Research in Medical School

A guide to embarking on your own Research Journey

"If we knew what it was we were doing, it wouldn't be called research, would it?"

Have you always wanted to start on a research project but don't know how and when you should start? Are you already on a research project but don’t know how to analyse your data or publish your results? Then this would be the exact guide for you with information on how to start a project, how to write your paper and publish your findings. Further information on other research support is also available.
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Before Embarking on a Research Project:

When do I start a research project?

Begin only when you’re ready. Don’t feel pressured to get a research project just because your friends are doing one too. Also, make sure that you can cope with your studies as well as with research. Take your time to think about what areas you would like to do research in, via your interactions with doctors (who may talk about their projects!) and think of what mentors might be suitable for you. Start a project only when you are ready.

How many projects should I take part in?

There is no magic number. The key is to be able to handle all your commitments. It is advisable to start small and build up your confidence. Some handle a few small projects to get a broader set of skills and have more chance of success, while others devote most of their time to a large project. Both approaches have their advantages. We encourage you to devote at least some time to taking a project through all stages – conceptualise a project of your own, find the resources to carry it out (e.g., working with a professor in the field), getting ethics approval, obtaining the data, analyzing the data, writing the paper/report and presenting/publishing it. This will allow you to get a sense of how the entire process will work, and it will help you do independent work in the future. I think this is better than being a small part of a huge research effort (e.g., preparing one figure/table for your mentor’s paper in Lancet). The important part is not just the end-result but also the learning process.

What research projects are available?

There is a spectrum of projects available, ranging from the basic sciences to clinical research. We won’t go into the specifics of each project, but here’s a brief introduction. Basic science research involves a lot of wet lab and experimentation with cell lines, animal models and in silico work, all with the aim of elucidating molecular mechanisms of diseases or pathological processes. Translational research serve as the bridge between the basic sciences (molecular pathways) and clinical practice. It aims to expand on the basic sciences to develop interventions to treat diseases. Clinical research in essence encompasses clinical trials, studies investigating associations and relationships between two factors that could be involved in disease progression, and studies investigating how to improve management of specific diseases. This description is not meant to be comprehensive, but you do get the main gist of it. Do ask around your seniors or batchmates who have embarked on a research project to find out more.

What is a good time-frame for a research project?

A good project timeframe really depends on the scale of the project and the nature of the project: cross-sectional and cohort studies would take more than a year while wet lab projects can easily take 2-3 years to get reasonable amount of data. The following breakdown is a rough guide:

- 2 months for preparation (getting documents like ethics approval, survey forms, etc. ready)
- 3 months for data collection
- 3 months for data entry and cleaning
- 2 months for data analysis
- 2 months to write the manuscript

Nevertheless, this also depends on your level of commitment and project type.

You may also want to consider doing a project-within a project. For example, you can start a cross-sectional study and turn it into a cohort study. A cross-sectional study is a study in which you look at a particular population at one point in time. A cohort study is one in which you look at a study over a period in time. So basically if you do a survey on one population, it is a cross-sectional study; and if you follow that up with another survey later and compare the two results, it becomes a cohort study. That way you can publish on both the cohort and the cross-sectional studies.
Should I take a year off medical school to do research?
It depends on the nature of the project that you are involved in. Taking a leave of absence is certainly a big commitment to make. It is also reflected on your transcript, and will be questioned by program directors of the residency program you apply to in future. You can consider registering your project under UROP, but this should be done only if your project has tangible outcomes. Remember that there are very specific criteria for grading a UROP project, one of which is publication/presentation at a conference. You might want to ask your parents, the DO and also the faculty. Taking a year off school is not easy and can be quite disruptive. After all, you are a medical student first and then a researcher. Also, UROP can be something that you can handle concurrently with your studies, not something that you take a year off for.

What is wet-lab research anyway?
Wet lab research projects have often been misunderstood as "time-consuming" and "difficult". Well, there's some truth in it, but it isn't as difficult or time-consuming when you get things up and running. Indeed there are a lot of techniques that you need to be familiarized with, but it'd be rewarding in the long run when results start pouring in. Depending on the nature of the project, you'll be exposed to common lab techniques - ELISA, Western Blot, PCR - all of which would come in useful in the future if you are considering to dwell further into research after graduation.

For the basic sciences, it is definitely rewarding to learn more about the molecular basis of diseases which often would not be covered in the school syllabus into detail, and to discover novel molecular pathways. For a deeper insight into what basic sciences wet lab exactly is, Cell Journal (www.cell.com) is an amazing collection of top-notch research publications that contribute extensively to medical knowledge.

Translational research projects do involve wet lab too! Some of the exciting work here include investigating specific diagnostic or prognostic biomarkers for diseases, and the effects of drugs in vitro or in vivo.

What is the difference between wet-lab research and dry-lab research?
Population research involves mainly data entry & analysis. It is often easier to do and pays dividends faster. Often, the main aim of a population research is to find an association between two variables, and to convince others that a) the association is genuine, and b) the association is meaningful and of interest to the rest of the world at large.

Wet lab research in general is more complicated. It requires slightly greater commitment, good grasp of the research skills to conduct experiments, and most importantly, patience. Unlike population research, wet-lab procedures cannot be rushed. If you do not have prior experience in the lab, the learning curve would be steep, and it may take months for a newcomer to be proficient in the techniques. However, if you are ever considering a PhD, and prefer work that involves both aspects of thinking and doing, wet lab research can be very rewarding.

At our level, it is difficult to do a really outstanding population research because we do not have the ability to recruit an entire cohort of 10,000 babies and follow up with them for 10 years. We can probably only manage small cohorts, and small papers, but probably not reach the level of NEJM or Lancet or Nature by our own efforts. For wet-lab research, the bar is lower and we have the opportunity to make an outstanding discovery by ourselves, given the appropriate amount of luck and hard work.

So it's a gamble in a sense, one with low risk and low payout, and one with high risk but high payout—you have to see what's right for you: some people cannot stand running gels and blots; others cannot stand sitting in front of a computer for hours on end. More information is given during the annual Research Directorate (RD) talk ‘Research – Uncovering Its Mystique’.
Phases of Research
1. Conceptionalisation Phase (including literature review)
2. Getting IRB ethics approval
3. Data Collection/Laboratory Tests in Progress
4. Data Analysis Phase
5. Writing and Publishing of Manuscripts

Hone your Research Skills:
- Books written on the skills of clinical research, and several are suitable for medical students.
- Lectures on research skills given to third year Medical Students of the Duke-NUS GMS are available freely online (http://teamlead.duke-nus.edu.sg/preview/), and these voice-animated powerpoint lectures are ideal and excellent for self-directed learning. The recommended links are the Duke-NUS and KCS lectures. Highly recommended are the excellent lectures delivered by Professor John Rush on Topic 2: Developing an impactful research question and Topic 3: Developing a research grant proposal
- Learn on the job under the apprenticeship of a mentor

Step 1: Conceptualization and Literature Review
Often, mentors expect the student to have an idea on the type of research and approach they would like to take in the research. Only then, the mentors will guide the students accordingly. As you start your research, it is important to have a research question. This may be your hypothesis which you want to prove or answer with the results from your research.

Generally, to formulate an impact-worthy research hypothesis, it is important to do a good literature review. It is important to understand the current situation of your research question in the scientific world, to understand what else may be lacking in your topic of interest, and to find possible patterns across the scientific reports which may guide you on how your research may be conducted. PubMed (http://www.ncbi.nlm.nih.gov/pubmed/) serves as a good start.

Next, question yourself if you can answer the hypothesis. Clarify definitions in your hypothesis. E.g. if the research question you are answering is "Are caregivers of stroke patients depressed?" Make sure you have a definition of depression that can stand up to scrutiny (e.g. DSM-IV criteria for diagnosing depression, not just, "are you depressed?"). Consult your mentor to ask for advice.

Step 2: Getting IRB Ethics Approval
If you’re setting up your own project, you need to get ethics approval. Being an NUS student, you can approach the NUS-IRB which will provide ethics approval for free, unlike some other boards (eg. Parkway Ethics Board).

You must have a mentor to sign off on your application, as the IRB doesn't accept applications made solely by students. If the results will be published, IRB approval should be submitted under supervisor’s name. Retrospective IRB approval is not encouraged; it is advisable to get IRB approval before starting the project. Do note that NUS-IRB approval is for research that does not involve patients (i.e. epidemiological studies). For research involving patients, DSRB (Data Safety Review Board) approval is also needed.

There are two categories of projects: those that require full ethics approval, and those that can be exempted from full ethics approval. Generally, only projects in medical education would fall into the latter category. The forms, as well as a helpful FAQ section, are found at the NUS-IRB website: http://www.nus.edu.sg/irb/. Projects dealing with vulnerable populations (eg. children) and those requiring biological samples (cell lines, tissue, blood) generally require additional forms.

If you are still unsure about how to submit an IRB application, the Research Directorate would be organising a talk to address your queries. Stay tune for the next IRB session with one of our professors!
Other Important Courses:

**Collaborative Institutional Training Initiative (CITI)**

CITI [https://www.citiprogram.org/](https://www.citiprogram.org/) is a web-based training program in human research subject protection. Register for CITI under the institution you are doing research with (e.g. if your project is under KKH, you should register under Singhealth). Depending on the type of research you are undertaking, you will take different components of the test. Hence, the test you took for your first project may not apply for your current one. Multiple attempts within individual sections are allowed, and some questions may be repeated in your subsequent attempts. At the end of the online course, you will receive a certificate with individual scores for the components you took.

**Animal Handling Courses by IACUC**

If your research involves animals, there are training courses conducted in house by the Institutional Animal Care and Use Committee (IACUC). This course consists of a General Lecture Programme and a Species Specific Training Programme. The fee is $50 for NUS Students for the compulsory lecture and $50 for each species specific session. For more information, visit: [http://www.nus.edu.sg/iacuc/training.html](http://www.nus.edu.sg/iacuc/training.html)

**Step 3: The Actual Research and Paper Writing**

**Data Collection and Entry Phase**

This is the most laborious part. Data collection depends on the nature of your study, and varies between projects. This phase of research is the key differentiating factor between a wet-lab & a dry-lab research. The following general principles apply for clinical research.

Data can be entered using both excel and SPSS. It is important to have a clear idea of your aims and hypothesis, so that you can begin with the right data entry template. You should discuss this with your mentor and have him/her approve it before you start entering data. The headings in the template determine what data you will be collecting, so if you do make any changes later, you will have to go back and redo some/all of the work.

If you are using SPSS for data entry, also remember to set the correct variables and parameters under the “variable view” before you embark on collecting data. For a more detailed guide on using SPSS, please refer to the attached SPSS coursebook for year 4 community health project students made by the School of Public Health.

In certain instances, you may find access to Electronic Medical Records useful during the data entry process. Unfortunately, due to the confidential nature of the database, the IT departments of various hospitals do not always grant access for medical students who are not on clinical postings with the hospital. You will need to be resourceful here.

Finally it will also be good to meet/update your mentor frequently during the data collection process, so he/she is aware of your progress and can help steer you in the right direction if necessary.

**Data Analysis Phase: Using SPSS**

SPSS is among the most widely used programs for statistical analysis in social science.

We can’t teach SPSS here, but you would eventually learn more about SPSS when you do your Community Health Project in year 4 (or during our SPSS workshops!). You can refer to the guide mentioned above, or you can attend lessons coordinated by Wong Hock Boon Society. SPSS, together with a whole range of statistical programs, is available at the Department of Epidemiology and Public Health computer labs at MD3, Level 3. But you can only use it there, and during office hours.

SPSS is easy to use because of its user interface (click-and-point). However, it isn’t a very powerful program and cannot do everything. STATA and R are other options, but they are generally command-line software, meaning that some knowledge of programming is required.

You will need to employ different statistical tools in SPSS depending on the nature of your study. As there is a wide variety of tests, it is not feasible to cover them in this guide, and it is best to consult a statistician. Every institution has
statisticians to help investigators in the data analysis part of their research. There are in general two ways to involve a statistician in your project:

a) Involve him/her right at the very beginning of your study. Discuss with him/her the nature of your project and how data should be collected and subsequently analysed. He/she will be able to help you identify pitfalls in your study design, improvise the methodology and construct an efficient data entry template that can be easily used for subsequent data analysis. You can also have him/her to generate the results for you. This is suitable for large scale studies involving many participants, or if your methodology is complex.

b) The do-it-yourself style. Try to figure out as much as possible on your own how to use SPSS and selecting the correct tests. There are guides online that help you do just that. If your mentor is experienced and has previously published many papers, he/she may also be able to help you as well. During the data analysis phase, prepare a list of questions and make an appointment to consult a statistician to have your questions answered. This is suitable if your study is a case series or a simple cross-sectional study.

It is assumed that if you do involve a statistician for the most part of your study, you need to give credit to him/her through authorship in your paper.

Reference Citations- Vancouver Style
For those who want to know how to cite articles in the references, http://www.nlm.nih.gov/bsd/uniform_requirements.html provides examples of what is known as the Vancouver style (valid for many international journals and our local Annals of Academy of Medicine). Most journals also include examples of how to cite in their Instructions to Authors.

Step 4: Publishing and Presentation

Submission Process to the Local Annals of Academy of Medicine Singapore
For submission to the local Annals of Academy of Medicine Singapore, the submission process works like this:

1) 1st Submission: A copy of the main text of the paper, anonymised (remove all author identifying details); a Title Page (with the author identifying details); and a Cover Letter. After submitting online to the AAMS website, the editor can come back 1 to 3 months later with the Reviewer’s comments. If the reviewer asks for certain changes to the paper before it can be published, this will be reflected in the reviewer’s comments.

2) The author then resubmits an edited copy of the paper and a letter outlining, point by point, what the author has done to address the reviewer’s concerns.

This process of editing and submitting can go through a few cycles. When the paper is finally accepted, the author needs to submit a signed copyright assignment form assigning copyright over the paper to the journal.

The website for the AAMS is as follows: http://www.annals.edu.sg/instructions.html

For those thinking of submission to the Singapore Medical Journal, the website is as follows: http://www.sma.org.sg/smj/instructions.pdf

Generally, the principle is that the process from submission to acceptance and publication can take a long time, as long as half a year- so be prepared!

Submission Process to an International Journal
The submission process for international journals is much similar; however, the format as well as the supporting documents required differs from journal to journal. Students should check the Guidelines for Authors for the journal they plan to submit to in order to ensure that they have prepared all the necessary documents and made the necessary formatting changes before their submission. Also, some of the international journals publish papers online in advance of the print version, thus your findings can usually be published faster compared to the local journals.

To decide which international journal you should submit to, you may want to list out the different types of relevant international journals, and rank them according to relevance or prestige.
What journal should I submit to?
1. Ask your mentor or someone with experience working in your field, who will be able to guide you to a suitable journal.
2. Look at your reference list. If your manuscript’s reference list contains a clear concentration of articles from a particular journal, then that would probably be the best journal to aim for and have the higher likelihood of acceptance (as it takes in stuff that’s similar to your work).
3. List out the different types of relevant international journals.
4. Rank them according to relevancy of the topic and the reputability & impact factor. Generally, the quality of a journal is determined by its impact factor (the higher the impact factor, the greater the number of citations that past articles have received and thus the better the journal). It’s not perfect, but most people rely on it.
5. Check the NUS tiered list of journals. Tier 1-4 (Tier 1 being the highest). You can find the list at http://www.annualreviews.org/page/about/isi-rankings.
6. Read the previous articles in the journal on Pubmed and see whether the journal has published anything like your work before.

Conferences & Presentation
Generally, the best step would be to search online yourself for conferences to attend, as you would have the best idea of what your research topic is on and what sorts of conferences would be relevant. You can also ask your mentor. Generally some of the larger-scale conferences are recurring events, so you probably know whether they occur yearly, biannually, and at what times of the year. Also from past conferences you generally can tell when the abstract submission dates will open and close, so you know when to go online to check nearer the date to see if abstract submission has opened for a particular conference you’re interested in. The Directorate does announce conferences that we hear about/people inform us, but we obviously can’t catch everything.

Those applying for overseas conferences must submit an application for Leave of Absence to the Dean's Office. Please note that due to safety concerns, conferences in ASEAN countries are more recommended.

Source of Conferences:
This is a very brief example of the types of conferences available:

1) NUS-related Conferences:
   a. Annual Graduate Scientific Congress
   b. NUHS University Surgical Cluster (USC) Surgical Forum
   c. Wong Hock Boon Society Symposium
   d. NUHS Department of Medicine Open House
   e. Annual SMEC
2) Singhealth Conferences:
   a. Singhealth Biomedical Congress (SHBC)
   b. Singhealth Annual Scientific Meeting (ASM)
   c. Singhealth Surgical Congress
3) Local Conferences
   a. Singapore Health and Biomedical Conference
4) International Conferences in Singapore
5) International Conferences Overseas

For 4) and 5), it might be advisable to discuss with your mentor on which ones to choose.
Research Support

Source of Information on Research & Research Experiences
1) Research Directorate’s annual talk series: Research – Uncovering its Mystique
2) Annual Student Medical Education Conference (SMEC): Workshops on various specialties, students presentations of their projects, poster exhibition
3) Annual Wong Hock Boon (WHB) Society & Undergraduate Research Opportunities Programme (UROP) talk by Vice-Dean of Research & WHB President to M1s

Possible Project Opportunities:
1) Research Directorate (RD): Project matching for NUHS, KKH, SGH & Singhealth Specialty Centres
2) Wet-lab opportunities with pre-clinical year tutors
3) Collaborative work with other faculties (Science, Pharmacy, etc.)
4) Part of an ongoing community service projects (Neighbourhood Health Screening (NHS), Public Health Screening (PHS), Overseas Community Involvement Project (OCIP))
5) Part of local delegations to overseas student conferences (EAMSC, AMSC) – Refer to International Affairs Directorate, MedSoc/AMSA
6) Self-source

Funding Support
1) Dean’s Office (Education) – Reimbursement for Overseas Conferences
   a. Email Ms Yap Pek Be – medypb@nus.edu.sg for more details
   b. Cap 50% costs or SGD1000, whichever is lower
2) Dean’s Office – Reimbursement for Poster printing for all conferences – no cap
3) WHB personal $700 funds (details below)
4) WHB Fellowship Award (see below)

Wong Hock Boon (WHB) Society

WHB Society’s Aim:
1) Attract, nurture and sustain early interest in research amongst medical undergraduate students.
2) Encourage, recognize and incentivize the medical students with active research projects
3) Enable students to develop key research skills and understandings, with the view of training potential clinician-scientists/clinical investigators for the future.
4) Fully support members in producing high-quality, practice-affecting research.
5) Collaborate with the Research Office of YLLSOM, the Research Directorate of the Medical Society, and all other relevant medical institutions in achieving the above aims.

Eligibility
Applications for membership in the Wong Hock Boon Society is open to all M1-M5 Yong Loo Lin School of Medicine students. Entry guidelines are as follows:

Membership of the WHB Society shall be by application or enrolment.

To be eligible for membership, the applicant should be:

- An undergraduate student in the MBBS course at YLLSOM, regardless of year of study.
- Presently engaged in a supervised research project in any field OR be in the process of beginning a supervised research project under advisement from the Medical Society Research Directorate.
- Of good academic standing.
Benefits:

1. Funding

A. Sponsorship for conferences
Each WHB society member is entitled to $700 in funding for attending conferences locally and in ASEAN countries, Japan, Taiwan, Korea and Hong Kong (as of April 2013). The student has to be presenting as a first author in a poster or oral format.

Do note, however, that first year Wong Hock Boon Society members are provisional members. Provisional members will not be funded until their membership is confirmed (refer to above). Application needs to be at least two months prior to conference.

Regarding project funding: Ms Yap Pek Be at medypb@nus.edu.sg If you have a question regarding NUS funding that is not answered in the website, you can also contact Ms Geetha Baskaran at medgb@nus.edu.sg

B. WHB Society Fellowship Award

There is a maximum of $2000 disbursement per project, 10% of which is available for travel-related expenses (for overseas conferences), but not housing allowance. The application is subject to approval and also depends on the availability of funds yearly. In 2013/2014, 3 projects were approved for this funding.

C. WHB Society Symposium

WHB members will be able to present all their work, regardless of status, and to share their research experiences at an annual WHB Symposium event, which represents a meeting of minds and scientific exchange at a student level.

D. Early Access to CSXchange

CSXchange is an online portal that will connect all the clinician scientists in Singapore. WHB members, as part of a pilot initiative, will be able to gain access to a special WHB group in the portal, and as a result be able to connect and communicate with clinician scientists from all across Singapore.
**Research Directorate of MedSoc**

Research directorate of MedSoc was set up to encourage the medical students to partake in research and develop an interest in it. It complements WHB society by providing research opportunities outside NUH for medical students. It also organizes talks to introduce research to students and develops guides (such as this) to guide students as they develop their research interest.

**Undergraduate Research Opportunities Programme (UROP)**

UROP details: [http://medicine.nus.edu.sg/corporate/urop/default.aspx](http://medicine.nus.edu.sg/corporate/urop/default.aspx)

UROP aims to promote research by our undergraduates. Undergraduate research in pre-clinical and para-clinical departments is usually carried out under supervision by the PIs and during the vacation period from the First to the Third year. The clinical departments also offer opportunities for research in the Fourth and Fifth year which can also be included in the elective posting schedule. Students who participate in UROP will be given credit for the research done in their Final year academic transcripts. Students participating in UROP are encouraged to apply for membership in the WHB Society.

**Registration**

Your supervisors/mentors should first register the project on an online portal: [https://itumed.nus.edu.sg/urop/main.htm](https://itumed.nus.edu.sg/urop/main.htm). Your mentor could discuss project & title with you and then register the UROP project on the portal. Afterwards, you can log in and select the project your supervisor has registered since he has already identified you to work on the project. Once the above is cleared, you can embark on the UROP project. Please note that only projects with NUH mentors as the main mentor can be under UROP.

**Benefits:**

**Funding**

Students in UROP are eligible to claim $500 for research consumables only (this includes printing costs, travel for research purposes, lab supplies, etc.). Students need to fill up the UROP Funding Reimbursement form and submit it to the DO along with necessary documentation for processing.

**Recognition for Effort in Research**

As mentioned above, students in UROP will be given credits for their efforts in the project in their Final year academic transcript. In addition, those who have achieved excellence in their research projects will be able to submit them for consideration for student research prizes such as the Outstanding Undergraduate Research Prize.