

Fostering creativity and innovation in the health system: the role of doctors-in-training in biomedical innovation and entrepreneurship

Doctors-in-training are well positioned to continue Australia's strong history of biomedical innovation and entrepreneurship

In Australia and overseas, there is growing interest in the development of biomedical innovation and entrepreneurship relating to improvement of diagnostics, treatments and health services.^{1,2} Innovation follows from the efforts of biotechnology and pharmaceutical organisations, academia and the health services sector. Entrepreneurship is then required to market innovations.

“Australia has a strong biotechnology sector, within which a stronger innovation-skilled medical workforce could be developed”



A lack of talented biomedical innovators and entrepreneurs limits positive change in health care. The Department of Health and Ageing's *McKeon review: strategic review of health and medical research — better health through research* proposed ways to enhance research capacity and commercial and non-commercial pathways to innovation.¹ The review strongly supported junior health professionals engaging in innovation research. These proposals were endorsed by the Australian Medical Association's position statement on clinical academic pathways.³

Doctors-in-training (DITs) — medical students, interns, residents and specialty trainees — are well placed to develop their innovation and entrepreneurship skills, given their traditional medical skills and knowledge. They have skills in basic, clinical and public health science. DITs train at the coal face of the health care system, and are therefore exposed to the practical outcomes of policies, procedures and systems. They have well developed skills that are empirically associated with entrepreneurial success,⁴ such as team work, communication, productivity, accountability, responsibility, problem solving and data analysis.

Biomedicine in Australia has many innovators and entrepreneurs (eg, CSL, Cochlear and the inventors of the human papillomavirus vaccine), and Australia has a strong biotechnology sector. According to the Scientific American Worldview scorecard for 2013, Australia ranked seventh in the world for biotechnology (across

health and non-health industries), up from tenth in the previous year, first for “best growth in public markets”, second for “greatest public company revenues” and second for “most public companies”.⁵ The 88 biotechnology companies listed on the Australian Securities Exchange are valued at more than \$51 billion. However, there is room to further support innovation and entrepreneurship training systems for our DITs to further strengthen the Australian outlook, particularly when considering the plethora of international training programs that are offered.²

Engagement with biotechnology and pharmaceutical industries can generate benefits for academic research, including funding, in-kind resources (eg, high-throughput facilities), commercial exploitation of technology or intellectual property, and cross-fertilisation of knowledge and skills.

In this article, we explore the role of DITs as biomedical innovators and entrepreneurs.

International experience with training in biomedical innovation and entrepreneurship

The US-based Society of Physician Entrepreneurs (SoPE) recently launched their Innovation Scholar Program, which offers doctors hands-on bioentrepreneurship experience through practicums with biomedical companies.⁶ The program comprises a 1-year apprenticeship, in which the junior physician is linked to a biomedical company, a mentor and a project. Companies provide the scholar with a broad

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array of knowledge, skills and experiences in product development and commercialisation. The scholar may also engage in an innovation-related university curriculum, depending on the geographical and workplace situation.

A Society for International Bioentrepreneurship Education and Research was recently proposed, with a mission to advance international bioentrepreneurship education and research.

A new course titled *Medical device design and innovation* from Yale University offers students opportunities to develop innovative solutions to problems posed by physicians.⁷ This course pairs physician mentors with students from medicine, engineering, physics, chemistry and management. Also, massive open online courses (MOOCs) on innovation are freely available online and are gaining popularity among junior doctors; for example, Coursera — an education platform that partners with top universities and organisations worldwide to offer free online courses — has a course titled *Healthcare innovation and entrepreneurship*.⁸

Other pathways exist for doctors to engage in specific innovation and entrepreneurship training. For example, in the United Kingdom, Industrial CASE (Collaborative Awards in Science and Engineering) Studentships⁹ are offered to bioscience PhD students in a collaborative environment; partnerships are established between academic institutions and organisations in the private, public and civil society sectors, with a PhD supervisor supplied by each branch. This program is administered by the Biotechnology and Biological Sciences Research Council and, in 2015, 125 of these 4-year studentships were made available. This program is funded by academic and non-academic partners, but financial obligations of non-academic partners depend on the size of the company.

Drivers of increased training in biomedical innovation and entrepreneurship

The development of innovation and entrepreneurship-related skills is emphasised in physician competency framework of the Royal College of Physicians and Surgeons of Canada (the CanMEDS Framework),¹⁰ and is supported by the Australian Medical Council's graduate outcome statements,¹¹ the *Australian curriculum framework for junior doctors*¹² and the Committee of Presidents of Medical Colleges' position statement on the role of the medical specialist.¹³ Through exposure to the health system, practitioners develop an understanding of the complex systems in which innovation will be applied.

It has been shown that device manufacturers gain more premarket approvals from the patents of physician-founded firms than from those of non-physician-founded firms.¹⁴

National experience with training in biomedical innovation and entrepreneurship

The role of DITs in Australian biomedical innovation and entrepreneurship has received little attention from researchers, and not much is known about current levels of activity.

Quality and safety improvement projects for junior doctors are now offered, albeit in selected hospitals in Victoria and Western Australia. These seek to develop skills and leadership in medical service safety and quality improvement.^{15,16} The Medical Service Improvement Program in WA includes 3 months' work on a quality improvement project.¹⁵ Throughout the program, junior doctors are offered supervision and mentorship, attend lectures, and visit non-health industry locations.

A recent review found that junior doctors entering the health care system are ideally placed to cultivate their interest and expertise in improving the health system.¹⁷ Collaborating with junior doctors rather than with their senior colleagues builds a strong quality culture. In the United States, quality improvement skills are now a core competency for accreditation of residents (ie, the vocational equivalent of DITs in the US) and this has stimulated quality improvement training in medical curricula.

The crisis in clinical academia and need for integrated pathways and structures for development of clinical academic careers has been widely discussed in Australia and overseas.¹⁸ There is a clear need for more medical practitioners to incorporate research, education and leadership dimensions into their clinical duties.¹ Interest in clinical academia is high among medical graduates — up to 56% of Australian medical students express interest in including research in their careers.¹⁹ Several universities in Australia now offer dual MBBS/PhD degrees, with the aim of strengthening clinical academic training.

Benefits of increased training in biomedical innovation and entrepreneurship

Trainees, health services that employ trainees, the Australian community, research institutions and biotechnology companies all stand to benefit from greater development of innovation skills and knowledge. A number of academic articles explore the effectiveness of residents' and trainees' participation in curriculum redesign, clinical guideline implementation and quality improvement teams.²⁰ Intuitively, health services are more likely to attract and retain a higher-quality workforce if they provide innovation-friendly positions.

Risks of increased training in biomedical innovation and entrepreneurship

Time away from clinical positions (part-time or full-time) means longer training, but evidence for compromised clinical learning as a result is slight.²¹ Greater non-clinical activities may draw medical practitioners out of clinical practice, but the effects of this remain to be empirically explored. The impact of a potential reduction in full-time equivalent DITs in clinical care owing to non-clinical activities (eg, research and innovation) should be tracked carefully. Population-based studies such as the Medicine in Australia: Balancing Employment and Life (MABEL) study enable such tracking.

Recommendations

To enhance innovation and entrepreneurship training for DITs, we recommend the following strategies.

Explore interest and engagement: Studies are required to better understand motivations for, perceived benefits of and detriments of engagement in innovation activities.

Encourage interest: A cultural change to enhance the focus on innovation in health care is needed. This could be brought about by advocacy, mentorship, education programs and grant funding schemes. Interest in innovation should be encouraged throughout the medical career continuum. Coordinated and strong agency-led leadership is important. The Australian Academy of Health and Medical Sciences may be a suitable leadership organisation.

Develop structured education, mentorship and coaching programs: These would enable freer interchange between researchers and the biotechnology, pharmaceutical and investment industries, and would embed a greater commercialisation culture in research.

Enhance flexibility of training pathways: This would include opportunities for breaks in training and allocation of protected time for innovation-focused occupations, which could be counted towards training requirements.

Develop funding incentives to drive research and innovation: Universities, health and hospital systems need to be effectively incentivised to promote innovation.

Australia has a strong biotechnology sector, within which a stronger innovation-skilled medical workforce could be developed. In developing such a workforce, it is important to focus on training DITs as they are our future workforce.

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