Medicine Needs Medical Student-Scientists: Update on an Old Theory

Cam Bringans BSc BMedSc(Hons)
School of Medicine, Faculty of Medical & Health Sciences, University of Auckland

Cam is a final year medical student at Waikato Hospital. During an Honours year Cam developed an electrochemical assay that can potentially be used in multi-modal neuromonitoring. Outside of medicine Cam is probably devouring a good book or dumplings.

The cynical medical student sees research as a frustrating task to be endured for career advancement. The idealistic student sees medical research as their way to contribute to humanity's greatest achievement. The professor sees research as a way to teach skills to students that will make them better clinicians. Each of these hypothetical characters are right, but only the cynic should be ignored.

Science needs medical student-scientists

Your biggest contribution to medicine as a medical student may not happen in a hospital. In the clinical setting, your job is to learn, cut sutures, and write the odd discharge summary. In the laboratory, you are free to create knowledge that could lead to better diagnostic techniques or treatments. Medical students have long known that knowledge can simultaneously be studied and created. Naïve medical students are uniquely qualified to challenge clinical dogmas because they have never experienced the "we have always done it this way" mentality. Young students are also unlikely to be restricted by the obligations of middle age (e.g. mortgage, children, golf). Most research produces small incremental advancements in knowledge, but there are a few medical students whose research had greater positive impact than the whole of that student's clinical career (Table 1).[1]

Table 1. Major discoveries and inventions by medical students

Medical student	Discovery or invention
Thomas Fogarty (1960)	Catheter based balloon angioplasty
Charles Best (1921)	Insulin
Jay McLean (1916)	Heparin
Ernest Duchesne (1897)	Penicillin*
Augusta Klumpke (1885)	Brachial plexus anatomy
Paul Langerhans (1867)	Microscopic anatomy of pancreas
William Clark (1842)	Ether anaesthesia

*Examples are discussed by Stringer and Ahmadi 2009.1 *Duchesne succumbed to tuberculosis soon after his discovery and never lived to see penicillin rediscovered.*

Times have changed since Paul Langerhans could use the same light microscope to discover pancreatic islet cells and make a diagnosis. Science and medicine are increasingly becoming dependent on complex techniques that require specialist training, take for example robotic prostatectomies and viral vector gene transfer methods. The increasing challenge of mastering both science and medicine may explain why the numbers of physician-scientists are in decline.[2] Losing the unique insights that can only come from clinical training and patient contact will slow the progress of medical science. Fogarty catheters may not exist if the inventor had not witnessed patient's suffering after invasive open embolectomy surgery.[1] Reversing this workforce trend will require introducing more medical students to research and providing stronger support to those students that choose to pursue both clinical and research training.

Clinical medicine needs student-scientists

Doctors constantly update their clinical practice based on their interpretation of scientific data. Proper data analysis demands an understanding of the strengths and flaws of specific statistical methods, experimental designs and outcome measures. Analytical thinking is hard to teach and even harder to learn. Many medical students, including this author, wouldn't think twice about skipping an hour-long lecture on multivariate regression analysis. Designing and carrying out your experiment to test a question that you care about is the best way to learn these essential thinking skills. Understanding the scientific method will make you better at spotting bad data that shouldn't influence your practice.

> *"The first principle is that you must not fool yourself and you are the easiest person to fool"*
> — Richard Feynman.

Listening to Richard Feynman, the quintessential scientist, could make us all better clinicians. Doctors are vulnerable to cognitive biases that worsen clinical decision making and cause medical error.[3] Scientific training teaches you to identify and overcome bias in yourself and others. Good scientists seek out criticism as a way of protecting themselves from confirmation bias. A critical review of your research proposal or manuscript by a supervisor or peer reviewer may be crushing at first, but ultimately is the best way to improve your writing and thinking skills. In contrast, there are several well-known disasters caused by senior doctors' reluctance to accept criticism from junior staff.[4] Scientists interpret data from experiments with a slow, explicit, and reflective reasoning style (i.e. Kahneman's "system 2" thinking). Doctors interpret data from patients using both system 1 (i.e. instinctual, rapid and non-analytical) and system 2 thinking styles. Diagnostic instinct, a celebrated hallmark of the respected clinician, is easily foiled by recent diagnosis bias, anchoring, and availability bias.[5] Encouraging clinicians to adopt science's system 2 style has been shown to improve diagnostic accuracy.[6]

Advice for the frustrated medical student-scientist

I have experienced some of research's classic frustrating moments: when you realise the data doesn't care about your hypothesis, when your funding gets revoked because your study failed to get ethics approval, and that bitter taste in your mouth when you open an email saying "manuscript rejected". Overcoming those challenges taught me that theories must be made to fit evidence and not vice versa and how to convince intelligent people that my ideas have value. The frustration heightened my joy on seeing p-values < 0.05, presenting my findings at an international conference, and soon I will see those two magnificent words "manuscript accepted". Medical students should find their own research problem that will challenge them to develop their analytical and communication skills so that they can advance patient care.

Conflict of interest: None

Correspondence: Cam Bringans, cameronbringans@gmail.com

References

1. Stringer MD, Ahmadi O. Famous discoveries by medical students. ANZ J Surg. 2009 Dec;79(12):901-8.
2. Wyngaarden JB. The clinical investigator as an endangered species. New England Journal of Medicine. 1979 Dec 6;301(23):1254-9.
3. van den Berge K, Mamede S. Cognitive diagnostic error in internal medicine. Eur J Intern Med. 2013 Sep 30;24(6):525-9.
4. Beament T, Mercer SJ. Speak up! Barriers to challenging erroneous decisions of seniors in anaesthesia. Anaesthesia. 2016 Nov 1;71(11):1332-40.
5. Saposnik G, Redelmeier D, Ruff CC, Tobler PN. Cognitive biases associated with medical decisions: a systematic review. BMC Med Inform Decis Mak. 2016 Nov 3;16(1):138.
6. Mamede S, van Gog T, van den Berge K, Rikers RM, van Saase JL, van Guldener C, Schmidt HG. Effect of availability bias and reflective reasoning on diagnostic accuracy among internal medicine residents. JAMA. 2010 Sep 15;304(11):1198-203.