The clinician-scientist: Uniquely poised to integrate science and medicine

Kiryu K Yap
Associate Editor, AMSJ
Sixth Year Medicine (Undergraduate)
The University of Melbourne

Introduction

Growing in the world of academic medicine is a new generation of doctors known as "clinician-scientists". Trained in both science and medicine, with post-graduate research qualifications in addition to their medical degree, they serve as an essential bridge between the laboratory and clinic.

The development of sophisticated experimental approaches has created opportunities to investigate clinical questions from a basic science perspective, often at a cellular and molecular level previously impossible. With new and detailed understanding of disease mechanisms, we are rapidly accelerating the discovery of new preventative measures, diagnostic tools, and importantly, novel therapeutic approaches. In these emerging avenues there is not just a need for collaboration between scientists and clinicians, but a need for individuals who are fluent in both science and medicine – hence, the advent of clinician-scientists. The terms "translational research" or "translational medicine" are often associated with clinician-scientists, alluding to the notion that these people facilitate the two-way process of translating scientific findings into clinical applications (bench-to-bedside), and provide clinical data and specimens back to the laboratory to investigate underlying disease processes (bedside-to-bench).

From a student's perspective however, these concepts can be confusing and finding their way through the breadth and categories of research conducted in academic institutions and hospitals may prove daunting. A discussion of the clinician-scientist niche and some of the challenges and opportunities faced may prove helpful.

Defining the clinician-scientist

Most clinicians at an academic hospital are engaged in research to some extent, but this tends to be mainly clinically-oriented, with patient care, treatment outcomes, and population health being broad areas commonly involved. Their day-to-day job is mostly defined by their clinical duties, often with some teaching responsibilities involved. Clinician-scientists, by contrast, dedicate a significant proportion of their time to research, typically spending ≥50% protected time in order to be remain academically competitive. [1] Whilst still loosely defined, in a purist sense this is a clinician who is involved in research at an organ, tissue, cellular, or molecular level, as opposed to focussing solely on whole patients as a clinical subject. Such research may not always have clinical findings that are directly relevant to everyday medical practice but the difference from a pure basic scientist is that the science has been approached with clinical relevance in mind. Interestingly, on the other hand, science itself has become inter-disciplinary and is recognising the importance of clinical relevance and translation with new ventures such as the Stanford University PhD in Stem Cell Biology where graduate science students interested in involvement with translational research in regenerative medicine undertake rotations shadowing clinicians in order to develop a clinical perspective to their research. [2] These developments indicate that not only are the frontiers between science and medicine becoming blurred, but that translational research is the exciting intersection where clinician-scientists, as well as scientists well-attuned to clinical practice, are uniquely poised to thrive.

The clinician-scientist niche

Clinician-scientists possess a distinctive set of skills, being trained as a clinician to apply scientific knowledge to patient care, and trained as a scientist with an enquiring mind designed to test hypotheses. Understanding the clinical relevance of observations in science and the ability to translate this back into clinical practice is truly the domain of the clinician-scientist, and uniquely so.

The pursuit of additional post-graduate research qualification such as a Masters or PhD has traditionally been the main pathway to becoming a clinician-scientist in Australia, unlike in the United States where combined MD-PhD programs have been well established in the past. However, the recent development of similar combined MBBS-PhD and MD-PhD programs in Australia is likely be instrumental in building a body of clinician-scientists that have been moulded specifically for this task. [3] Skills developed in scientific training essential for success in research include literature appraisal, manuscript and grant writing, and mastery of laboratory techniques, all of which are life-long skills honed over time, and which are rarely acquired in medical school.

It goes without saying that clinician-scientists are expected to be experts in both medicine and science. Anything subpar of clinical competence would pose a threat to patient safety and cannot be compromised. On the other hand without a solid commitment in research with the appropriate output in terms of publications, conference attendance, and grant proposals, a career in research will not take off since a track record is something that needs to be built on constantly. Given that clinical training itself takes a good number of years before being able to practice as an independent clinician it is little wonder that many are unwilling to tackle both clinical and scientific careers at once. Again, this lends further credence to the MD-PhD path where scientific training would have already been completed by the end of the program, although this itself has its drawbacks, since the science gained can become neglected in the last clinical years and will need to be polished again upon completion. [4]

But where lie challenges also lie opportunities: for the determined few, funding statistics indicate that the rigorous training is entirely worthwhile. Clinician-scientists have been found to consistently perform better in national funding programs such as the National Institutes of Health Research Project Grants (United States) than their pure clinician (MD only) and basic science (PhD only) counterparts. [5] Although the pool of clinician-scientists in Australia is significantly smaller than that of the United States and data on funding trends are less widely discussed in literature, it is generally acknowledged that clinician-scientists also do well in obtaining NHMRC funding. This may be due partly to the fact that clinician-scientists are afforded more flexibility in labelling their projects as "basic science" or "clinical", and therefore have access to funds for both basic science and clinical projects, whereas pure clinicians and scientists are generally limited to their own funding areas.

When describing the clinician-scientist niche, an aspect of research "translation" that is often neglected is the importance of the delivery of research-based medicine into actual practice. The classic bench-to-bedside process refers to the invention of a new drug, device, or diagnostic tool where the hope is that it will undergo clinical evaluation in a controlled setting with a specific patient cohort. But bringing a discovery into the market is simply the beginning, and to bring this to the general public a much more concerted effort is required involving collaboration between public health experts, policy makers, and clinicians amongst others. So drawn-out and complex is the process that it is well acknowledged that this area of "translational" research often fails, with many potentially important discoveries unable to

make changes to everyday medical practice. [6] However, clinician-scientists are well suited to play an active role in negotiating the many hurdles in this endeavour by facilitating communication between the various experts involved, whilst providing a first-hand inventor as well as treating clinician's perspective that is not only unique but critical in ensuring that an invention is appropriately implemented and evaluated. In the Australian context, the National Health and Medical Research Council (NHMRC) has recognised this gap in research translation and the Centres for Research Excellence and Translating Research Into Practice (TRIP) Fellowships are specific measures aimed to address this issue. [7]

Wearing two hats: double the challenges?

A commonly quoted recommended research:non-research ratio for workload is 75:25, with the majority of time devoted to research in order to succeed as a clinician-scientist. [8] In reality this is more likely to be exactly opposite the case, where a 75:25 ratio in favour of clinical work becomes the norm instead. [9] This may be particularly so in the early years after graduation when specialist training is being undertaken, despite the fact that this is also the time when a solid research foundation needs to be built in order to establish a clinician-scientist's academic presence. As pressing as clinical demands may be, it is widely recognised that a research career cannot flourish without negotiating some protected time from clinical duties with the hospital department.

The biggest challenge for clinician-scientists is therefore time management. In addition to patient care, clinical training, and teaching responsibilities, clinician-scientists are expected to undertake labwork, keep abreast of advances in both scientific and medical literature, and engage in professional development and conferences on both fronts. They must maintain manuscript preparation and grant proposals, complete administrative duties, and often lead research teams. To realistically keep up with these demands of juggling a dual career, the ability to delegate and seek cooperation from scientist and clinician colleagues is critical. The lack of a supportive environment and a suitable mentor who can share their experiences and show the way can present an impossible struggle to the time-constrained clinician-scientist.

On the clinical front, to manage their workload clinician-scientists may tightly focus their interests to subspecialised areas to maintain an adequate caseload and expertise without stretching oneself too thin. This depends however on working in an environment where the volume and diversity of patients permits such subspecialisation, with appropriate facilitation by supervisors such as Department Heads. Unfortunately these conditions tend to be found only in major tertiary hospitals, relegating clinician-scientists to these settings.

Additionally, a research career is often less financially rewarding than clinical work particularly when private practice may need to be sacrificed in order to undertake lab work. This can pose a significant barrier particularly because the number of years required to gain appropriate training results in clinician-scientists being likely to be older than their scientist and clinician counterparts and may therefore have family commitments, and have often also accumulated student debts that need to be repaid. [10] Some solutions to this may be the Practitioner and Career Development Fellowships offered by the NHMRC aimed at clinicians involved in research, [11] as well as hospital and philanthropic organisation funding specifically for buying time out from clinical practice for research.

Opportunities for the clinician-scientist

For any researcher, securing funding is a lifeline in continuing their work and burnishing a track record, and it is here where clinician-scientists can be creative in sourcing their benefactors. Philanthropic organisations often affiliated with a disease or clinical cause, specialist training colleges like the Royal Australasian College of Surgeons, hospital based foundations, pharmaceutical companies, and fundraising from patient advocates are all important and significant funding avenues that clinician-scientsts may find more accessible than pure scientists. [12] These grants often allow pilot projects to be undertaken in order to generate sufficient amount of preliminary data to become competitive for major research funding such as from the NHMRC. Additionally, a number of these organisations offer clinician-scientist fellowships similar to the NHMRC.

Apart from funding success, it has also been found that many clinician-scientists opt to apply for and are successful in obtaining university academic positions. [12,13] Such engagement in academia provides synergy for research efforts by opening up institutional resources often more diverse than hospital settings, prospects for networking with like-minded professionals and mentors.

Additionally, the scope translational research itself is widening. An increasing number of academic hospitals are dedicating departments to translational research, with clinician-scientists often taking the lead. The need to prioritise translational research has been further underlined by the Chief-Scientist of Australia's recent speech calling for increase in research funding for this area. [14] Whilst these are positive developments, further input from clinician-scientists themselves is required to shape policy changes and design steps to increase their numbers.

Moving forward

An apt saying may be, *"Clinicians know all of the problems, but none of the solutions; scientists know all of the solutions, but none of the problems"*. [15] This is where clinician-scientists represent a unique breed suited to fulfil this vacant niche, and are absolutely necessary in forging the next success stories of medicine. Despite the complexities of a dual career, the rewards and satisfaction in pursuing this path are evident and meaningful, and can lead to tangible health outcomes in patients. Although it is important to maintain a realistic notion that being a clinician-scientist is by no means an easy feat, it is equally important to take hope that the best of both worlds can be experienced. These perspectives are increasingly acknowledged in the form of progresses being made in the right direction to encourage clinician-scientists. In light of this, perhaps it is well worth noting that there may never be a better time than now to venture into, and indeed take charge in riding this next wave of medical evolution.

References

1. Archer SL. The making of a physician-scientist--the process has a pattern: lessons from the lives of Nobel laureates in medicine and physiology. Eur Heart J. 2007 Feb;28(4):510-2
2. Stanford University School of Medicine, Institute for Stem Cell Biology and Regenerative Medicine. PhD Program: Curriculum Overview. [updated February 17th 2009; cited March 8th 2012]; Available from: http://stemcell.stanford.edu/education/phd/curriculum.html
3. Power BD, White AJ, Sefton AJ. Research within a medical degree: the combined MB BS-PhD program at the University of Sydney. Med J Aust. 2003 Dec 1-15;179(11-12):614-6
4. Marban E, Braunwald E. Training the clinician investigator. Circ Res. 2008 Oct 10;103(8):771-2
5. Dickler HB, Fang D, Heinig SJ, Johnson E, Korn D. New physician-investigators receiving National Institutes of Health research project grants: a historical perspective on the "endangered species". JAMA. 2007 Jun 13;297(22):2496-501
6. Woolf SH. The meaning of translational research and why it matters. JAMA. 2008 Jan 9;299(2):211-3
7. McCallum J, Forster R. From the NHMRC: Research translation network targets the evidence-practice lag. Med J Aust. 2011;195(5):252
8. Tai IT. Developing a clinician-scientist career. Clin Invest Med. 2008;31(5):E300-1
9. Bosse D, Milger K, Morty RE. Clinician-scientist trainee: a German perspective. Clin Invest Med. 2011;34(6):E324
10. Lander B, Hanley GE, Atkinson-Grosjean J. Clinician-scientists in Canada: barriers to career entry and progress. PLoS One. 2010;5(10)
11. National Health and Medical Research Council. Fellowship Awards. [Internet] [updated December 21st 2011; cited March 1st 2012]; Available from: http://www.nhmrc.gov.au/grants/apply-funding/fellowship-awards
12. Hayward CP, Danoff D, Kennedy M, Lee AC, Brzezina S, Bond U. Clinician investigator training in Canada: a review. Clin Invest Med. 2011;34(4):E192
13. Toouli J. Training surgeon scientists. ANZ J Surg. 2003 Aug;73(8):630-2
14. Australian Government - Chief Scientist of Australia 2012. Can Australia afford to fund translational research? [updated April 3rd 2012]; Available from: http://www.chiefscientist.gov.au/2012/04/can-australia-afford-to-fund-translational-research/
15. Hait WN. Translating research into clinical practice: deliberations from the American Association for Cancer Research. Clin Cancer Res. 2005 Jun 15;11(12):4275-7