Duke-NUS Medical School

1 Faculty’s Commitment

Centrally located in a modern facility on the grounds of Singapore General Hospital, Duke-NUS is Singapore’s first US-style graduate-entry medical school. We draw on the rich medical training and research at Duke University in North Carolina and the outstanding resources at the National University of Singapore (NUS). In addition, Duke-NUS partners with Singapore Healthcare Services (SingHealth) to form an Academic Medicine Institute which integrates three pillars of medicine – clinical care, education and research. We also collaborate with a number of strong research institutions in Singapore, including the National Cancer Centre, the National Heart Centre, the National Eye Centre, the National Neurosciences Institute, and the Agency for Science, Technology and Research (A*STAR).

Offering innovative MD, PhD, and MD-PhD programmes with a focus on medical research, Duke-NUS prepares doctors who are not only skilled in patient care, but who are also well equipped to practise in the rapidly changing world of medicine. We prepare physician leaders who are problem solvers committed to improving the health of individuals and communities through research. At Duke-NUS, we are committed to helping our graduates transform medicine in the 21st century. The Duke-NUS MD degree is jointly awarded by Duke University and the National University of Singapore, while the PhD degree is awarded by the National University of Singapore.

For more information, please visit our website at: https://www.duke-nus.edu.sg/about

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3 Graduate Education

3.1 Degrees Offered

Duke-NUS Medical School offers the following programmes:

1. MD Programme

The Duke-NUS MD programme is distinctively designed to prepare physician leaders in medical research, education, and patient care. This programme spans 4 years, and graduates are awarded the degree of Doctor of Medicine (MD) jointly by Duke University and NUS.

For more information on our MD programme, please click here.

2. MD-PhD Programme

Duke-NUS also offers a combined MD-PhD programme that is unique to Singapore. This option is most appropriate for students who are committed to intensive research-oriented careers, combining biomedical research with the practice of clinical medicine. The duration of the MD-PhD programme varies, but is approximately 7 years. MD-PhD students start their PhD component after completing the 2nd year of the MD programme. Upon completion of PhD, students will complete the final (4th) year of the MD programme.

For more information on our MD-PhD programme, please click here.

3. PhD Programme in Integrated Biology and Medicine (IBM)

The Duke-NUS PhD programme in Integrated Biology and Medicine provides training in translational bioscience, covering a broad spectrum of disciplines including cell and molecular biology, biochemistry, physiology, and health policy. The main research areas that are offered include cancer stem cells, neuroscience, cardiovascular and metabolic disorders and infectious disease. The goal of this programme is to train PhD scientists across multiple disciplines with the skills and ambitions of translating basic scientific discoveries into useful therapies for patients. The education and training of the students is supported by award-winning research faculty. Students in the IBM programme will be awarded a joint PhD degree from Duke University and the National University of Singapore.

For more information on our PhD programme in Integrated Biology and Medicine (IBM), please click here.

4. PhD Programme in Quantitative Biology and Medicine (QBM)

Biostatistics and bioinformatics are increasingly important areas for advancement of biomedical research. There is high demand for trained professionals in these areas, locally and internationally.

Biostatistics and health data science is responsible for experimental design, data analysis, and evidence synthesis and interpretation for answering questions in translational, clinical, epidemiological and health services research. Recent years have seen major changes in the medical landscape, such as the needs for rapid responses to infectious diseases, personalised medicine, and the availability and connectivity of big data. They demand innovative approaches to statistical problem solving. Some examples include adaptive clinical trial designs, dynamic treatment regimes, and high-dimensional data analysis methods.

Computational biology is an integration of data analytics, statistics, machine learning, modelling, software engineering, and computer science to answer questions in basic and translational biomedical research. The explosion of demand for bioinformatics in the last five years has been driven partly by huge decreases in the cost of next generation DNA sequencing, which is 10,000 times cheaper than it was in 2006[1]. As a result, next-generation sequencing is now a foundational technology for much of biological research. The rapid development of many other high throughput technologies is also driving demand for bioinformatics experts.

Duke-NUS will launch its inaugural PhD programme in Quantitative Biology and Medicine (QBM) in August 2017. **The programme distinguishes itself from others by focusing on issues in modern biomedical research and preparing researchers to take their skills to advance medicine.**

Students will complete their training in Duke-NUS' Center for Quantitative Medicine (Biostatistics and Health Data Science) and Center for Computational Biology (Computational Biology).

The degree, which will take on average 4 to 5 years to complete, culminates with the development of a written thesis and a successful oral dissertation defense.

For more information on our PhD programme in Quantitative Biology and Medicine (QBM), please click here.

5. PhD Programme in Clinical Sciences (CS)

The aim of the PhD Programme in Clinical Sciences (PhD CS) is to educate and train medical doctors and other health science professionals to perform clinical and translational research. The proposed programme will focus on the interface between clinical, biological and social research methods by bringing together experts in quantitative sciences (biostatistics, epidemiology, and bioinformatics), biological basic sciences (genomics, immunomics, metabolomics), ethics, clinical therapeutics, health services and systems research.

For more information on our PhD programme in Clinical Sciences (CS), please click here.

3.2 Curriculum Information (MD Programme)

MD Programme

The Doctor of Medicine (MD) programme at Duke-NUS is a 4-year course comprising of the following phases: pre-clerkship, clerkship, research and advanced clinical.

The programme begins with the pre-clerkship curriculum, introducing students to basic sciences and the fundamentals of patient care. Courses cover the basic science content fundamental to clinical core, including: biochemistry, genetics, cell biology, microanatomy, anatomy, physiology, neurobiology, behavioural sciences, pharmacology, microbiology, pathology and immunology. The pre-clerkship curriculum is covered in one year.

In their second year, students go through a series of clerkship rotations, gaining broad exposure to core specialties such as Paediatrics, Obstetrics and Gynaecology, Neurology, Psychiatry, Surgery and Medicine. Students are required to complete 5 blocks of 8-week clerkship rotations.

The research and advanced clinical phases span the third and fourth years of the MD programme.

Students spend approximately 8 months on scholarly research activities. They get to select a research area of their interest and carry out a research or scholarship project in that area under the supervision of an academic mentor. At the end of the research experience, they are required to submit a thesis based on their research or scholarship project. Students may carry out their research or scholarship locally or at our affiliated institution, Duke University.

The advanced clinical rotations in the final phase of the MD programme provides students with opportunities to participate in patient care with increased responsibilities. The focus of this year is to have the following core specialties such as Family Medicine, Emergency Medicine, Surgery, Medicine, Musculoskeletal and Critical Care. Students are also given elective time to explore areas based on their career interest.

C.A.R.E (*Connect, Assimilate, Reflect and Explore*) is a newly developed, multi-faceted longitudinal programme that spans the 4-year Duke-NUS curriculum (C.A.R.E 1, 2, 3, 4) and encompasses the “Transition” periods T1 (*Joining the medical profession*), T2 (*Learning from and for patients*), and T3 (*Caring for patients*). It aims to complement the competencies and capabilities students develop as they progress through clinical and scholarly experiences, enhance learning through active engagement within communities of learning and practice, and equip them with tools to effectively and efficiently practice medicine in an evolving healthcare environment.

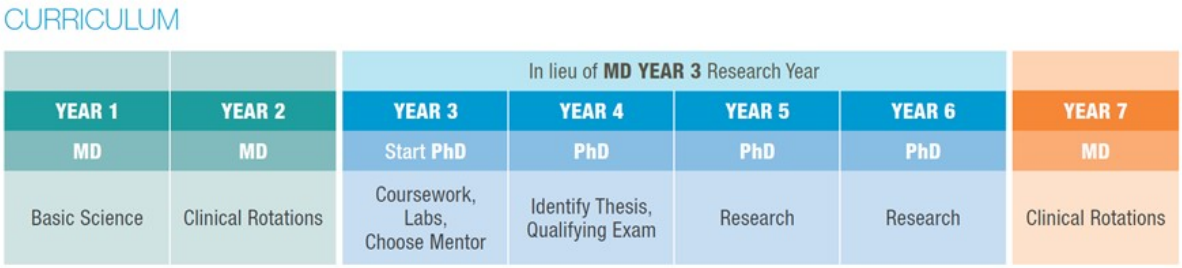
The course of study for students admitted from AY2018/19 onwards is as follows:

Phase 1	• C.A.R.E 1: Joining the Medical Profession • Molecules, Cells & Tissues • Human Structure & Function • Brain & Behaviour • Body & Disease • Fundamentals of Clinical Practice
Phase 2	• C.A.R.E 2: Learning From & For Patients • Medicine Clerkship • Surgery Clerkship • Paediatrics Clerkship • Obstetrics & Gynaecology Clerkship • Neurology Clerkship • Psychiatry Clerkship • Geriatrics Medicine • Fundamentals of Family Medicine • Fundamentals of Research and Scholarship • Innovation & Design Thinking
Phase 3 (Research/Scholarship)	• Research Methods and Analysis • Research/Scholarship (Part 1) • Research/Scholarship (Part 2) • Research/Scholarship Thesis

Phase 4 (Advanced Clinical)	• Family Medicine Clerkship • Advanced Medicine • Advanced Surgery • Musculoskeletal Rotation • Critical Care Rotation • Emergency Medicine • Student-In-Practice (Medicine) • Student-In-Practice (Surgery) • Advanced Clinical Practice • Practice Course 3 • Capstone Course • Electives • Student as Future Educator

3.3 Curriculum Information (MD-PhD Programme)

Duke-NUS offers a combined MD-PhD track to students who wish to further their academic training. The programme combines medical education with research training to develop clinician-scientists who interface between medicine and science. All students admitted into the programme will be offered a full scholarship for the PhD component as well as scholarships to cover tuition fees for their first 2 years in the MD programme and their final year of MD training (funding amount will depend on bursaries and other scholarships already awarded to assist with MD tuition fees).



Students embark on the PhD component after completing their second year of the MD programme. Upon completion of the PhD component, students will complete the final (fourth) year of the MD programme. Interested students can either apply directly to the MD-PhD programme at the time of initial application or after matriculation into the MD programme. Every year, approximately 15-20% of the MD cohort may be offered a place in the MD-PhD track.

All applicants for the MD-PhD programme are required to sit for the MCAT. This programme does not accept GRE scores. Assuming successful fulfillment of requirements, students in the MD program will be awarded a joint Doctor of Medicine (MD) degree from Duke University and the National University of Singapore. For those having completed the MD-PhD option, the PhD degree will be awarded by the National University of Singapore.

3.4 Curriculum Information (PhD Programme in Integrated Biology and Medicine)

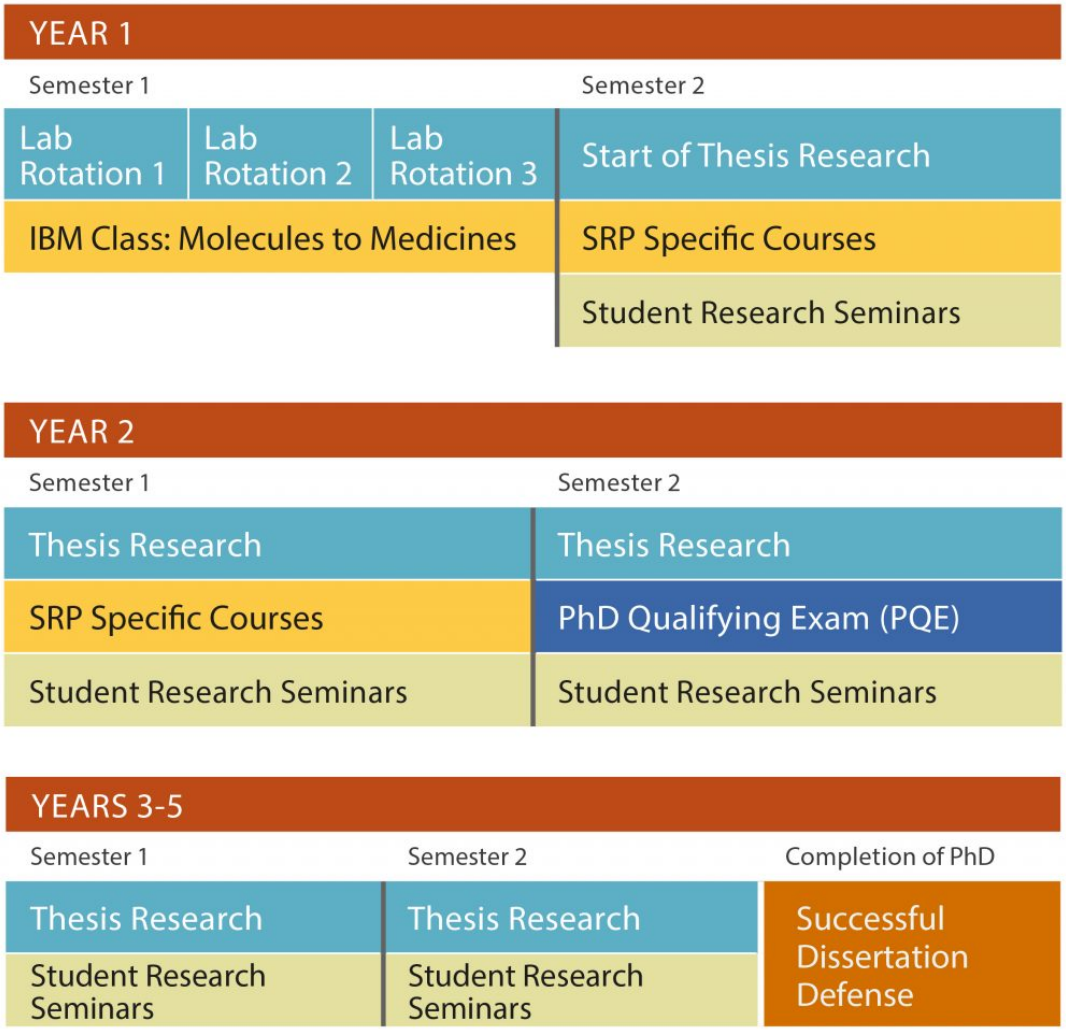
PhD Programme in Integrated Biology and Medicine

The Duke-NUS PhD programme in Integrated Biology and Medicine provides training in translational bioscience, covering a broad spectrum of disciplines including cell and molecular biology, biochemistry, physiology, and health policy. During the first semester students complete a core course entitled “Molecules to Medicines” where they learn fundamentals in biomedical research, while simultaneously conducting two laboratory rotations. Subsequently, students choose a thesis mentor and complete their advanced training in one of five specialty tracks:

- Cancer and Stem Cell Biology
- Emerging Infectious Diseases
- Cardiovascular and Metabolic Disorders
- Neuroscience and Behavioral Disorders
- Health Services and Systems Research

The degree, which will take on average 4 to 5 years to complete, culminates with the development of a written thesis and a successful oral dissertation defense.

Like the Duke-NUS MD programme, the Ph.D. core course incorporates a novel education strategy which rapidly transitions students to a mode of learning better suited for a lifelong career in biomedical research. From the first week in the programme, students are introduced to scientific literature searches, evaluation and critique of seminal scientific papers. The core curriculum is delivered in a small group collaborative learning environment that reinforces critical thinking and public debate. An overview of the curriculum follows.



Year 1 – Required coursework and lab rotations

All PhD candidates participate in the 15-week core course called “Molecules to Medicines” during their first semester of the PhD programme. This course introduces students to translational research, and provides training on experimental models, methods and mechanisms that drive current investigations into human disease. Scientific ethics training is woven throughout the course. This course is taught by a range of Duke-NUS faculty and staff who introduce their expertise to the students. This is not a lecture course, but an interactive learning course that requires significant preparation and participation.

Students will also conduct three 6-week lab rotations from among the Duke-NUS Signature Research Programmes. Mentors for the rotations must be regular ranked faculty and be on the approved mentor list. These rotations are structured to provide students with first hand exposure to the labs where they may choose to conduct their PhD research. At the end of the rotations, students will be asked to commit to a thesis mentor and a specialty discipline.

During the second semester, students may continue with coursework and/or begin primary research.

Specifics will be dependent on the specialty areas students choose to pursue.

Year 2 – Developing a thesis and qualifying exam

At the start of the second year, students will work toward developing their thesis projects. Students may or may not continue with formal coursework, however, all PhD candidates are expected to actively participate in Duke-NUS research seminars and Journal Clubs sponsored by their Signature Research Programmes. These seminars provide students with a forum to give oral presentations, evaluate literature, analyze competitive science, and share ideas on major breakthroughs and future directions for their research field. This activity provides a critical foundation for a career in translational research.

In the first semester, all PhD students take a qualifying or preliminary exam. Successful students will defend a mock grant proposal, providing the faculty with the opportunity to evaluate their fundamental knowledge and ability to purse hypothesis-based research.

Years 3 & 4 – Research and thesis

After the qualifying exam, the remainder of the PhD training consists of the execution of the thesis project and regular participation in Research Seminars and Journal Clubs. The thesis mentor will guide the student and act as the chair of the student’s Graduate Thesis Advisory Committee. Success of the thesis will be judged by the publication or anticipated publication of two quality first author papers, with the emphasis being on quality.

3.5 Curriculum Information (PhD Programme in Quantitative Biology and Medicine)

The Duke-NUS PhD programme in Quantitative Biology and Medicine provides training in quantitative methods in biomedical sciences, covering a broad spectrum of disciplines including molecular and cell biology, genetics and genomics, modern clinical trials, epidemiology, and healthcare analytics. Students choose one of two concentrations and a thesis mentor:

- **Biostatistics and Health Data Science**
- **Computational Biology**

During the first two years, students will complete a core set of courses including “Core Concepts in Biostatistics” and “Core Concepts in Bioinformatics”. The degree, which will take on average 4 to 5 years to complete, culminates with the development of a written thesis and a successful oral dissertation defense. An overview of the curriculum follows.

Biostatistics and Health Data Science Concentration

	Semester 1	**Semester 2**
Year 1	• Study Designs in Clinical and Population Health Research (GMS6801; 4 MC) • Core Concepts in Biostatistics (GMS6820; 4 MC) • R-Programming (GMS6821; non-credit) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800; 1 MC)	• Core Concepts in Bioinformatics (GMS6850; 4 MC) • Analysis of Complex Biomedical Data (GMS6802; 4 MC)
Year 2	• Thesis Research (4 MC) • Elective (4 MC)* • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800, 1 MC)	• Thesis Research (4 MC) • Biomedical Research Internship (GMS6804, 4 MC)
Year 3	• Thesis Research (6 MC) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800; 1 MC)	• Thesis Research (6 MC)

Year 4	• Thesis Research (6 MC) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800; 1 MC)	• Thesis Research (6 MC)

* Electives may include (non-exhaustive list and not open every year): Computer Intensive Statistical Methods and Statistical Models: Theory/Applications

Year 1 – Required Coursework

All PhD QBM Biostatistics and Health Data Science concentration students participate in the core course called “Study Designs in Clinical and Population Health Research” during their first semester of the program. This course introduces students to concepts, study designs and analytic issues that are commonly encountered in research on human subjects.

Students will also complete “Core Concepts in Biostatistics” in semester 1 and “Core Concepts in Bioinformatics”, and “Analysis of Complex Biomedical Data” in the second semester.

Year 2 – Developing a Thesis and Qualifying Exam

Students will take one elective course on advanced statistics. Some sample elective courses (non-exhaustive and may not open every year) include “Computer Intensive Statistical Methods” and “Statistical Models: Theory/Applications”.

Collaboration and consultation is an important part of the career of biostatisticians. During the second year, the students will participate in an internship in a clinical center or biomedical research institute. This will provide the opportunities to experience and practice in real-life research and stimulate thinking for methodological development.

At the start of the second year, students will work toward developing their thesis projects. All PhD students take a qualifying examination, which includes submission and defense of a research proposal.

Years 3 & 4 – Research and Thesis

After the qualifying exam, the remainder of the PhD training consists of the execution of the thesis project. The thesis mentor will guide the student and act as the chair of the student’s Graduate Thesis Advisory Committee. Success of the thesis will be judged by the publication or anticipated publication of quality first author paper(s), with the emphasis being on quality.

In addition, all Duke-NUS PhD candidates are expected to actively participate in research seminars and journal clubs. These activities provide students with a forum to give oral presentations, evaluate literature, analyze competitive science, and share ideas on major breakthroughs and future directions for their research field.

Computational Biology Science Concentration

	Semester 1	**Semester 2**
Year 1	• Molecules to Medicines (GMS6901, 4 MC) • Laboratory rotations X2 (4 MC total) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800, 1 MC)	• Core Concepts in Bioinformatics (GMS6850, 4 MC) • Student Research Seminars (GMS6900, 0.5 MC)
Year 2	• Core Concepts in Biostatistics (GMS6820, 4 MC) • Thesis Research (6 MC) • Student Research Seminars (GMS6900, 0.5 MC) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800, 1 MC)	• Thesis Research (6 MC) • Elective (4 MC) • Student Research Seminars (GMS6900, 0.5 MC)
Year 3	• Thesis Research (6 MC) • Student Research Seminars (GMS6900, 0.5 MC) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800, 1 MC)	• Thesis Research (6 MC) • Student Research Seminars (GMS6900, 0.5 MC)
Year 4	• Thesis Research (6 MC) • Student Research Seminars (GMS6900, 0.5 MC) • Integrated Biostatistics and Bioinformatics Journal Club (GMS6800, 1 MC)	• Thesis Research (6 MC) • Student Research Seminars (GMS6900, 0.5 MC)

Year 1 – Required Coursework

All PhD students participate in the 15-week core course called “Molecules to Medicines” during their first semester of the program. This course introduces students to biomedical research, and provides training on experimental models, methods and mechanisms that drive current investigations into human diseases. This course is taught by a range of Duke-NUS faculty and staff who introduce their expertise to the students. This is not a lecture course, but an interactive learning course that requires significant preparation and participation.Students will also complete “Core Concepts in Biostatistics” in semester 1 and attend New Student Research Seminars in semester 2. The major landmark at the end of Year 1 is the identification of a thesis research mentor and a research area to work on.

Year 2 – Developing a Thesis and Qualifying Exam

In Year 2, students will be required to complete any remaining coursework, and pass the PhD Qualifying Examination (PQE) in the form of submission and successful defense of a research proposal, to qualify for

PhD candidature. To train students in writing competitive grant proposals, the research proposal for the PQE will need to be written in the format of a grant proposal following the guidelines of the National Medical Research Council (NMRC), Singapore; however the students will not be expected to bring in grant funding at this stage to start their thesis research.

Year 3 – Research and Thesis

After the qualifying exam, the remainder of the PhD training consists of the execution of the thesis project. The thesis mentor will guide the student and act as the chair of the student's Graduate Thesis Advisory Committee. Success of the thesis will be judged by the publication or anticipated publication of quality first author paper(s), with the emphasis being on quality.

In addition, all Duke-NUS PhD candidates are expected to actively participate in student research seminars and journal clubs. These activities provide students with a forum to give oral presentations, evaluate literature, analyze competitive science, and share ideas on major breakthroughs and future directions for their research field.

Year 4 – Research and Thesis

In Year 4, the thesis research is to be completed, written up, and defended. The thesis should demonstrate scholarship and the student's ability to perform original, independent research, be pre-approved by the mentor and the programme director, and be evaluated by at least 3 reviewers in the field. The thesis should therefore contain published or publishable work in international peer-reviewed journals.

Elective Modules

Students in the Computational Biology concentration are required to take one elective module to fulfil their coursework requirements. In general, suitable modules offered by Duke-NUS or elsewhere in NUS can be taken as elective, subject to the thesis research mentor's approval. In particular, students in the bioinformatics concentration can choose one of the biostatistics courses (other than the 'Core Concepts in Biostatistics' which they are already required to take) offered by the CQM as their elective. Some additional sample elective modules are listed below (but this list is not exhaustive).

Module Number	**Module Name**	**MC**	**Offered By:**
ST 4231	Computer Intensive Statistical Methods	4	DSAP, Faculty of Science, NUS
ST 5217	Statistical Methods for Genetic Analysis	4	DSAP, Faculty of Science, NUS
CDM 5101	Fundamentals of Cancer Biology	4	Cancer Science Institute of Singapore, NUS
GMS 6904	Principles of Infectious Diseases	4	Duke-NUS

3.6 Curriculum Information (PhD Programme in Clinical Sciences)

PhD Programme in Clinical Sciences (CS)

The aim of the PhD Programme in Clinical Sciences (PhD CS) is to educate and train medical doctors and other health science professionals to perform clinical and translational research. The proposed programme will focus on the interface between clinical, biological and social research methods by bringing together experts in quantitative sciences (biostatistics, epidemiology, and bioinformatics), biological basic sciences (genomics, immunomics, metabolomics), ethics, clinical therapeutics, health services and systems research.

The goal is that clinician scientists trained in this PhD programme will lead research efforts in Singapore in the future and will enhance Singapore's international reputation in medical research.

Candidates may be admitted on a 3-year full-time or 4-year part-time basis. The programme is self-supporting and the candidates are encouraged to apply for NMRC Research Training Fellowship.

Mentorship

Each student will be supervised and guided by one main mentor who is an established clinician-scientist. The mentor will provide the research environment and research support to the student. Further, a thesis advisory committee (TAC) comprised of up to four faculty will meet with the student and mentor on a regular basis to provide expert guidance.

Mentor Eligibility

1. Medically qualified and leads a successful research programme in translational and/or clinical research.
2. Evidence of national competitive funding such as NMRC Clinician-Scientist Awards (STaR, CSA, IRG)

3. Sufficient funding to support the students' research project

4. Proven track record of peer-review publications in international journals.

5. Faculty appointment with Duke-NUS

Curriculum

	Semester 1	Semester 2	Overview
Year 1	1. Principles of Clinical Research 2. Foundations of Precision Medicine 3. Forums/Workshops 4. Good Clinical Practice Course 5. Graduate Seminar	1. Research Methods from Medicine to Population Health 2. Protocol Submission 3. Research grant application for thesis project 4. Graduate Seminar	**Coursework** **Thesis research (start)** **PhD Qualifying Exam** (PQE) (either in Year 1 or Year 2)
Year 2	1. Study Initiation Visit 2. Graduate Seminar	1. Elective 2. Forums and Workshops 3. Attend 2 IRB meetings 4. Graduate Seminar	**Thesis Research (continued)** **Course work**
Year 3	1. Attend 2 IRB and 2 grant review committee meetings 2. Graduate Seminar	1. Assist in reviewing 2 grants under the mentorship of the official reviewer 2. Graduate Seminar	**Thesis Research (continued)** **Preparation of Manuscript** **Successful Dissertation Defense**

4 Admissions and Financial Aid

4.1 Admissions

At Duke-NUS, we utilize a holistic admissions review process that is individualized to each applicant. Broadly speaking, the admissions process takes into account a combination of personal attributes, experiences, and academic accomplishments. In keeping with our School's mission, as well as our Academic Medicine partnership with SingHealth, our ambition is to make significant contributions to improving the practice of medicine in Singapore and beyond. As such, we enthusiastically look forward to having promising applicants from diverse academic backgrounds join our community and help realise our vision.

For details on the admission requirements for our MD, MD-PhD, or PhD programmes, please visit https://www.duke-nus.edu.sg/admissions/admission-requirements

4.2 Financial Aid and Awards

To ensure that financial difficulties or economic circumstances do not hinder students from applying to Duke-NUS, we provide financial aid to our students in the form of merit scholarships, need-based scholarships (bursaries) and loans. Details on financial aid can be found here.