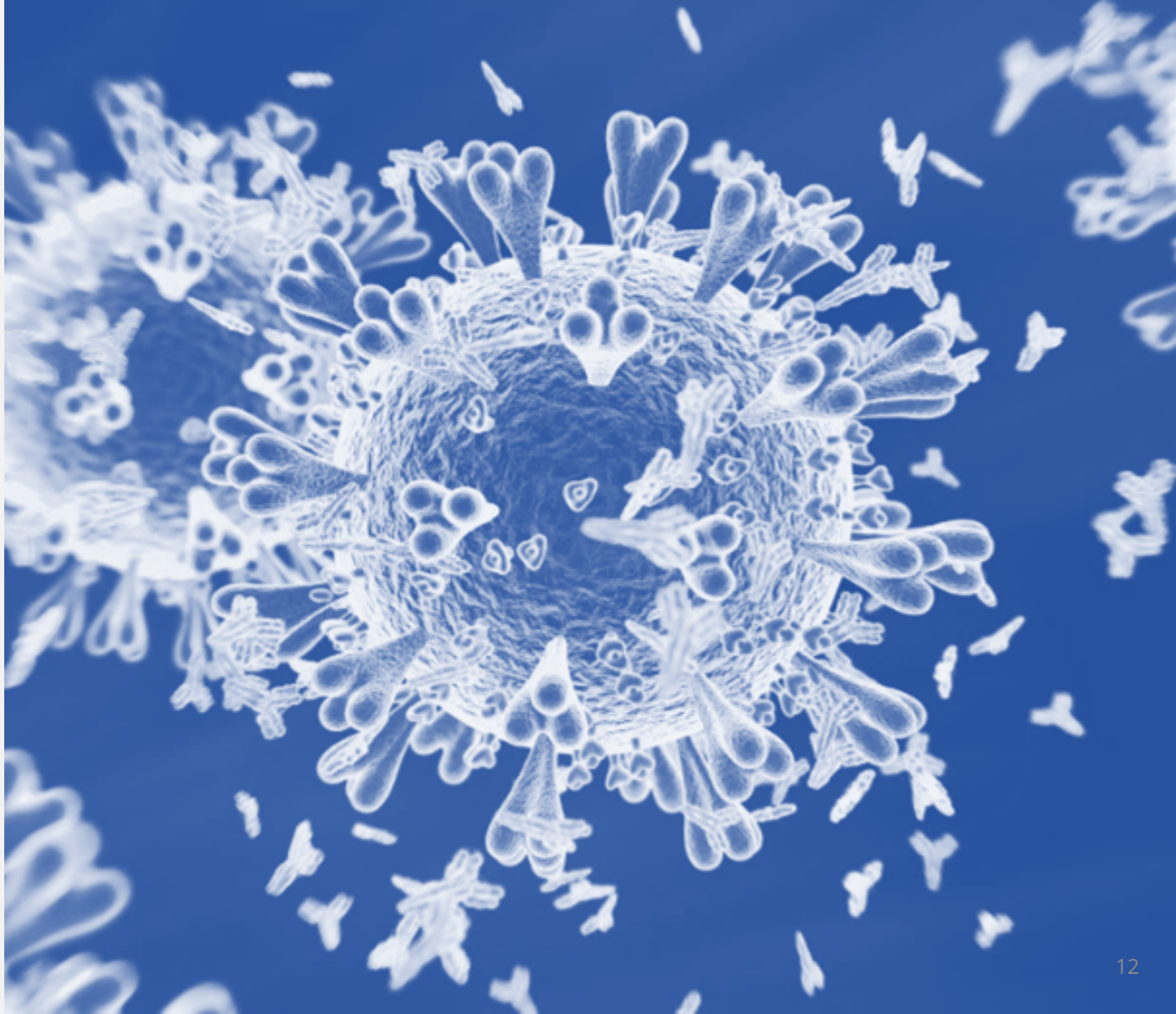
4 Internal Projects



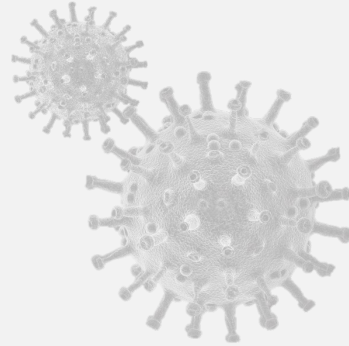
BTI: Bioprocessing Technology Institute | DSO: DSO National Laboratories |
 Hummingbird: Hummingbird Bioscience | IBB: Institute of Bioengineering and Biomedicine |
 IMCB: Institute of Molecular and Cell Biology | NCCS: National Cancer Centre Singapore |
 NUS: National University Singapore | SERI: Singapore Eye Research Institute |
 SGCC: Singapore Gastric Cancer Consortium

*Recently concluded

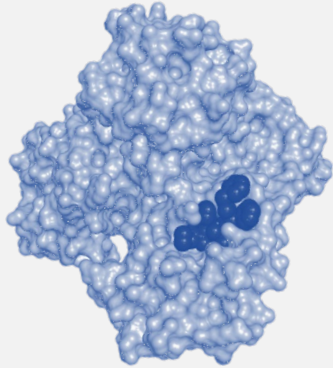
Joining Singapore's Fight Against COVID19



EDDC's Diagnostics team helped to develop one of the world's first COVID19 diagnostic kits in 2020. In 2021, EDDC bolstered Singapore's fight against COVID19 through the development of novel therapeutics.



PanCoV (EDDC-2214): Pan-Coronavirus Small Molecule Inhibitor

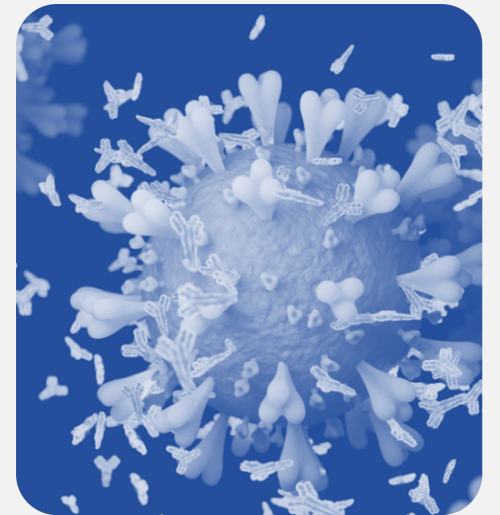


Click [here](#) to read more!

- **EDDC accelerated our drug discovery engine** to identify drug candidates effective against SARS-CoV-2 and other coronavirus strains **in less than one year.**
- **A preclinical development candidate, EDDC-2214** was declared in November 2021. This novel molecule has the potential to be developed into an **oral treatment for COVID19 and future pandemics caused by other coronaviruses.**
- Discussions are underway with potential corporate partners to expedite the development of EDDC-2214 through preclinical and clinical development.

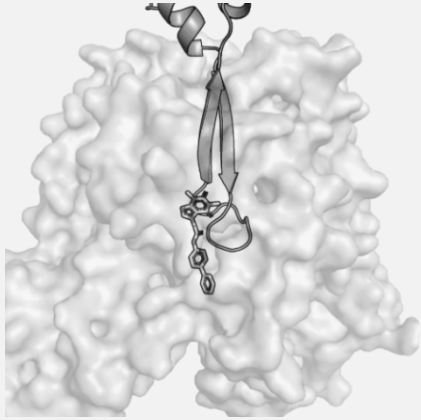
AOD01 / AOD02: COVID19-Neutralizing Monoclonal Antibodies

- AOD01 and AOD02 are two lead COVID-19 neutralizing antibodies that were identified by **DSO National Laboratories (DSO)** with **National University of Singapore (NUS)**, from convalescent COVID-19 patients. A national consortium was set-up to progress the development of these antibodies.
- EDDC coordinated the drug development activities, leading to the rapid completion of preclinical and Phase 1 studies of AOD01 within 9 months from the start of the programme. AOD01 was proven to be safe in Phase 1 healthy volunteer studies completed this year.
- EDDC also drove the development activities for AOD02.



Our Key Projects



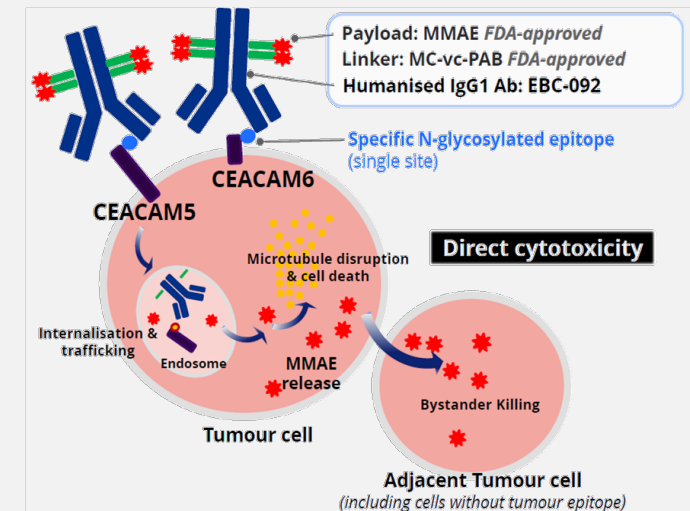


ETC-159: A Best-in-Class Small Molecule Inhibitor of Upstream Wnt Signalling (Oncology)

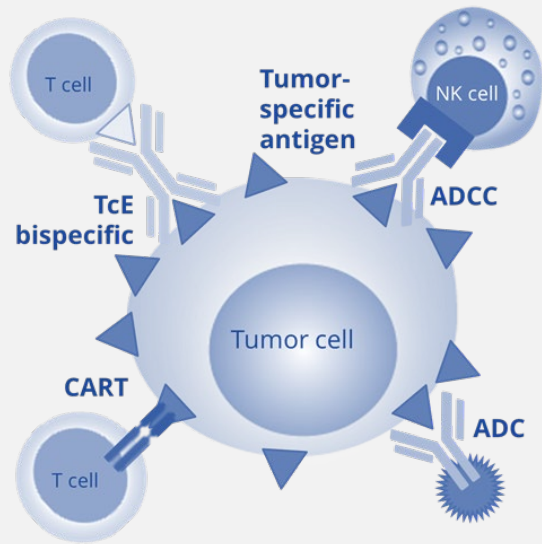
- **ETC-159** is a small molecule inhibitor of O-acyl transferase porcupine (PORCN) with a best-in class pharmacokinetic profile. This project is a collaboration between EDDC and Duke-NUS.
- ETC-159 is currently in Phase 1b clinical trial and is the only PORCN inhibitor in the clinic with a fully analytically validated, PCR-based companion diagnostic for patient selection.
- Phase 1b dose expansion studies are expected to have an early read-out in Q3 2022.
- Outreach to companies, including Pharma, Biotech and accelerators has been ongoing in parallel.

EBC-129: A First-in-Class Antibody-Drug Conjugate (Oncology)

- **EBC-129** is an antibody-drug conjugate that binds to a tumor-specific, N-glycosylated CEACAM5/6 epitope.
- In-vivo efficacy and good pharmacokinetic properties were shown in models of gastric, pancreatic, colorectal, lung and prostate cancer.
- EBC-129's mechanism of action was demonstrated, confirming its first in class denomination, with clear differentiation from competitors.
- An IHC-based companion diagnostic is being developed in collaboration with IMCB.
- Preparation for IND-enabling studies has been ongoing, including:
 - GMP manufacturing of the monoclonal antibody
 - Bioanalytical assay development for GLP assays
 - Preparation of a protocol and a statistical model for the preclinical development study, after guidance from the US FDA and Singapore HSA



P201806: A First-in-Class Antibody-based targeted therapy (Oncology)



This highly tumor-specific surface antigen, expressed in multiple solid tumors (including gastric, ovarian, colorectal, endometrial and testicular cancers), was first identified by the Singapore Gastric Cancer Consortium. Lead antibodies against the target were generated by the Institute of Bioengineering & Bioimaging. EDDC further humanised, engineered and characterized these antibodies for high specificity and affinity, with diagnostic application, cross-species reactivity and favourable developability.

The lead antibody demonstrated potent *in vitro* / *in-vivo* efficacy and a favourable safety profile in a T-cell engager model. It is well positioned for plug-and-play application into various therapeutic modalities e.g. TcE, chimeric antigen receptor T-cell (CAR-T), antibody-dependent cell-mediated cytotoxicity (ADCC), and antibody-drug conjugate (ADC) therapies.

EDDC assigns an ADL to oversee the progress of projects entering preclinical to clinical development. These include EDDC-2214, AOD001/02, ETC-159 and EBC-129. ADLs have extensive discovery and/or development experience and they lead driven, dynamic project teams that include colleagues from

- Discovery Biology
- Discovery Chemistry
- Translational Sciences
- Development
- Project Management
- Business Development

ADLs ensure that the team generates critical data packages within project budgets and timelines.

Planning ahead is done to prepare for regulatory submissions, as well as to ensure that the projects' differentiation against the competition is well exemplified.

Asset Development Leaders (ADLs)



Growing Networks

Drug discovery and development is a team sport.

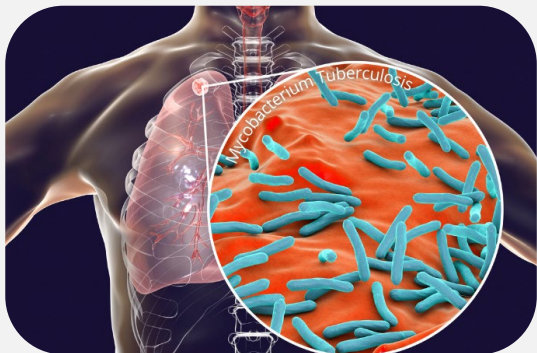
EDDC thus actively engages partners in the public and private sector to jointly develop new drug candidates or new technology platforms.

Here are highlights of some key projects this year.



Public Partners | Projects

Collaborative Efforts

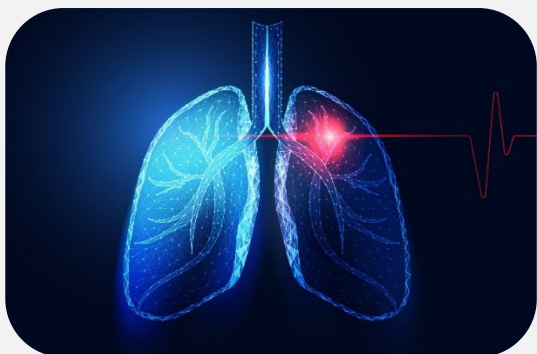
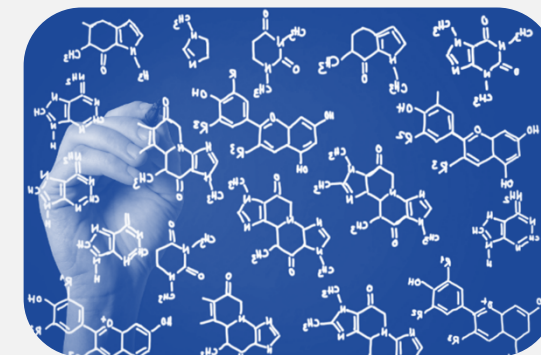


EDDC, NTU and LKC Medicine collaborated as part of TOPNet (*Targeting oxidative phosphorylation for the rational development of sterilizing drug combination for drug-resistant tuberculosis Network*), a TB Excellence Cluster funded by NRF. **Two lead series of compounds acting on different key enzymes in the bacterium's oxidative phosphorylation pathway have been developed.** One of these lead series has been patented and licensing negotiations with a pharma company are underway, led by NTUitive.

Click [here](#) to read more!

EDDC and NUS's Cancer Science Institute collaboration, funded by an NMRC grant, led to the **development of sub-micromolar PROTAC* compounds** that trigger degradation of an intracellular epigenetic regulator. The degradation of this protein decreases the level of its transcription factor activity, leading to the activation of tumor suppressor genes. These PROTAC compounds could potentially be developed into **a novel therapeutic modality** for oncology.

***PROTAC**: Proteolysis targeting chimera



EDDC collaborated with **IMCB** on a **Singapore Therapeutics Development Review-funded project.** Two inhibitors were found to be efficacious in a mouse therapeutic model of Idiopathic Pulmonary Fibrosis (IPF) induced by bleomycin, in comparison with standard of care.

Public Partners | Platform Development

Collaborative Efforts

A multi-party partnership comprising **NUS, GIS, p53Lab and EDDC** have come together to integrate multidisciplinary technologies to **discover and validate macromolecular interactions as novel therapeutic targets**. This programme **led by Prof Ashok Venkitaraman, Director of the NUS Cancer Science Institute**, was awarded an IAF-PP (Industry Alignment Fund – Pre-Positioning) grant to create a unique technology platform that will enable the discovery of a novel class of medicines. “Target Enabling Packages” will be developed to provide enabling technologies and knowledge that will feed Singapore’s drug discovery and translational pipeline.



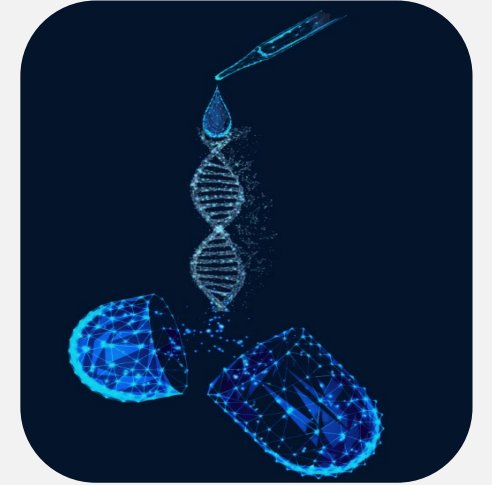
EDDC will be involved in the National Structural Biology Consortium (NSBC), initiated by LKC Medicine. The NSBC brings together experts from NTU, NUS, and A*STAR to accelerate drug discovery efforts by applying structural biology methods to evaluate and identify drug binding pockets for drug design. Techniques like X-ray crystallography, NMR spectroscopy and Cryogenic Electron Microscopy (Cryo-EM) will be integrated to facilitate drug design and development. Access will also be provided to state-of-the-art technology and equipment across Singapore.



Public Partners | Platform Development

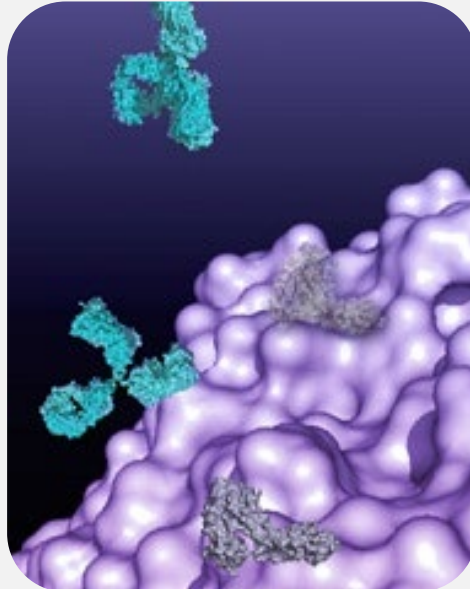
Collaborative Efforts

Targeting RNA in Disease – Recent advances in high throughput sequencing has propelled the development of methodologies for high throughput mapping of RNA structures. The ability to drug RNA would open up a new range of therapeutic targets for previously intractable diseases. **In collaboration with the Genome Institute of Singapore**, EDDC is establishing and validating an approach to identify targets and screen compounds that can bind to disease-related RNA targets. Such hits will be thoroughly validated and has the potential to be developed into drugs to treat diseases.



Industry | Projects

Collaborative Efforts



EDDC and Hummingbird Bioscience, a clinical-stage biotech company headquartered in Singapore, entered a three-year partnership to develop novel antibodies for cancer immunotherapy.

The partnership brings together Hummingbird’s Rational Antibody Discovery (RAD) platform and EDDC’s proprietary High Throughput Antibody Discovery (HiTAD) platform. Hummingbird’s RAD platform will use computational and biological insights to identify novel epitopes implicated in cancer and generate antibodies based on proprietary know-how around immunisation. EDDC’s HiTAD platform will subsequently rapidly screen and characterize B cells that produce antibodies against the epitopes identified. The two parties’ complementary expertise in systems biology as well as antibody generation and development will greatly increase the chances of identifying developable therapeutic antibodies against various targets.

Click [here](#) to read more!

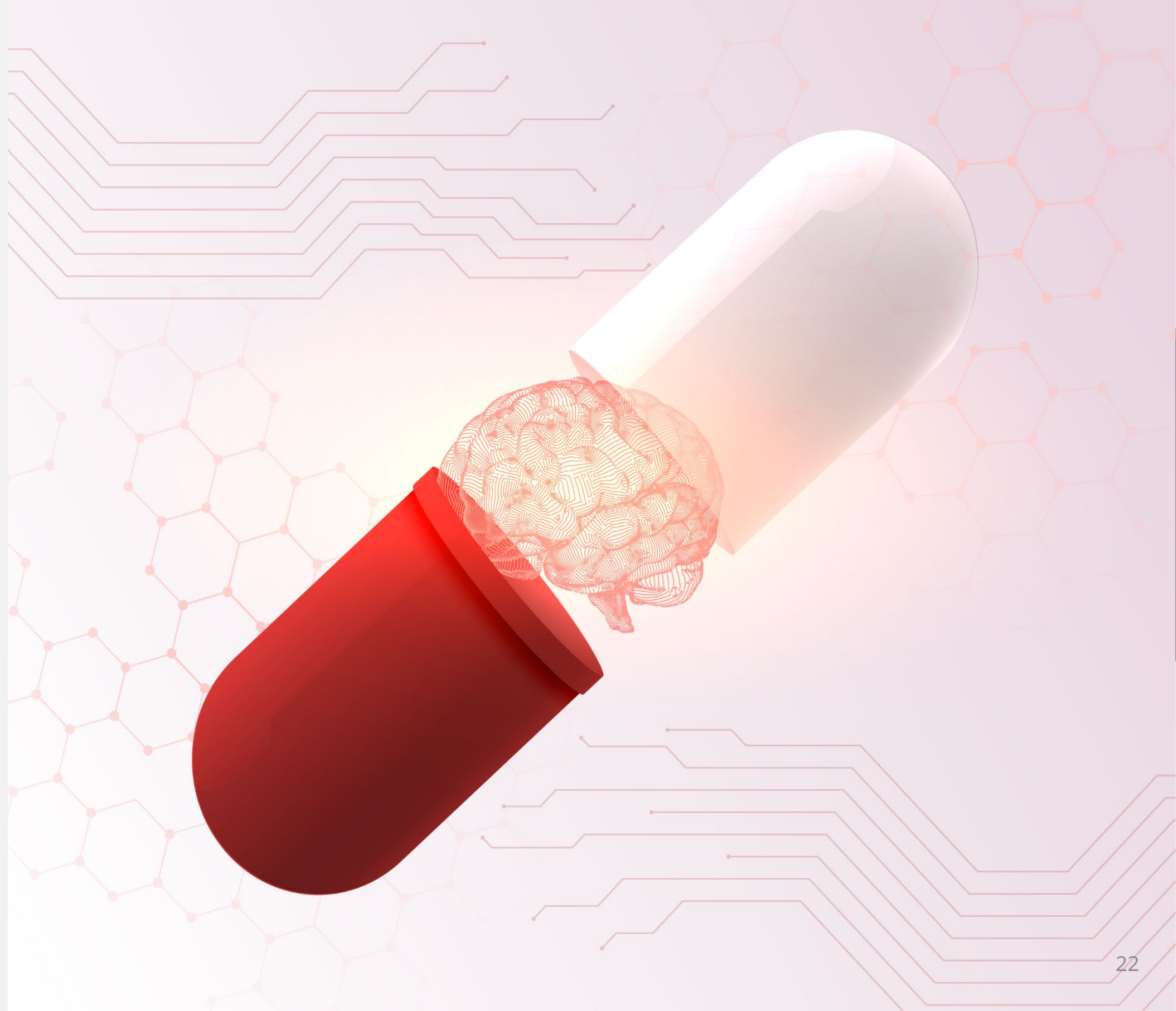
EDDC and GenScript ProBio are collaborating in an anti-fibrosis therapeutic programme to address high unmet medical needs in idiopathic pulmonary fibrosis (IPF). GenScript ProBio and EDDC are committed to the rapid development of novel antibody therapeutics against IPF.

This partnership will leverage the complementary strengths and capabilities of both drug discovery units. EDDC will combine its HiTAD platform and its experience in both *in vitro* and *in vivo* pharmacology, with therapeutic antibody drug discovery capacities from GenScript ProBio.

Click [here](#) to read more!

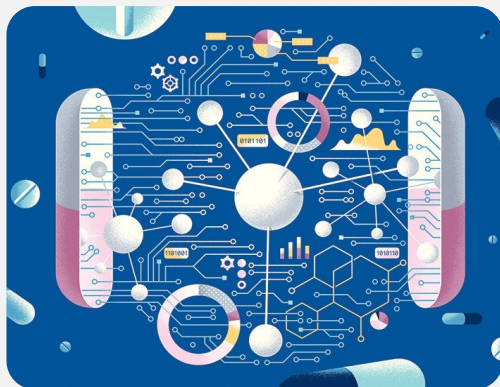


Drug Discovery Platforms



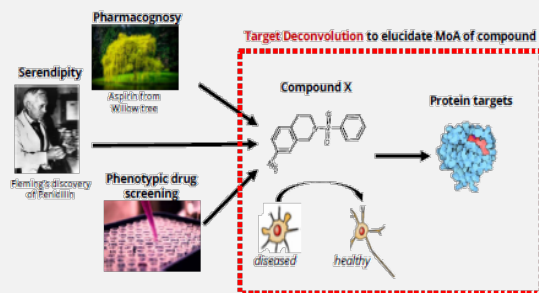
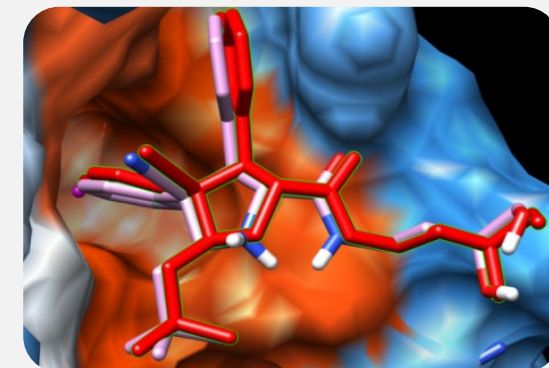
Platform Development | Small Molecule Drug Discovery

Drug Discovery Platforms



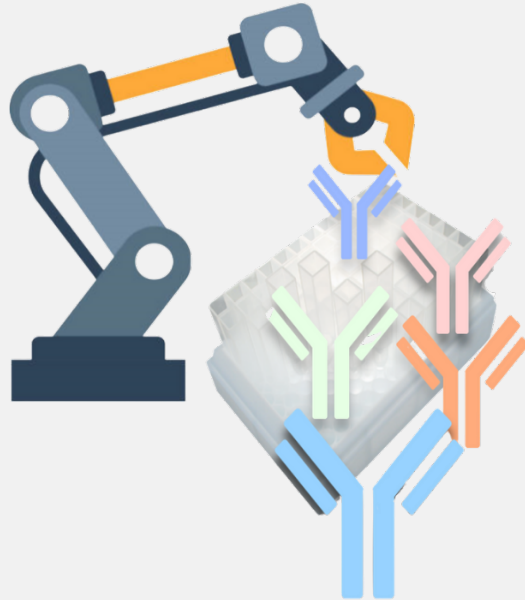
Application of deep learning for data analysis and compound design (ADLDA) - EDDC is working closely with Optibrium on a “Chemistry Focused, Physics Based Machine Learning” approach to pilot the application of deep learning techniques to small molecule drug discovery. This approach makes use of sparse data and imputation and prediction models to (i) aid in data generation and (ii) assist in multi-parameter data analysis, allowing us to prioritize compounds for synthesis. If successful, this approach could potentially speed up and reduce the cost of traditional small molecule drug discovery.

Virtual screening platform - EDDC is testing the feasibility of using large-scale virtual screening as a method to find chemical starting points. With a dedicated workflow, this approach can screen up to 500 million molecules against targets with known crystal structures to identify *virtual* hits within 5 weeks. These hits are then prioritized and purchased for actual screening using a wet-lab assays. Validating this approach would help EDDC to screen up to 8-10 targets per year, potentially increasing our screening capacity alongside traditional high throughput screening, and also significantly shorten the hit finding process.



UCeP (Universal Cellular Protein Profiling) - EDDC has been incubating this platform which aims to identify and validate the biological protein targets underpinning the Mechanism-of-Action (MoA) of a candidate drug. UCeP is a novel, direct and rapid cellular assay for target engagement and deconvolution. By measuring all possible drug-target interactions of a drug-like molecule, UCeP enables the elucidation of the molecule’s MoA, which is in turn critical for downstream drug design optimization and for assessing potential adverse effects.

Platform Development | Large Molecule Drug Discovery



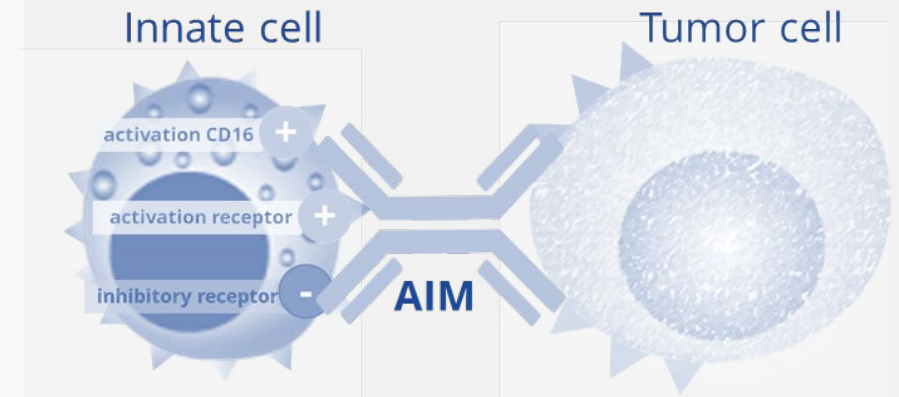
High Throughput Antibody Discovery (HiTAD)

EDDC has established HiTAD, a B-cell cloning platform which is able to isolate, screen and evaluate the immune B-cell repertoire at the single cell level, in a fully automated fashion. This allows rapid and robust therapeutic antibody discovery versus the conventional cell fusion and library construction approach. Multi-parameter profiling screens are run on the antibodies produced to quickly identify lead antibodies with the optimal characteristics. The HiTAD platform is integrated with a biologics registration and data management system that enables full sample life cycle traceability and IP protection.

EDDC is applying HiTAD in the collaborations we initiated this year with GenScript and Hummingbird Bioscience.

Fc enhanced/ADCC-enhanced Innate cell Modulators (AIM)

Antibody engineering can be used to develop effective, targeted antibody-based therapeutics. EDDC is working on developing an innovative antibody engineering platform which it hopes to use to generate enhanced antibodies that can activate the innate immune system to destroy cancer cells. The goal is to engineer antibodies to hit multiple disease-related targets with potential synergistic potency and superior safety.



Developing Talent

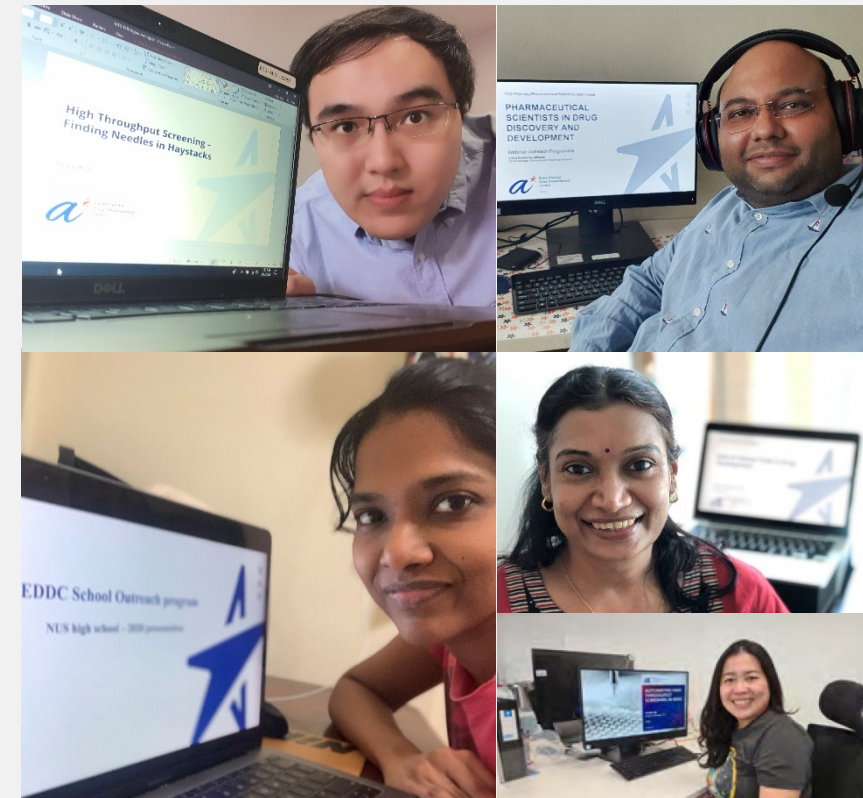
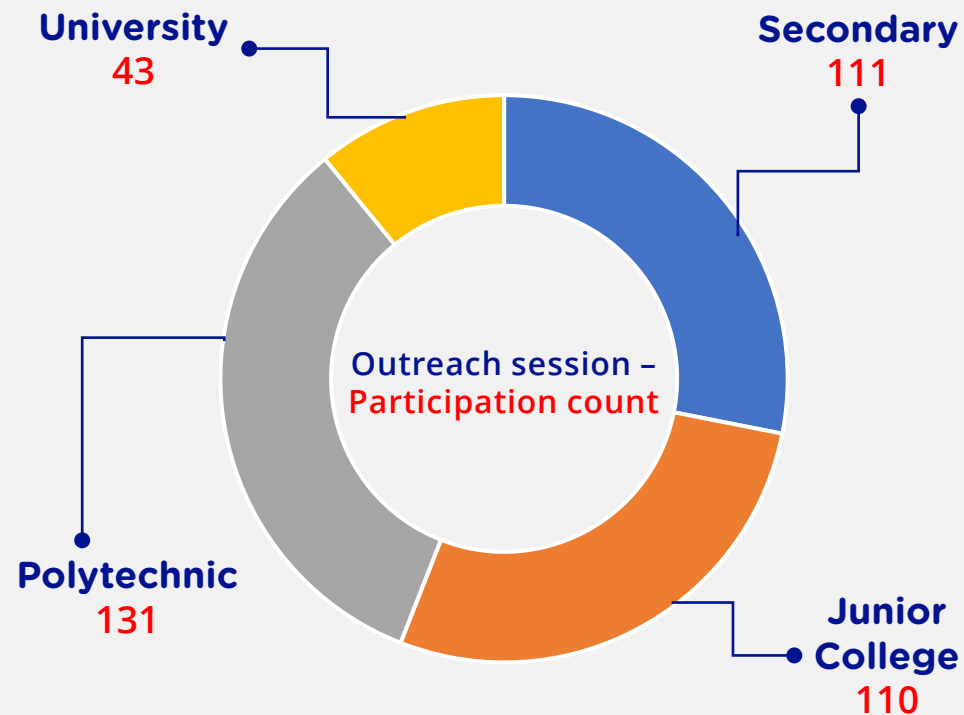


Inspiring the Next Generation of Drug Discovery Researchers

EDDC's outreach efforts began in late 2019 with the aim of inspiring and educating secondary to tertiary students about drug discovery and development. Experts at EDDC gave talks to visiting students and held causal chat sessions to address any questions they had.

In 2021, after getting used to a year of remote conferencing, we brought our outreach sessions online and were welcomed back with enthusiasm.

Outreach efforts



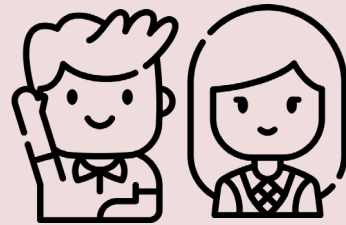
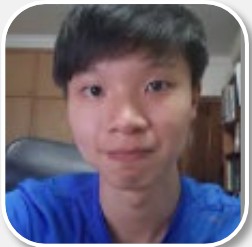
Lectures were taught by respective in-house experts who volunteered their time. *Note that this compilation is not exhaustive.*

Nurturing a New Generation @ EDDC

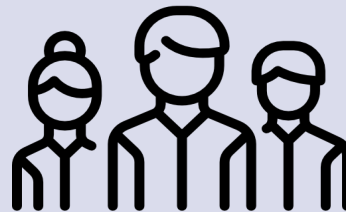
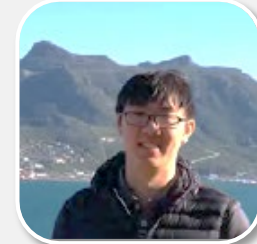
EDDC's scientific staff are nurturing a new generation of drug discoverers and passing on knowledge and know-how through the SG United Traineeship programme. This programme is a national initiative aimed at enabling fresh graduates and locals to gain professional skills despite the pandemic-hit economic climate.

These traineeships typically last for a year and may be extended. Selected trainees are also provided with the opportunity to become full-time employees.

SG United Traineeship



12 Traineeships
ending in 2021 or after



7 Trainees converted
to full-time employees



Considerations in Drug Discovery

In a bid to further educate the wider community on key considerations in drug discovery, the TTC coordinating team at EDDC has produced a 9-episode eponymous video series featuring various experts from EDDC, Duke-NUS Medical School, and the National Cancer Centre Singapore. Videos are available on EDDC's [YouTube](#), [LinkedIn](#) and [website](#). Refer to [Page 60](#) for more details.

TTC's Video Series



Leadership & Organizational Development (L&OD) in EDDC

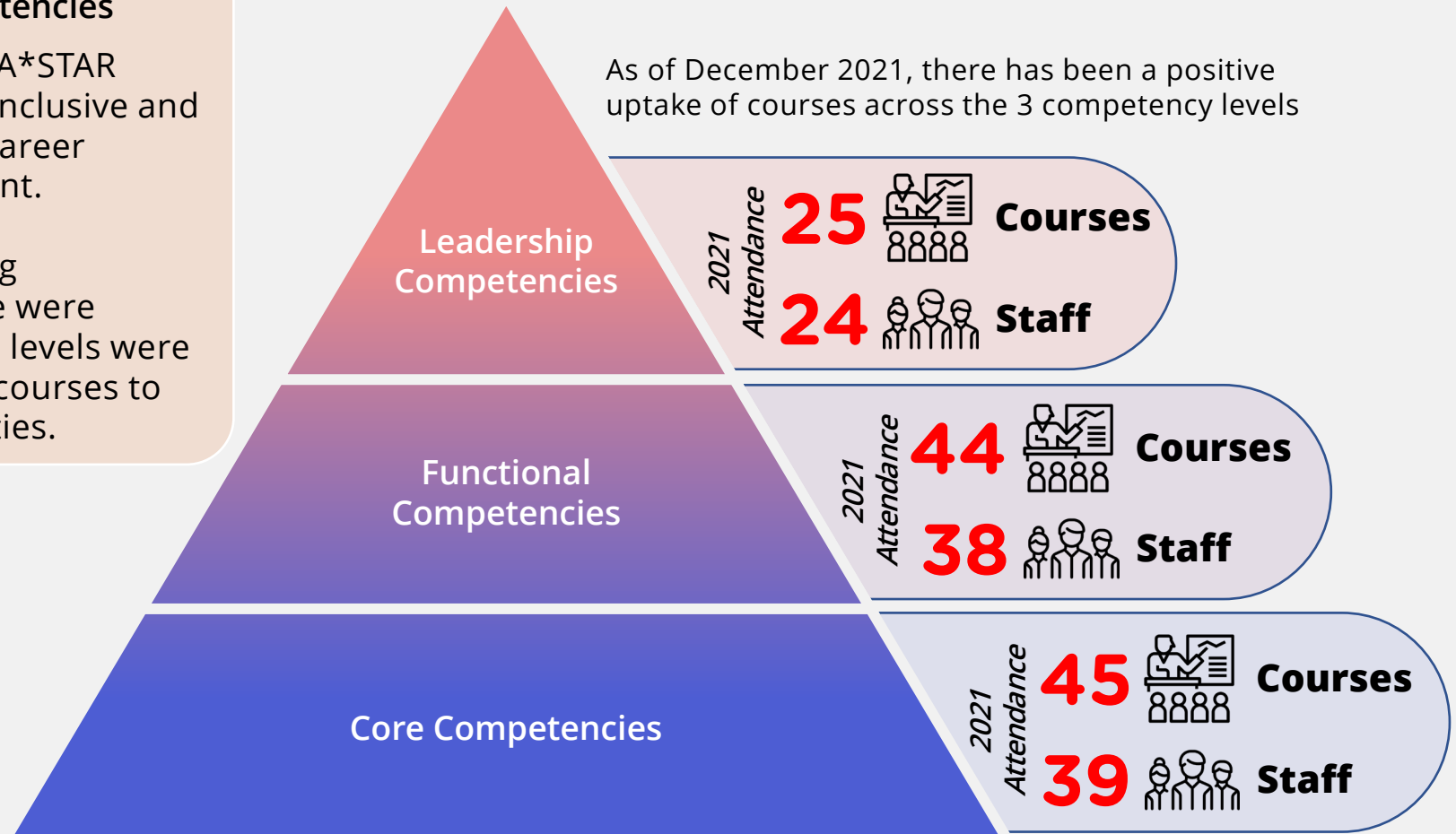
Staff Development

Developing Our Staffs' Competencies

EDDC actively participated in A*STAR L&OD efforts to establish an inclusive and standardized framework for career development and advancement.

Key competencies and training programmes to develop these were identified. EDDC staff from all levels were encouraged to take up these courses to build their individual capabilities.

As of December 2021, there has been a positive uptake of courses across the 3 competency levels



Leadership & Organization Development (L&OD) developmental framework for People Development.

Behind The Scenes



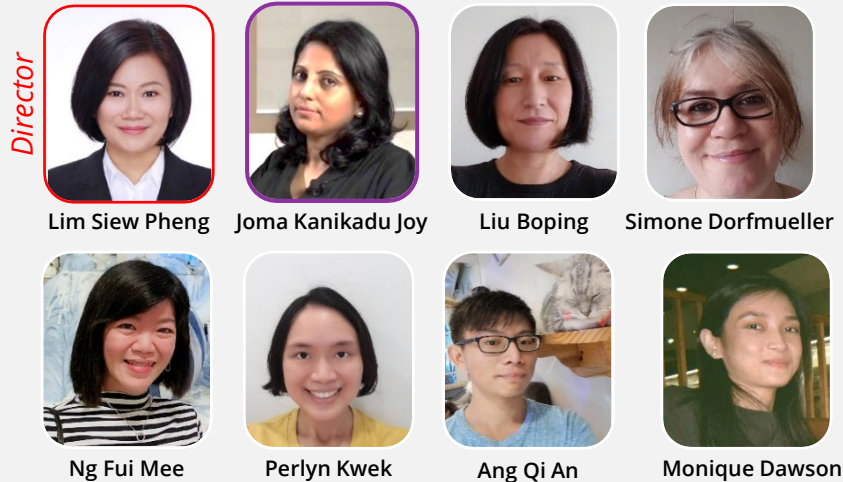
Meet The Team



Discovery Biology I

EDDC's Discovery Biology I team is made up of the following groups:

- Target & Assay Biology I
- Target & Assay Biology II



Target & Assay Biology I (TAB I)

The TAB1 team develops **biochemical assays** amenable to HTS & uses **biophysical tools** to characterize the binding properties of the molecule and understand mechanism of action.

The team has broad experience in design, development and implementation of assays required for **primary and secondary screens**, identification of **leads** and assays to support the **lead optimization** phase of the drug discovery project.



Target & Assay Biology II (TAB II)

We design, implement and perform biological studies, particularly **cellular approaches** to drive preclinical discovery workflows from hit-to-lead, lead op to PDC.

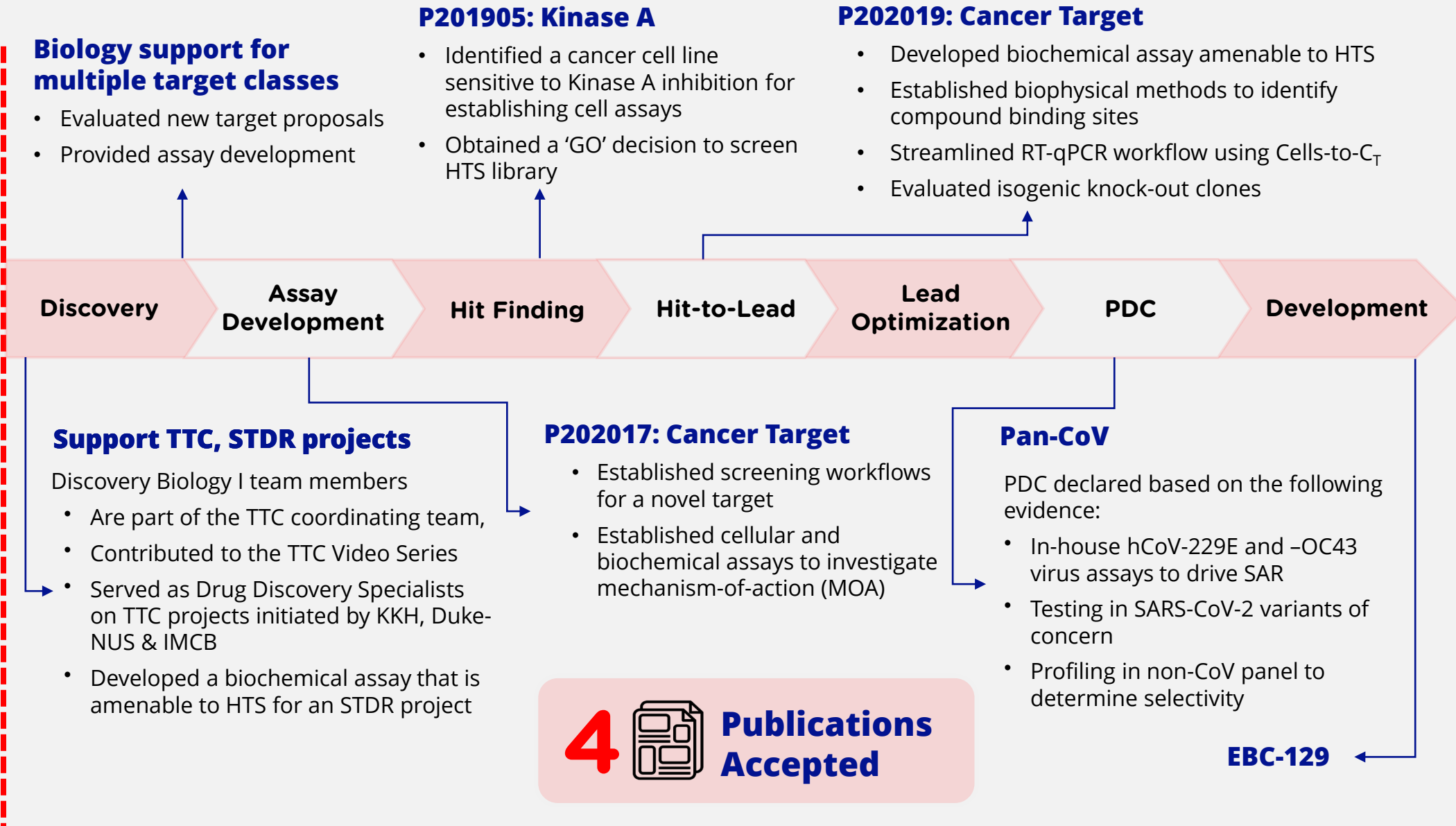
Our team has expertise in **biochemical and biophysical assays**, enabling deeper exploration of therapeutic hypotheses and derivation of mechanistic insights on drug action.





Snapshot of 2021

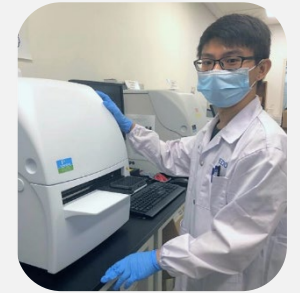
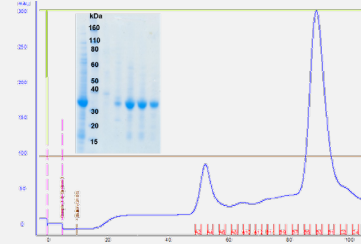
Here's a look at Discovery Biology I's undertakings for this year.





EDDC-2214 - Pan-CoV

In under a year, our biochemists have successfully purified an active enzyme and developed assays to identify inhibitors against the SARS-CoV-2 3CL protease.

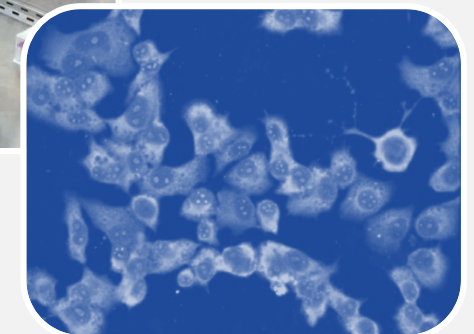


The demonstrated selectivity of the preclinical candidate molecule against a panel of human proteases shows potential in its ability to inhibit other viral targets, as well as a mechanism of action that is distinct from competitor molecules (See [Page 13](#))

EBC-129 - Antibody-Drug Conjugate (Oncology)

Our team measured the cell-killing potency of EBC-129 against a panel of cell lines of various cancer indications, and demonstrated that the cell-killing is via the ADC, not the unconjugated mAb. We established EBC-129's specificity for CEACAM5/6 and in collaboration with Contract Research Organizations, showed that the ADC had no off-target effects.

Through the team's effort, we were able to show differentiation from competitor molecules. Our data was included in the pre-IND/HSA briefing package and in the filing of a Technology Disclosure.



Meet The Team



Discovery Biology II

EDDC's second Discovery Biology team is made up of the following groups:

- Target & Assay Biology III
- Antibody Biology
- Computational Biology

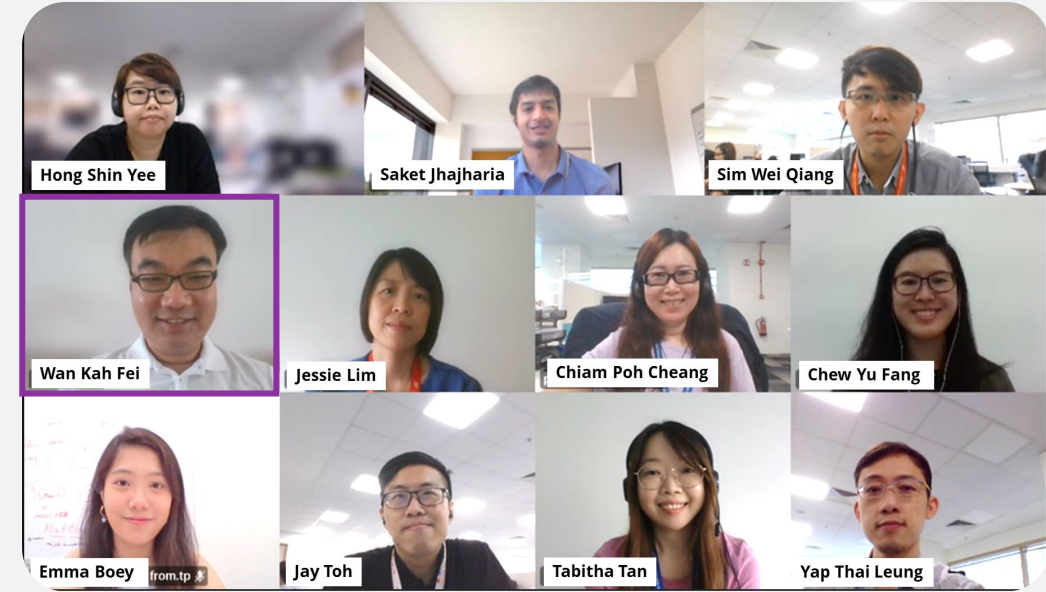


Target & Assay Biology III (TAB III)

The TAB III team is responsible for cell-based functional assay development and characterization of therapeutic candidates

Computational Biology

The Computational Biology group works to incorporate computational biology and digital science approaches into drug discovery and development. They are responsible for setting up platforms and pipelines for identified scopes of applications, in order to build up functional capabilities and establish cross-institute relationships



Antibody Biology

The Antibody (Ab) Biology team is responsible for therapeutic Ab generation, optimization; biochemical & biophysical characterization; tool reagent preparation & characterization; and companion diagnostic Ab generation & evaluation



Sun Miao



Snapshot of 2021

Here's a look a look at Discovery Biology II's key achievements and undertakings this year.

2  **Technology Disclosure Filed**

1  **Patent Applications**

2  **Partnerships With Industry Initiated**

1  **Innovative Platforms Initiated**



Supported the following



8 **Projects/
Pilot Projects**

2 **Target Translation
Consortium Projects**

- ✓ Established industry-like large molecule discovery workflow
- ✓ Integrated with high-throughput automation system and data management
- ✓ Proprietary T-cell engager and enhanced ADCC Fc engineering capabilities
- ✓ Full suite of biophysical and bioassays to discover functional therapeutics



Highlights

Here's a look a look at Discovery Biology II's key undertakings this year.



Highlights of our contributions to projects

- **Industry Partnerships:** We established co-development partnerships with Hummingbird Bioscience, a biotech company headquartered in Singapore as well as with GenScript Probio, listed in Hong Kong (See [Page 21](#))
- **P201806:** In collaboration with the Institute for Bioengineering and Bioimaging, we were able to demonstrate that the tumor-specific T-cell engager antibody candidates we developed have anti-tumor effects in *in vivo* models of gastric cancer (See [Page 16](#))
- **EBC-129:** The Antibody-Drug Conjugate we developed in collaboration with the Bioprocessing Technology Institute was successfully declared as a preclinical development candidate (See [Page 15](#))

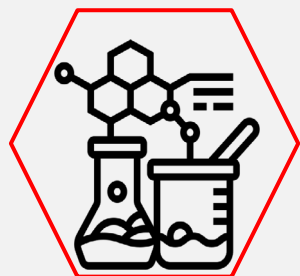
Innovative Platforms



We are

- Actively enhancing our **High Throughput Antibody Discovery (HiTAD)** platform (See [Page 24](#))
- Developing an innovative antibody engineering platform **ADCC-enhanced Innate cell Modulators (AIM)**. As part of AIM, we are developing approaches to tailor the efficacy and safety of antibody-based therapeutics through engineering bi/multi-specific antibodies (See [Page 24](#))

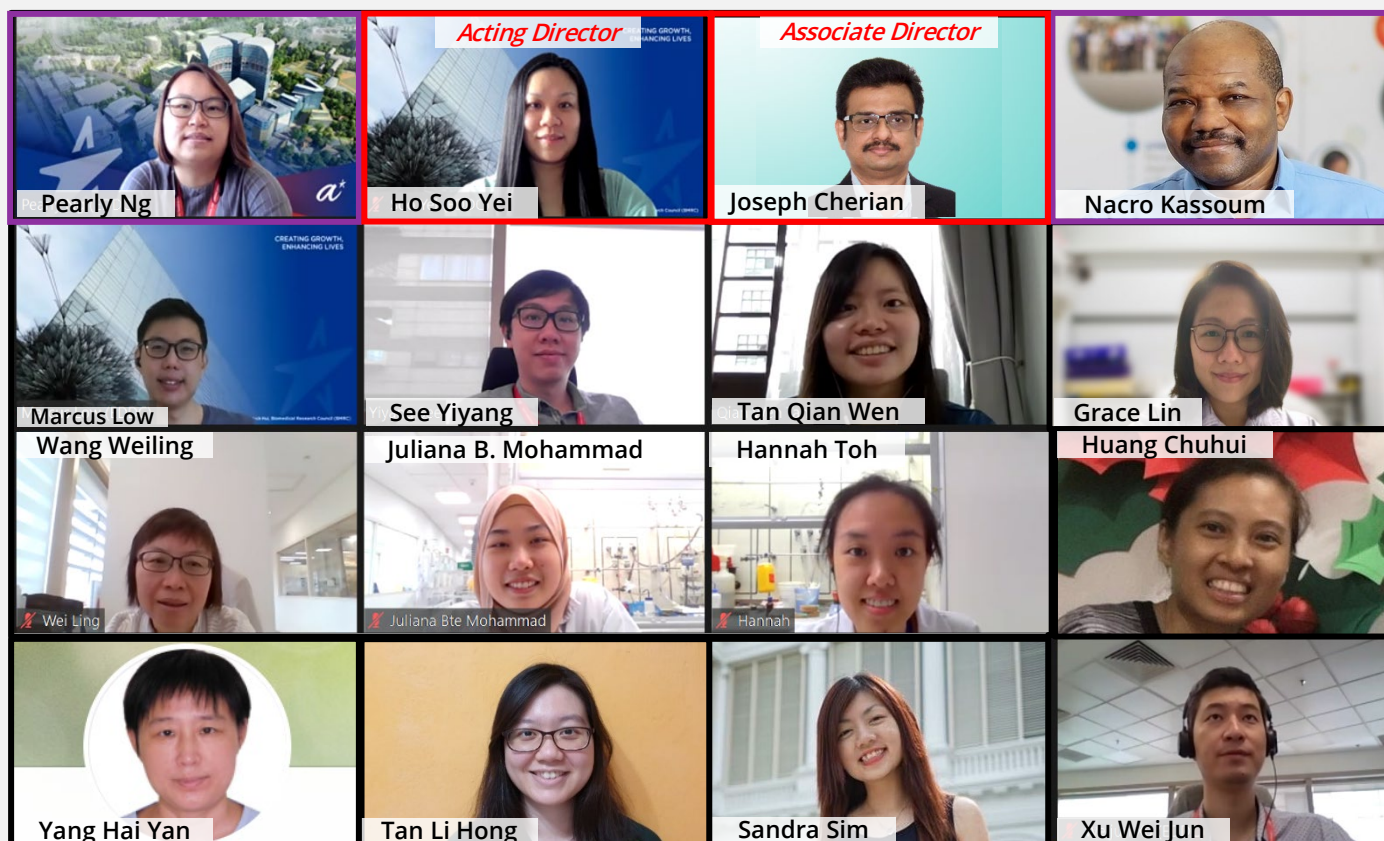
Meet The Team



Discovery Chemistry

EDDC's Discovery Chemistry arm is made up of the following groups:

- Medicinal Chemistry
- Chemical Biology
- Peptide Chemistry



Medicinal Chemistry

We are the only group in Singapore with industry-level expertise in design, synthesis and optimisation of new chemical entities. Through computational methods and AI approaches, the group investigates ways to accelerate drug discovery and is dedicated to producing preclinical development candidates with the most balanced pharmacokinetic profile.

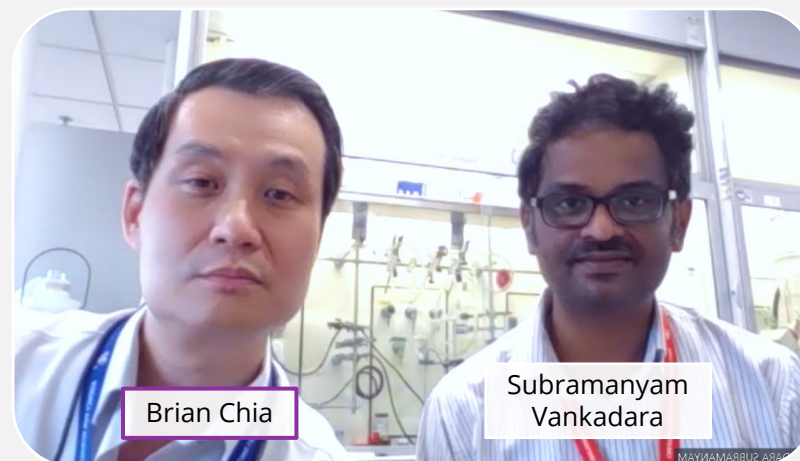
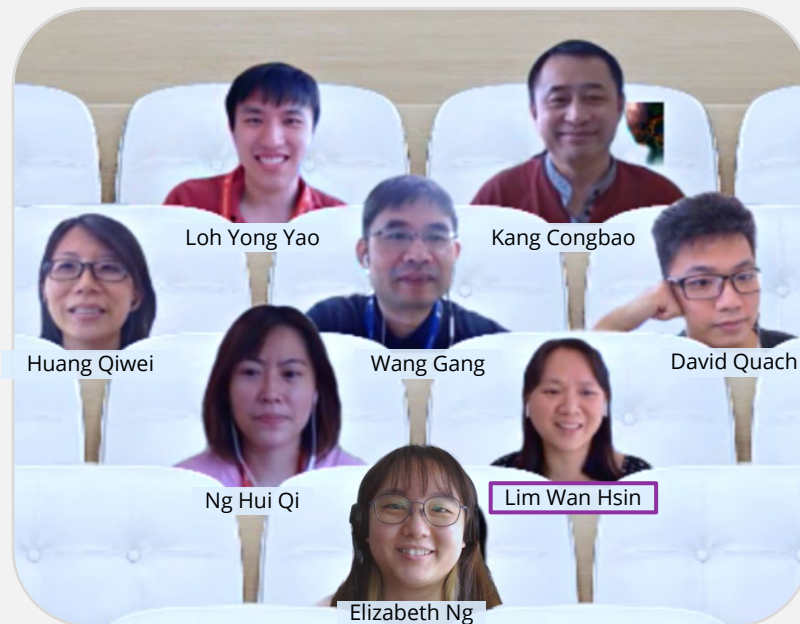
Meet The Team



Discovery Chemistry

EDDC's Discovery Chemistry arm is made up of the following groups:

- Medicinal Chemistry
- Chemical Biology
- Peptide Chemistry



Chemical Biology

A multidisciplinary group including chemists, biologists, and structural biologists, who collaborate to develop tool compounds for novel targets and create chemical probes for target identification. We will establish a workflow from chemical probes generation to phenotypic screens to identify oncology targets. This target identification workflow can be applied to search for novel targets in other diseases indication.

Peptide Chemistry

The Peptide Chemistry group is an agile 2-person drug-hunting team specializing in peptide drug discovery & development with a special focus on initiating and delivering new drug assets into EDDC's pipeline.



Snapshot of 2021

Here's a look a look at Discovery Chemistry's key achievements and undertakings this year.

2



**Technology
Disclosure Filed**

2



**Patent
Applications**

11



**Publications
Accepted**

4



**Innovative Platforms
initiated**



Supported the following



8 Projects

**6 Target Translation
Consortium Projects**

**5 Grant-funded
projects**



Highlights

Here's a look a look at Discovery Chemistry's key achievements and undertakings this year.



Highlights of our contributions to projects

- **EDDC-2214 – Pan CoV:** Our 14 medicinal chemists were able to design several small molecules effective against SARS-CoV-2 and other coronavirus strains in under one year. The structure-activity relationship information garnered has the potential to identify additional scaffolds targeting other viral proteases. (See [Page 13](#))
- **P202017 – Cancer Target:** The Chemical Biology group successfully obtained 25 fragment hits & identified three potential small molecule binding sites.
- **PROTAC approach for an epigenetic regulator:** This collaboration with NUS led to the development of sub-micromolar PROTAC molecules that caused the degradation of an intracellular epigenetic regulator. (See [Page 18](#))



Innovative Platforms

We are

- Actively trialling **computational approaches to small molecule drug discovery** (See [Page 23](#))
- Developing workflows and capabilities to **target RNA with small molecules** (See [Page 20](#))
- Participating in the **National Structural Biology Consortium**, led by LKC Medicine and a new platform **targeting Macromolecular Interactions** led by Prof Ashok Venkitaraman at NUS/IMCB. (See [Page 19](#))

Meet The Team

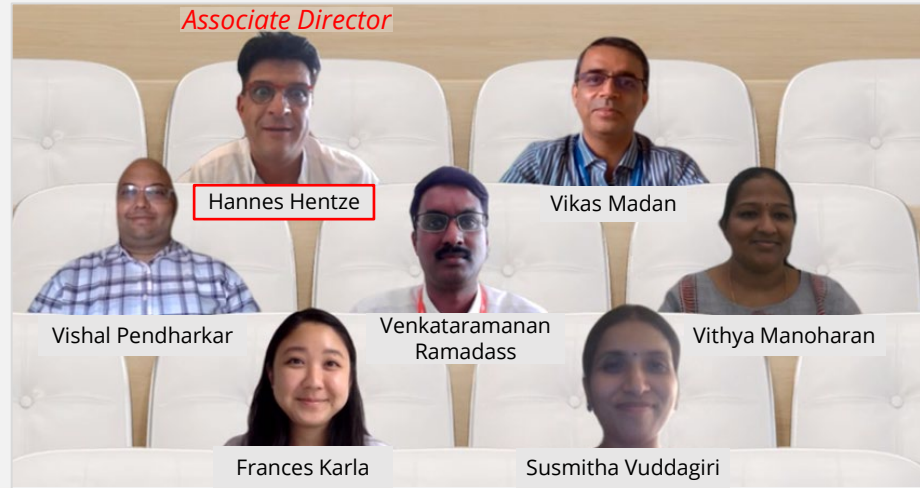


Translational Sciences

EDDC's Translational Sciences team consists of two groups with overlapping & complementary capabilities:

- *In vivo* Pharmacology
- Biomarker Development

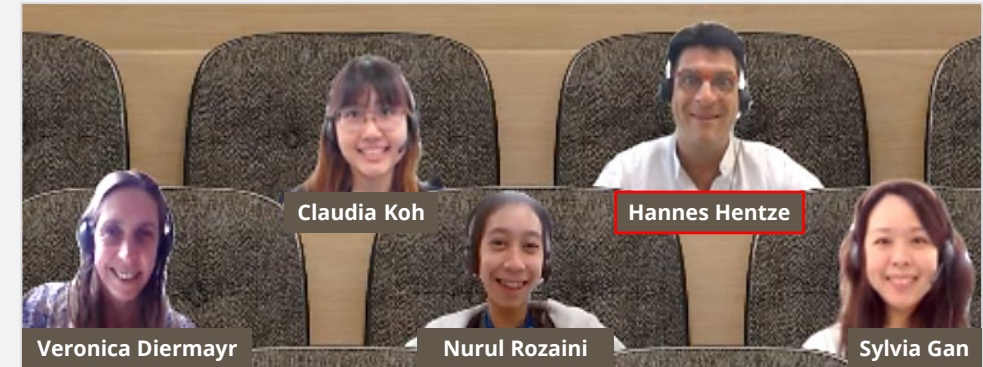
In Vivo Pharmacology (IVP)



The **IVP group** enables project transition from discovery to PDC/IND stage by providing critical IVP expertise

- We are executing high-quality in-house studies, and facilitating outsourcing to CROs
- Our capabilities cover efficacy studies in oncology and immuno-oncology, fibrosis, infectious diseases, and toxicology, as well as pharmacokinetics and modelling
- We are using a state-of-the art animal vivarium at Biopolis, and a designated laboratory software platform for data capture & analysis

Biomarker (BM) Development



The **BM development group** develops biomarker assays to enable project transition from discovery to PDC/IND stage

- Design, development & execution of BM and translational strategies from program inception to First in Human
- We translate high quality pharmacodynamic BM assays and patient selection biomarker companion diagnostics in alignment with clinical development objectives
- Our capabilities span from assay design & feasibility studies, design verification & validation (in compliance with industrial standards), preclinical/clinical sample processing, to data analyses and FDA-compliant data reporting



**Snapshot
of 2021**

Here's a look a look at Translational Sciences' key achievements and undertakings this year.

1  **Technology Disclosure Filed**

11  **QMS Documents Drafted**

4  **Publications/ Posters Accepted**

4  **Workflow Improvements**



Supported the following



13 Projects

3 Assay Validations

1 HBR Audit

- ✓ Improved capabilities in humanised mouse model
- ✓ Executed & facilitated >60 pharmacology/toxicology studies
- ✓ Built extensive BM-related sample repository (56 FFPE blocks, 87 cell line pellets)
- ✓ Expanded technical BM-relevant technical capabilities (IHC & ELISA)

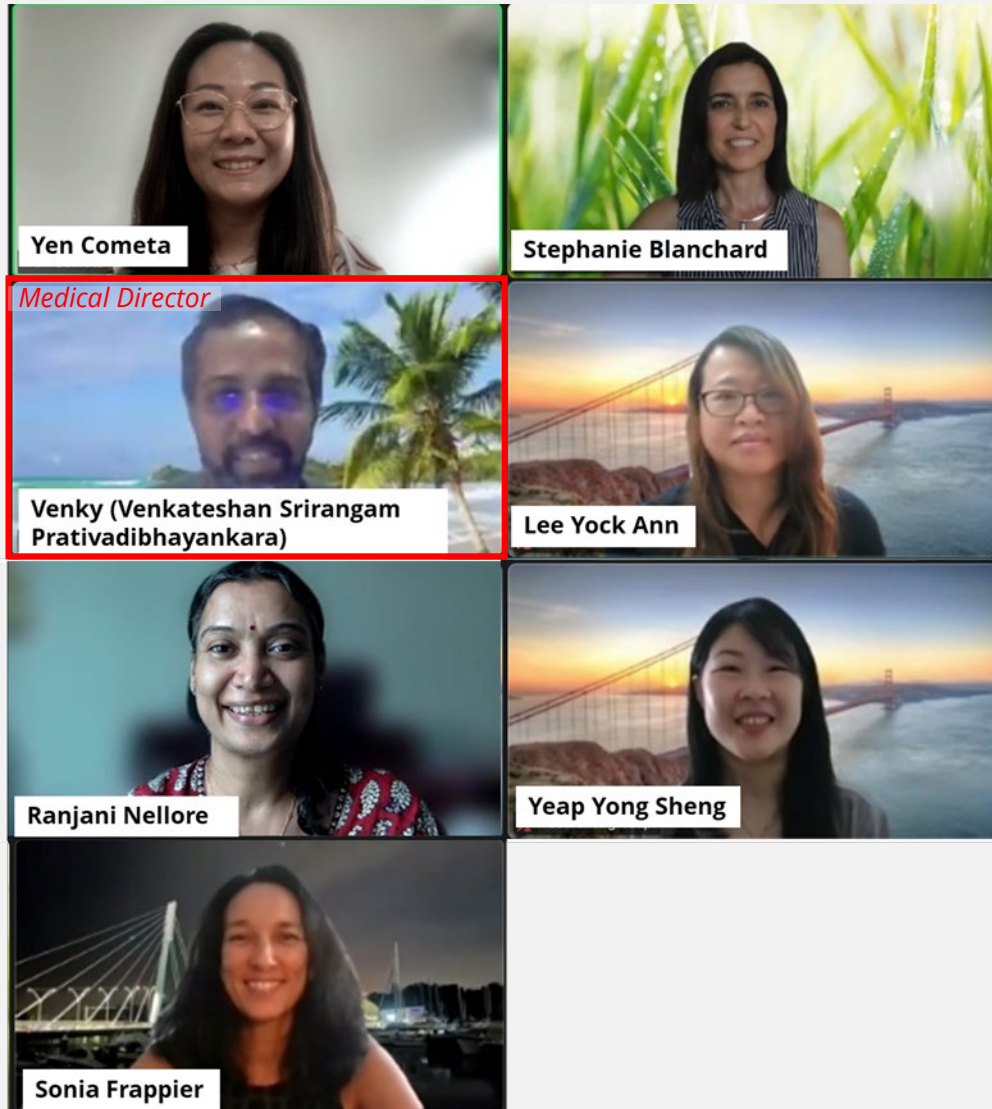
Meet The Team



Development

EDDC's Development team is made up of the following groups:

- Medical
- Clinical Operations
- CMC
- Regulatory Affairs



Yen Cometa

Stephanie Blanchard

Medical Director

Venky (Venkateshan Srirangam Prativadibhayankara)

Lee Yock Ann

Ranjani Nellore

Yeap Yong Sheng

Sonia Frappier

Medical: Safety lead, sponsor medical oversight | Clinical development planning | Designing clinical studies

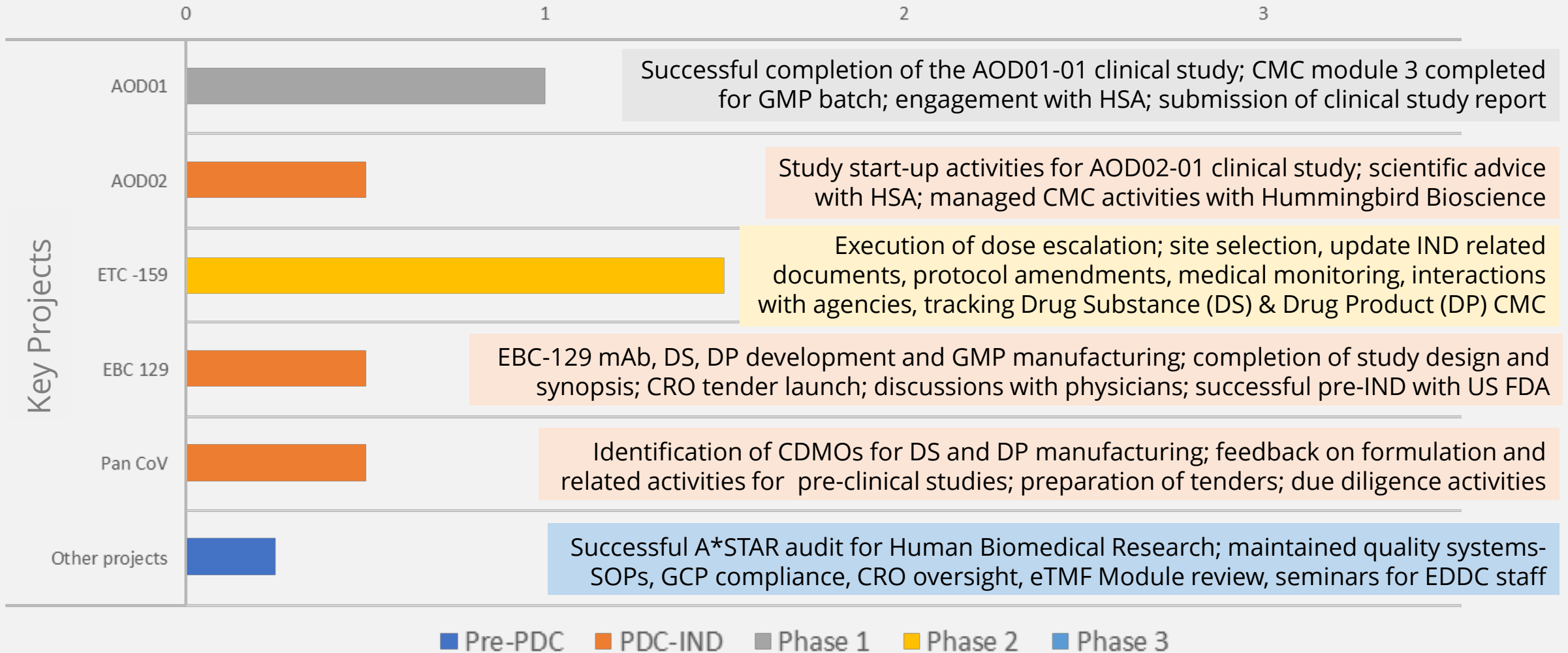
Clinical Operations: Manage development and execution of all clinical studies | Start up activities | CRO selection and oversight | Maintain study quality

Regulatory Affairs: Regulatory interactions with HSA and FDA | Regulatory consultation on IND submissions | Development planning

Chemistry, Manufacturing & Controls (CMC): Small molecules and biologics | Drug substance and drug product | Oversight of CMC activities | CDMO/CMO for contract manufacturing | Regulatory submissions



Projects Supported and Key Highlights in 2021

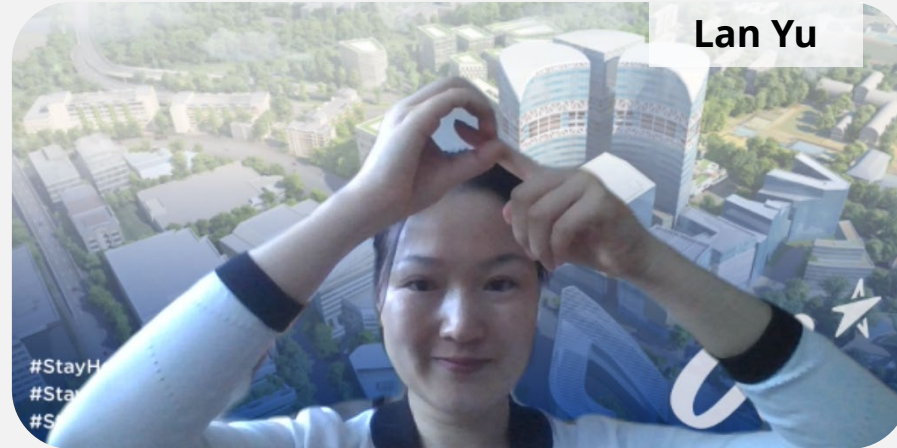


Meet The Team



Quality Assurance

EDDC's Quality Assurance team is responsible for ensuring that the integrity and quality of our research is maintained



Our Mission:

Orientate EDDC towards quality improvement and process standardisation.

To achieve it: Establish an effective Quality Management System (QMS) and ensure continuous improvement.

Benefits of Having An Effective QMS:

Develop quality culture, support data integrity, reduce the time and cost to manage documents.

Improve information management and provide unprecedented data visibility through discovery and development value chain.

Facilitate EDDC-wide transparency, increase drug discovery and development processes' compliant by providing end-to-end quality visibility from design to delivery.



Snapshot of 2021

Here's a look at Quality Assurance key achievements and undertakings this year



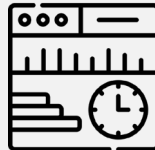
Establishment of EDDC QMS (Quality Management System)

- EDDC Standard Operating Procedures and Work Instructions completed
- Functional processes under development by various EDDC functions.



ISO9001 Certification for EDDC Academic Research Organization

- Provide certified quality services to customers.
- Target to obtain ISO9001 certification by Q1 2022!



QMS Software Implementation (Master Control System)

- One stop solution for EDDC SOP and related documents, EDDC training management.
- Compliance system for regulated documents management
- Went live in December 2021



Internal QMS Audit

- Self-check for QMS execution compliant status.
- Provide opportunity for continuous quality improvement.

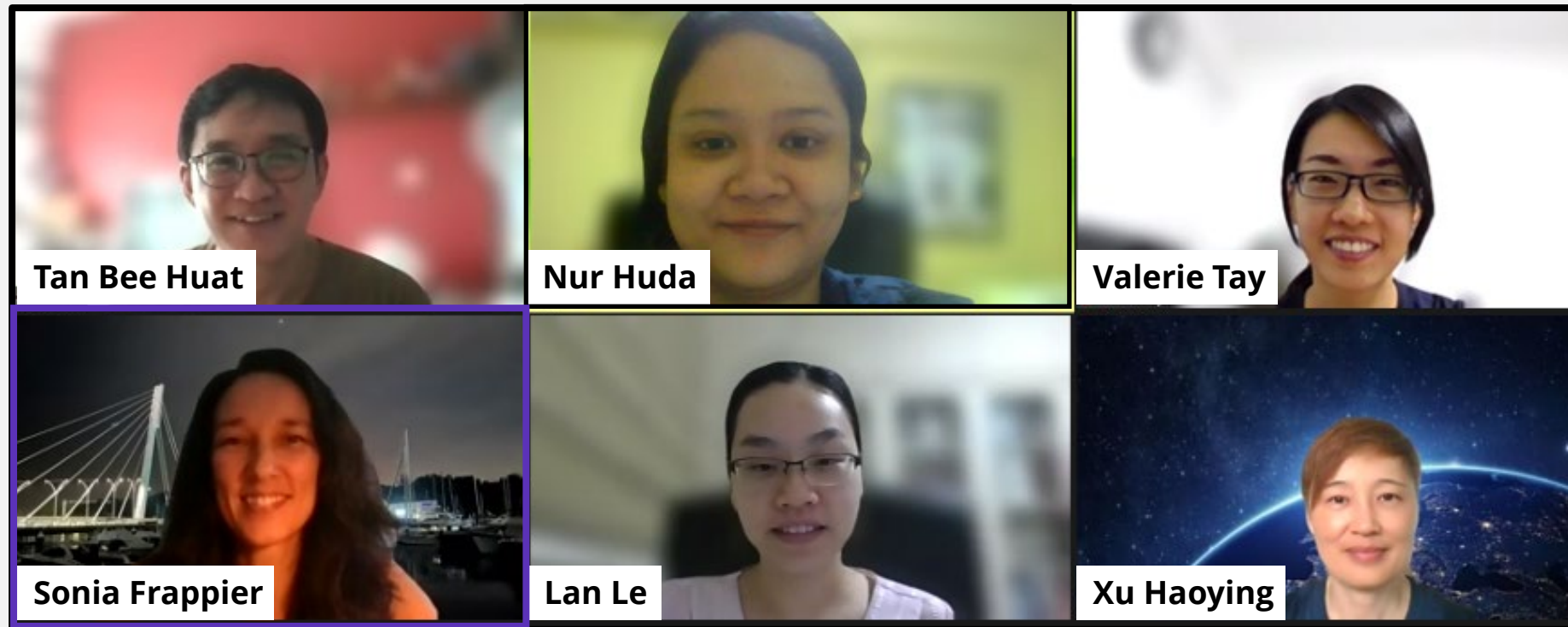
Thank you to all EDDC colleagues that have contributed to the successful establishment of EDDC QMS!

Meet The Team



Project Management

EDDC's Project Management team helps our scientists stay on track to achieve project goals



The Project Management team is a multi-disciplinary group that includes chemists and biologists. They support EDDC's ADL/SPLs in managing the current portfolio projects and platforms, ensuring that projects proceed according to plan, timelines and budget.



Snapshot of 2021

Here's a look at Project Management's undertakings for the year



Establishment of dashboard for EOM/OOE & resource utilization

- Captured OOE and EOM spent by the various projects and platforms
- Provided key data for RCA and BD outsourcing on manpower utilization



Supported PRC & PMG meetings

- 11 PMG & PRC meetings organized in 2021
- Facilitated prioritization of projects and Go / No-Go decision



Publication OIC for EDDC and from DCE-R's Office

- 12 manuscripts reviewed & approved
- 9 manuscripts accepted for publication in Oct 2021
- Updated the institutional publication KPI



Management of competitive grant applications

- 10 grant applications
- 7 newly awarded grants in 2021



ADME profiling, FTE tender & Project Master list Tracking

- Monitored shipment & study delivery
- Amended LOA / retagged POs
- Generated new project codes and folders

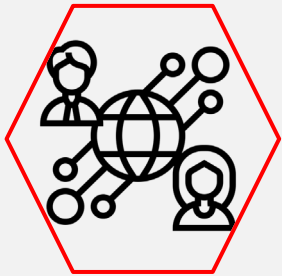


Highlights from existing portfolio & platforms

- Pan-CoV PM contribution for accelerated lead declaration in Jun 2021
- Ensured key projects drew down on funding allocated before expiry of funds

14
Ongoing
Projects

Meet The Team



Business Development

EDDC's Business Development team has the following functions:

- Business Development
- Alliance Management

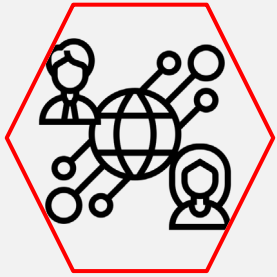
The **Business Development and Alliance Management** team is responsible for partnering with public research performers in Singapore, and industry partners in Singapore and worldwide.

The team works closely with A*STAR Legal and Dr. Kwan Meng Hui of A*STAR Enterprise on all licensing agreements

Business Development : Drives EDDC's outreach efforts to pitch our projects to potential pharma and biotech partners, as well as works closely with EDDC Innovations to support the development of business plans for potential spin-offs.

Alliance Management : Coordinates EDDC's efforts around the Target Translation Consortium and the Singapore Therapeutics Development Review, and supports EDDC's discovery teams in their outreach to the local scientific and clinical community.

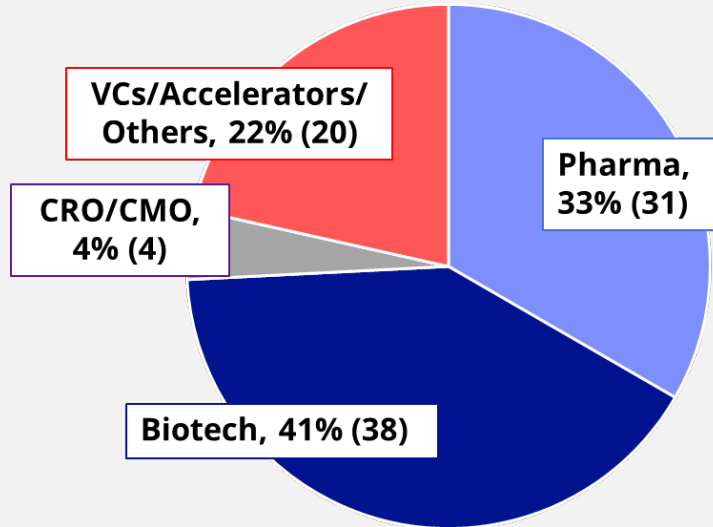





Snapshot of 2021

Here's a look a look at Business Development's key achievements and undertakings this year.

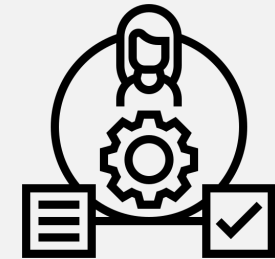
93 Unique Companies Engaged



Executives Engaged  **>100**
At VP Level and Above
 for 4 Priority Projects

Established regular exchanges with
6 APAC Partnering Leads of Pharma MNCs

Supported **Execution of 166 Agreements**



EDDC's LinkedIn Page
 Launched in August 2021



445 Followers

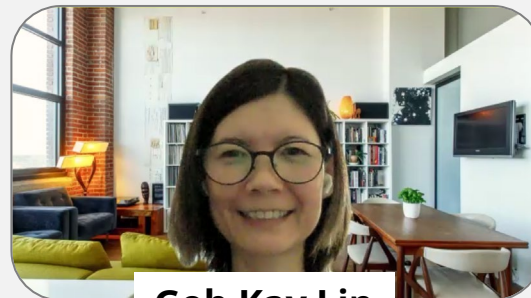
8.3% Average engagement rate

38,559 Total post impressions since launch

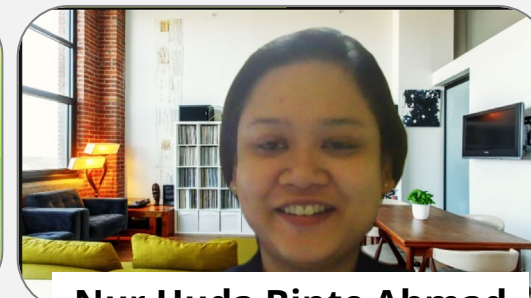
Meet The Team



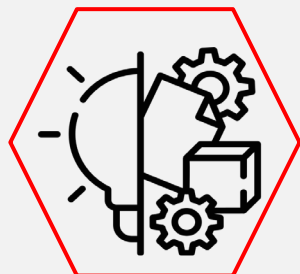
Teo Hsiang Ling



Goh Kay Lin



Nur Huda Binte Ahmad



Innovations

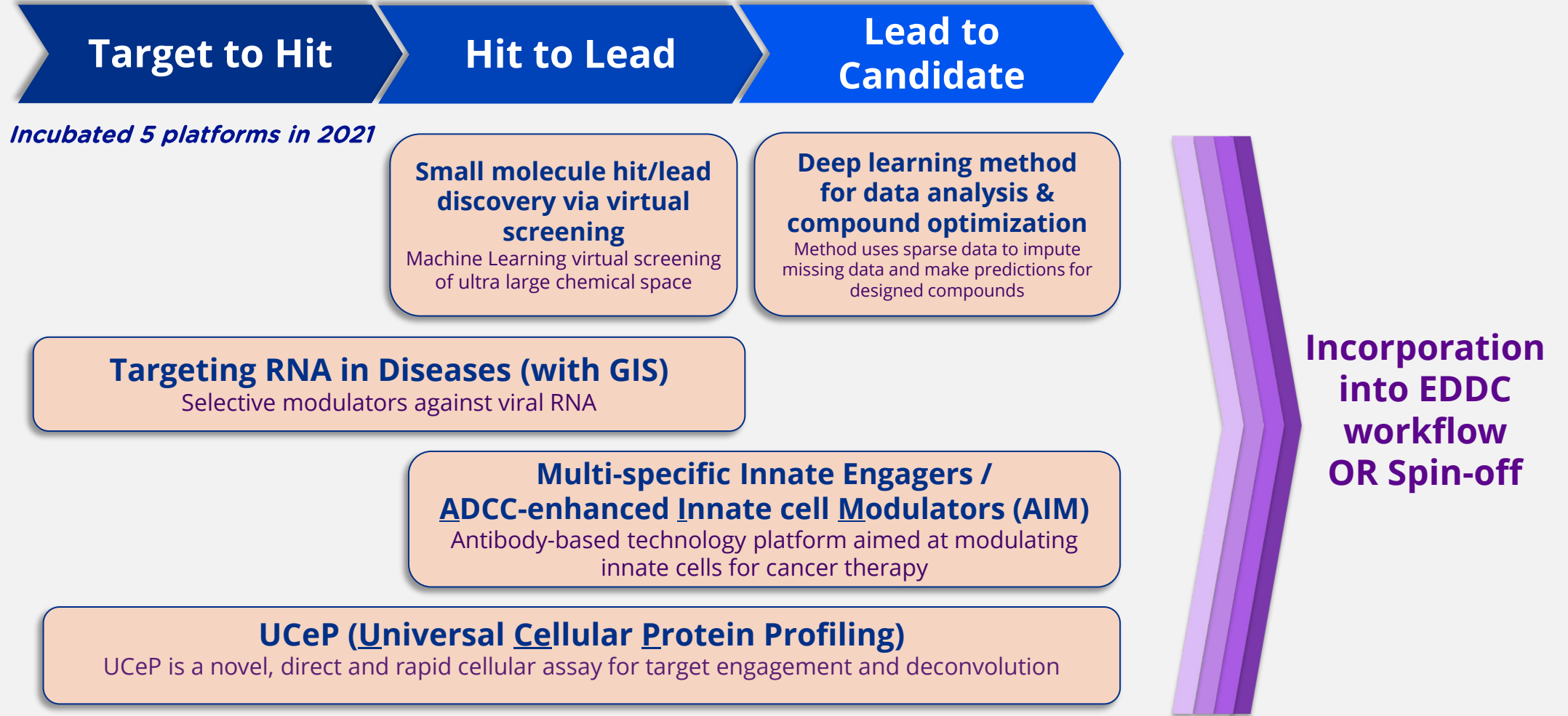
Development of 4 new platforms in 2021



The **Innovations** team was formed in late 2020 and it set out to establish an Innovation strategy and framework. The team not only manages new and existing innovation platforms, but also actively engages EDDC scientists to ensure a continuous pipeline of new platforms. **Innovations** will help to engage the right expertise to map out the IP landscape & exit strategy as well as support the training of EDDC scientists through bootcamps, workshops and masterclasses.



2021 Highlights



Outcomes

- Increase R&D efficiency and accelerate timeline for drug development
- Incorporate innovative tools into EDDC workflow for pipeline projects that may later be spun out.

Meet The Team



Operations

EDDC's Operations team comprises:

- Admin Operations
- Laboratory Operations
- IT / IS
- Resource Management

Key goals for 2021

1. Sustain and secure business continuity
2. Safeguard compliance
3. RIE2025 transition

Chief Operations Officer



Isaac Chow

Laboratory Operations



Poh Zhi Ying

Goh Chang Long

Resource Management

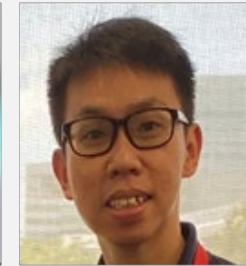


Sharon Tay

Admin Operations



Connie Er



Edrick Tan



Dakshani Selvakumar



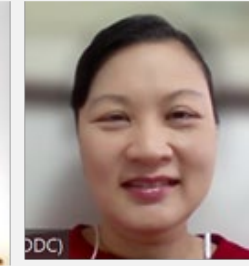
Helen Yeo



Cecilia Leong



Alex Khong



Selina Chan



Debbie Soh

Information Technology (IT)/Information Systems (IS)

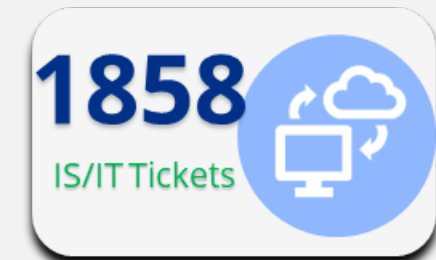
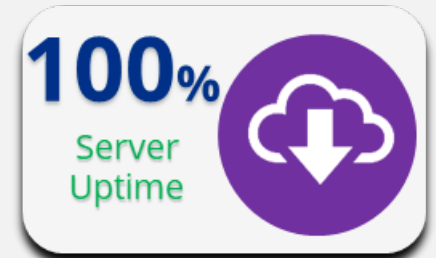
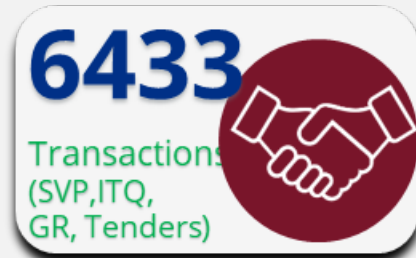
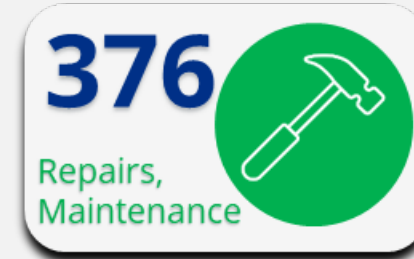


Left to right: Dai Mingyan, Damon Chong, Tan Shan Ho, Sebastian Tan, Samantha Lee



Snapshot of 2021

Here's a look at the key achievements and undertakings of the Operations team this year

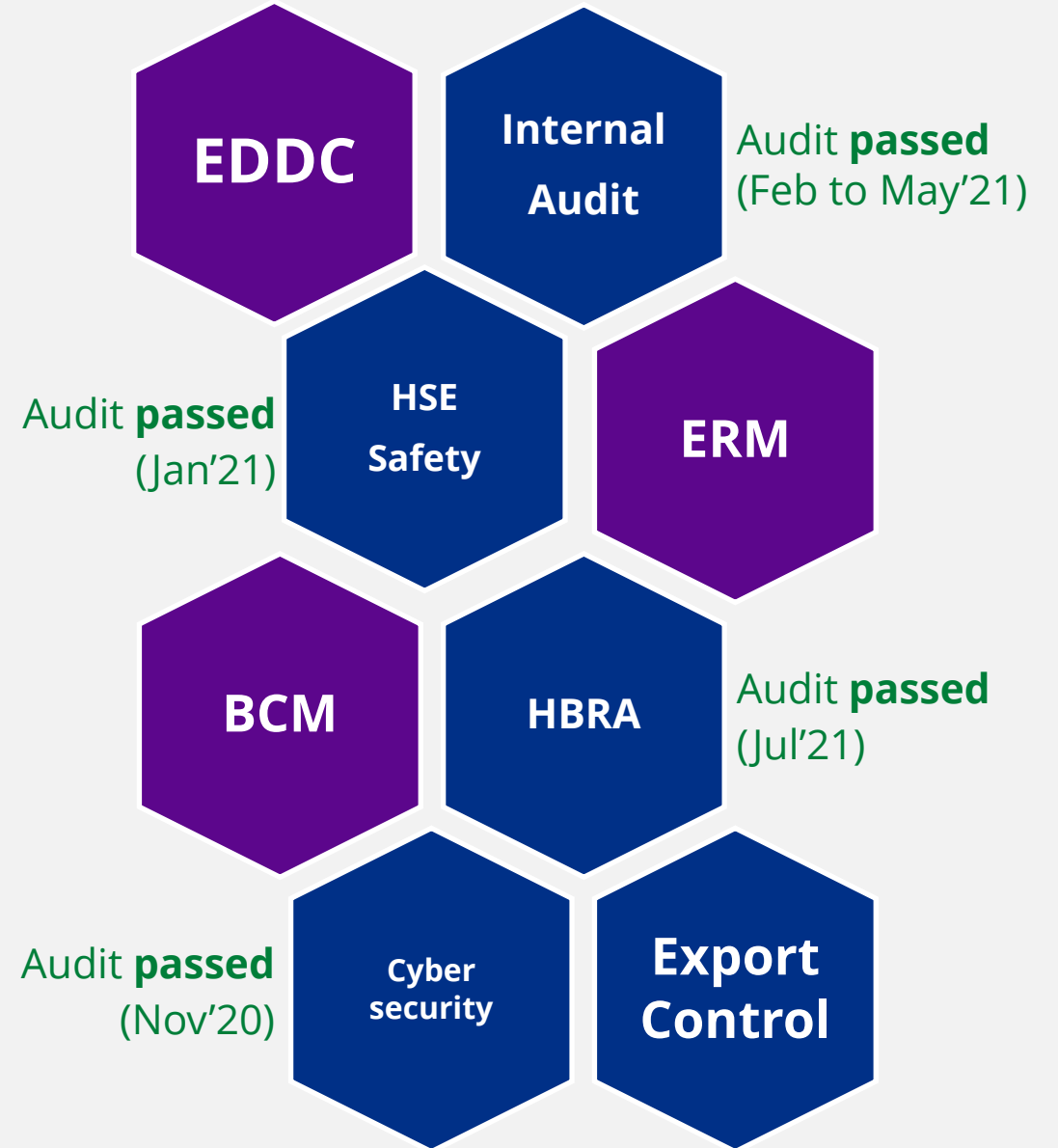




Highlights

Highlights:

1. **Compliance** is embedded in daily activities.
2. No major findings in audit(s), and notable **best practices** cited.
3. **Sustainable** involvement required in **ERM** and **BCM**.



Meet The Team



**EDDC
Academic
Research
Organization**

EARO is made up of the following groups:

- High-Throughput Screening (HTS)
- High-Throughput Phenomics (HTP)
- X-Ray Crystallography
- Computational Phenomics (CP)

Click [here](#) to find out more about EARO!

High-Throughput Screening



Left to right: **Wong Mei Yee, Jackie Ang, Amelia Yap, Choong Meng Ling, Justina Fulwood, Doris Tee, Umayal Lakshmanan, Quraishah Adanan**

High-Throughput Phenomics



Left to right: **Shivaji Rikka, Narmada Balakrishnan, Giri Periyasamy, Gian Yi Lin, Matan Thangavelu**

Computational Phenomics



Left to right: **Padmanabhan Anbazhagan, Judice Koh**

X-Ray Crystallography



Left to right: **Jothi Anantharajan, Nithya Baburajendran, Yeo Yee Khoon**

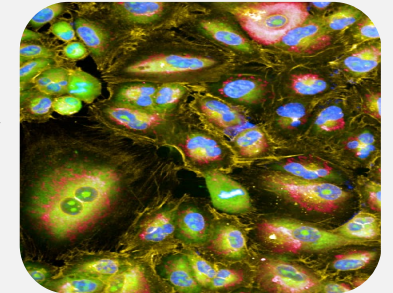
In 2021, EARO increased its local and international outreach to offer access to EDDC's unique technologies.

This effort captured wide interest and EARO forecasts a revenue of close to S\$1,000,000 for FY2021.



The X-Ray group generated and solved 82 crystal structures of 3CL-Protease in complex with compounds for EDDC-2214 (pan-CoV project) enabling structure-based design by EDDC's medicinal chemists. The structure of proteases from 4 viruses (229E, MERS, SARS, SARS COV1) helped to decipher the key interactions needed for pan-coronavirus activity.

To support a client's request, the High Throughput Phenomics group has developed a cell painting phenotypic assay for morphological profiling. To do this, thousands of image features are extracted from cells and used to identify biologically relevant similarities and differences between compounds with unknown mechanisms and drugs with known mechanisms. This technology is amenable for high throughput screening (HTS).



In November 2021, the HTP platform conducted a 2-day virtual User Group Meeting on High Content Imaging (HCI) together with Perkin Elmer. Experts in HCI shared their screening experiences with more than 100 scientists from the community.

The HTS platform began to provide fee-for-service access to the only fully automated screening system in Singapore. This unique technology makes EDDC the go-to place for large screening campaigns. In 2021, two high throughput screens (>150,000 compounds) were performed to support projects funded by the STDR.



Meet The Team

Target Translation Consortium (TTC)

Established in June 2019, the TTC comprises the 8 public sector performers in Singapore.

The TTC is coordinated by EDDC in our role as the national drug discovery and development platform.

Click [here](#) to find out more about TTC!



Informing Early, Informing Better

The TTC was established to facilitate the preclinical validation of putative drug targets arising from publicly-funded research. Our aim is to inform investigators earlier and better about the drug development potential of their proposed target, by helping investigators to:

- Establish a stronger, causal link between the target and disease pathogenesis
- Demonstrate that target modulation may potentially result in the desired therapeutic effect

From 2019 - 2020

In the past 2 years, the TTC has received **over 40 proposals** from across the partner institutions. By working together, the proposals were peer reviewed from inter-disciplinary perspectives and, through EDDC, drug discovery consultancy and seed funding were provided to **17 projects**.

Key Developments in 2021



Snapshot of TTC in 2021

Here's a look at TTC's key developments this year.



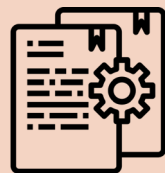
Combined Efforts with the Singapore Therapeutics Development Review

- The TTC was integrated into the expanded Singapore Therapeutics Development Review (STDR) grant scheme, in recognition of our critical role in building a pool of early stage validated targets for drug discovery.
- This enables a streamlined funding pathway and continued support for promising drug discovery and development projects in Singapore.
- Under the expanded STDR programme, the TTC serves as a "Pre-Pilot" funding stream for early-stage projects. Successful TTC projects can go through an accelerated review process for STDR ("Pilot") funding.



STDR

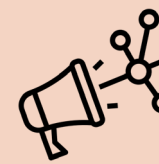
Singapore Therapeutics
Development Review



**TTC Funding for
RIE2025 (FY21-FY25)
secured**



**Programme
operational
processes
agreed**



**Joint grant
call launched.**

Proposals will be
decided upon in
February 2022



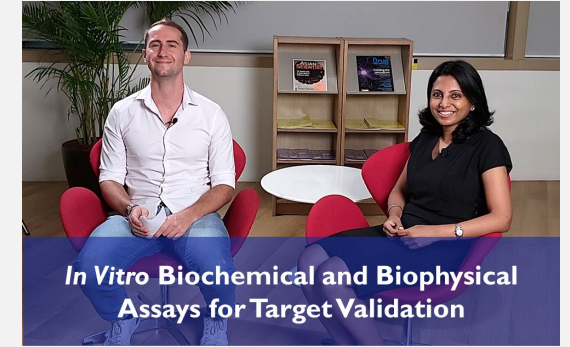
CONSIDERATIONS IN DRUG DISCOVERY

Video Series

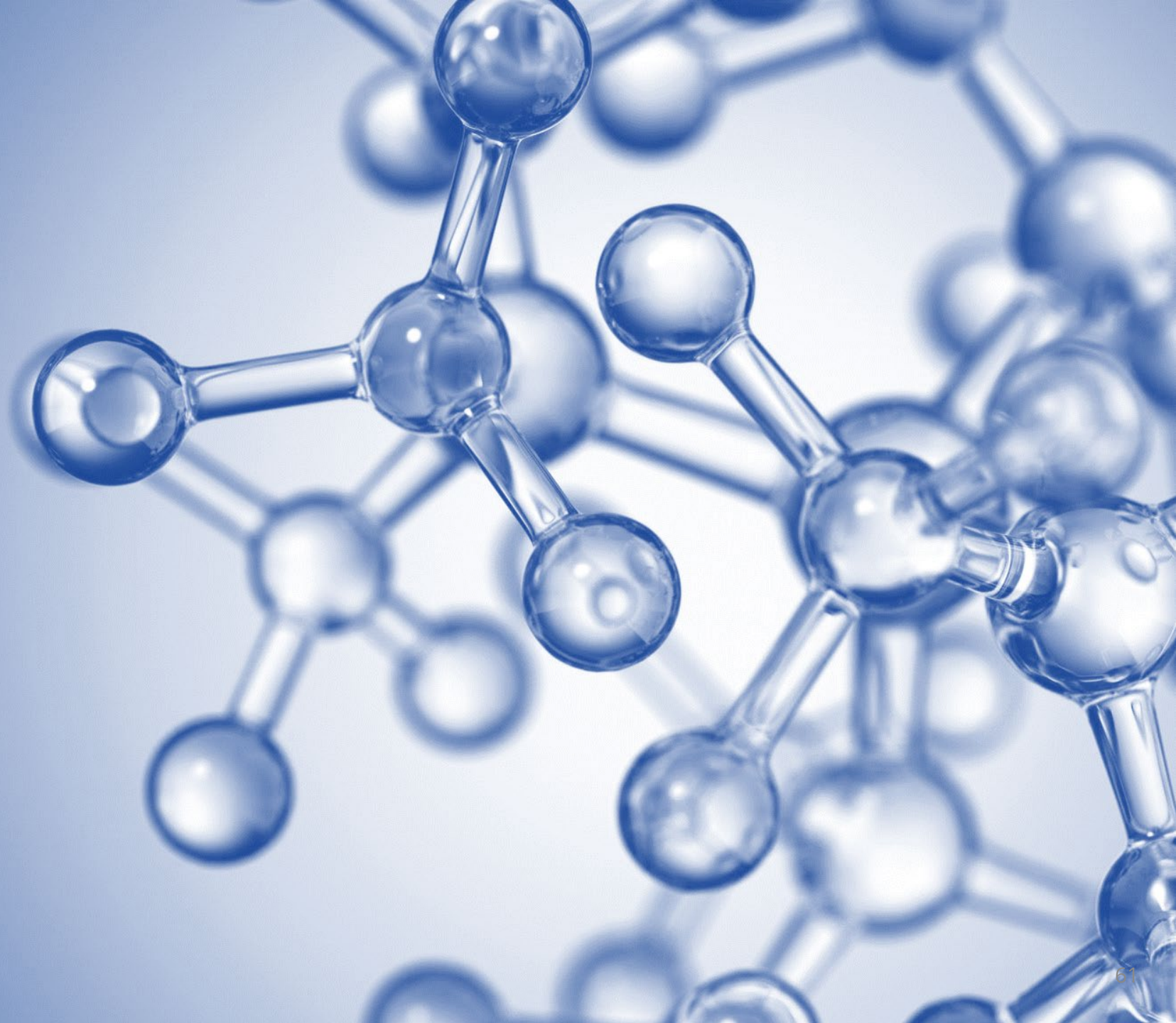
A series of videos were produced in 2021 and made publicly available for the community in Singapore and beyond.

You can view the video series [here](#).

We thank Duke-NUS for co-producing two of the videos with us



Looking Ahead





Looking Ahead to 2022



Diversifying Our Portfolio

EDDC has appointed Portfolio Discovery Leaders (PDLs) to develop disease-specific portfolios that leverage our understanding of common mechanisms across diseases of global importance and unmet medical needs:

- The intersection of immuno-oncology and auto-immune diseases
- Fibrosis
- Infectious diseases



Fostering Local Biotech Ecosystem

- We will increase our engagement with local Biotech companies in the coming year.
- We hope to expand EARO's support for the biotech community by extending EARO's service offerings beyond screening.
- We will also aim to develop a collaborative research effort with at least one local biotech company.



Collaborating & Contributing to National Efforts

- As part of our portfolio diversification, EDDC will continue to reach out to clinical experts and local research groups with a deep understanding of the Asian phenotype, clinical needs, and disease biology.
- We will contribute actively to national efforts like the National Structural Biology Consortium and PREPARE (pandemic readiness) in 2022 and seek to collaborate.



Leveraging the Potential of Computational Drug Discovery

- Our computational efforts in 2021-1H2022 are centred on piloting cutting-edge, AI or deep learning based methods to small molecule drug discovery as well as understanding drug-target-disease relationships.
- We are aiming to incorporate selected approaches into EDDC's workflow in 2H2022, and to continue to explore the applicability of other next generation technologies.

EXPERIMENTAL DRUG DEVELOPMENT CENTRE (EDDC)

Agency for Science, Technology and Research (A*STAR)
10 Biopolis Road, #05-01, Chromos, Singapore (138670)



+65 6404 4333



Experimental Drug Development Centre (EDDC)



info@eddc.a-star.edu.sg



<https://www.a-star.edu.sg/eddc/>