Research in the Medical Curriculum
Volume 1

A Window on Innovation and Good Practice

March 2022
Message from the Chair

The Research Committee of Medical Deans Australia and New Zealand (Medical Deans) was established as a standing committee in recognition of the importance of training our future doctors within the context of evidence-based medicine and ensuring they have the foundational research skills needed to become good doctors.

As Chair of the Research Committee, I am proud to introduce the first annual volume of case studies to be published under the auspices of the committee, Research in the Medical Curriculum in Australia and New Zealand 2021 – a window on innovation and good practice. The eight case studies included here illustrate the breadth and quality of research in the curriculum underway within the 23 medical schools in Australia and New Zealand.

Publication of this volume comes at a time when Medical Deans is working together with other stakeholders to try to strengthen the training pathway for clinician researchers in Australia, to ensure we have sufficient numbers of medical students and doctors choosing to build a career in both research and clinical practice. The clinician researcher training pathway begins in medical school, and it is at this point that we hope to win over those students with a talent for and interest in research.

The importance of medical research has come to the forefront in the last two years as we have lived through the devastating impacts of the COVID-19 pandemic. It is a good time to get the message out that medical research is fundamental to driving innovation and high-quality healthcare for our populations. Within these pages is a picture of how medical schools are currently delivering this message to their students through good practice, notable and innovative programs of research in the curriculum.

I commend these case studies to you and congratulate all the contributing schools and researchers on their fine work.

Distinguished Professor Annemarie Hennessy AM
Chair, Research Committee
Medical Deans Australia and New Zealand
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Introduction

Despite challenges to work practices and time due to the impacts of COVID-19, we received a great response to our call for Expressions of Interest (EOIs) in contributing to the inaugural volume of case studies on research in the curriculum, to be published by the Research Committee of Medical Deans Australia and New Zealand (Medical Deans).

The 31 EOIs we received from medical schools in Australia and New Zealand were reviewed by committee members and a short list of 14 presented to the full Research Committee for consideration. This volume presents the eight case studies selected through that process.

Each case study truly exemplifies the high quality curricular research education occurring across all medical schools in Australia and New Zealand. All the programs described are grounded in strong pedagogical practice and naturally share common features in program design; yet each one is also unique, reflecting the individual school’s mission and context.

Some show how research training programs are demonstrating mutually beneficial research and community partnerships, with research learning outcomes being equally important to clinical placements.

Others demonstrate how schools have overcome the tyranny of large numbers of students by creatively adapting relevant and immersive training to provide a quality research training experience for every individual student.

Interestingly, most of the research programs profiled in this volume – even though some were established over a decade ago – highlight how schools are continually innovating and improving the research training content of their curricula.

Most importantly, each case study provides evidence of good practice in integrating foundational research skills with clinical learning. Wher-ever their careers take them, we want all our medical graduates to realise the importance to their clinical practice of the science and research upon which medicine is based.

Professor Di Eley & Professor Kathryn Hird
Members, Research Committee
Medical Deans Australia and New Zealand
Building research capacity for rural and regional medical students – University of Wollongong

University Affiliation
University of Wollongong (UOW)

Title of the Program
Research and Critical Analysis program, UOW Medical Program

Team Members
A/Prof Judy Mullan (Academic Director: Research, Graduate School of Medicine, Science, Medicine and Health Faculty, University of Wollongong)
A/Prof Kylie Mansfield (Director of Curriculum, Graduate School of Medicine, Science, Medicine and Health Faculty, University of Wollongong)
Dr Christine Metusela (Lecturer: Research and Critical Analysis, Graduate School of Medicine, Science, Medicine and Health Faculty, University of Wollongong)

Date the project commenced
2011

Why was the program undertaken?

An increasing international focus on building research capacity among medical practitioners\textsuperscript{1-5}, and the aspirations of the Australian Medical Council (AMC) to improve the research skills of graduating medical doctors\textsuperscript{6}, together highlight the need for medical schools to develop their students’ research skills. However, engaging medical students in developing their research and critical appraisal skills is universally regarded as a challenge.

Many graduating doctors believe their knowledge of basic research skills is lacking and that they have limited experience with research\textsuperscript{7,8}. Similarly, while the majority of the Australian specialist college research curricula (n=58) have a scholarly research requirement, only 11 of these require formal research training and only two require experienced research supervision\textsuperscript{9}.

The Research and Critical Analysis (RCA) program within the medical program of the University of Wollongong (UOW) represents a departure from more conventional attempts to develop medical student research capacity in that it is integrated within the MD program and prepares students for an authentic research experience when on their longitudinal clinical placements. These approaches have been shown to promote a culture of research awareness in new graduates and can positively influence the development of a professional identity as a clinician researcher.

The program is modelled on Boyer’s suggested four domains of academic scholarship: discovery, integration, engagement and the scholarship of teaching\textsuperscript{10}. Students embrace the scholarship of discovery through their RCA lectures and assessment tasks, especially during the earlier phases of the MD program, and engage with their communities by undertaking research relevant to the community during the later phases. Boyer’s scholarship domains are also reflected in the integration of RCA learning outcomes into the MD program, and the subsequent integration of the students’ newly developed skills in research within the clinical and community settings of their placements, as they undertake their research projects.
How was the program implemented?

When first introduced in 2007, the UOW RCA program followed a traditional focus on statistical analysis as an example of research skill development. However, it received negative student feedback regarding this more traditional approach, providing the catalyst to revisit and redesign the program. As part of the redesign implemented in 2011, we embedded and integrated RCA throughout the four-year graduate-entry MD program. We also continued to seek student feedback, as well as detailed feedback from internal and external peer reviewers, helping to build coherence within the program.

Rather than provide one-off or disconnected lectures and teaching of research methods, we anchored and integrated the RCA program within all four phases of the degree (Figure 1). The program is characterised by its alignment with medical sciences and the clinical curriculum, its longitudinal nature and the students’ progressive development of research skills – culminating in their capacity to undertake their own research project with and without supervision and mentoring.

Nine RCA learning outcomes (Table 1) were used to guide the development of the program, ensuring that RCA principles being taught during the early phases (Phases 1 and 2) were fully integrated with the scientific and clinical content. The later phases build on this by incorporating rigorous critical analysis and research experience, with students undertaking a supervised research project in Phase 3, and independent reflective and critical evaluation of evidence-based practice in the clinical environment in Phase 4.

Figure 1: UOW Graduate School of Medicine MD Curriculum
### Table 1: Research and Critical Analysis Program Learning Outcomes

<table>
<thead>
<tr>
<th>RCA Program Learning Outcome</th>
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<tbody>
<tr>
<td>RCA01 Locating and accessing scientific and clinical information</td>
</tr>
<tr>
<td>RCA02 Critically evaluating and utilising information for solving problems and making evidence-based decisions relevant to the health of individuals and/or populations</td>
</tr>
<tr>
<td>RCA03 Continually seeking improved solutions/practices for positive organisational, social and cultural change</td>
</tr>
<tr>
<td>RCA04 Relate health services, social determinants of health and the burden of disease</td>
</tr>
<tr>
<td>RCA05 Appropriately interpret, appraise and use statistics and data</td>
</tr>
<tr>
<td>RCA06 Recognise appropriate research methods/study design and interpret results</td>
</tr>
<tr>
<td>RCA07 Set and test research hypotheses and/or research questions</td>
</tr>
<tr>
<td>RCA08 Interpret evidence-based medicine and clinical guidelines</td>
</tr>
<tr>
<td>RCA09 Identify and justify primary, secondary and tertiary prevention of disease</td>
</tr>
</tbody>
</table>

The redesigned program aligns with the spiral curriculum structure of the MD program and includes assessment tasks throughout its duration, which are designed to demonstrate development of RCA knowledge, skills and attributes linked to the learning outcomes (Table 2).

### Table 2: Research and Critical Analysis Knowledge, Skills and Attributes demonstrated by students across the four Phases of the UOW MD program

<table>
<thead>
<tr>
<th>Knowledge/Skills/Attributes</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Ethics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Ethics application</td>
<td>A</td>
<td>A</td>
<td>B, C</td>
<td></td>
</tr>
<tr>
<td><strong>2. Information Literacy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Conduct a comprehensive search of the relevant literature</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>2.2 Evaluate and search for relevance, comprehensiveness and scientific merit</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td><strong>3. Research methods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Define a research question/idea</td>
<td>A</td>
<td>B</td>
<td>C, D</td>
<td>C, D</td>
</tr>
<tr>
<td>3.2 Write a research proposal</td>
<td>A</td>
<td>B</td>
<td>C, D</td>
<td>C, D</td>
</tr>
<tr>
<td>3.3 Use and understand quantitative research methods</td>
<td>A</td>
<td>B</td>
<td>B, C, D</td>
<td></td>
</tr>
<tr>
<td>3.4 Use and understand qualitative research methods</td>
<td>A</td>
<td>B</td>
<td>B, C, D</td>
<td></td>
</tr>
<tr>
<td>3.5 Use and understand basic statistical concepts</td>
<td>A, B</td>
<td>B</td>
<td>C, D</td>
<td>C, D</td>
</tr>
<tr>
<td>3.6 Analyse and interpret results</td>
<td>A</td>
<td>B</td>
<td>C, D</td>
<td>C, D</td>
</tr>
</tbody>
</table>
Miller’s pyramid was used as a framework to demonstrate students’ progression through their research skill development, commencing as research novices in the earlier phases and becoming research competent in the later phases. The students’ research knowledge, skills and attributes, as outlined in Miller’s pyramid, could also be described as research competencies (Figure 2). Development of these research competencies leads to increased levels of research understanding, sophistication and proficiency, which contributes to the long-term goal of graduating research-aware doctors who can practise evidence-based medicine.

**Figure 2: Miller’s pyramid illustration of how UOW GSM Medical students progress through phases 1-4**

**Phase 1 (18 months, university-based)** focuses on delivering content typical of the research paradigm, through lectures, Journal Club presentations, discussions and assessment tasks. Moving away from old-style statistical methods, students are taught skills in literature searching, critical analysis, interpreting statistics, research methods and evidence-based medicine.

The unique feature of delivery, which appeals to the students, is the way RCA principles are integrated with the scientific and clinical content of the particular body system block being taught. For example, students learn how to interpret systematic reviews and meta-analyses during the Cardiovascular and Respiratory block, discussing the scientific and clinical evidence around the use of statins for hypercholesterolemia and cardio-vascular mortality prevention, whilst learning the basic and clinical pharmacology of statin actions. Other examples include: teaching principles of screening specificity and sensitivity in the context of bowel cancer, and burden of disease in the context of diabetes. The interactive Journal Club, embraced by students, encourages teamwork and promotes presentation skills in a supportive environment, and further extends student learning within a framework of the clinical and medical sciences.
Phase 2 *(12-months, hospital-based clinical placements)* involves seven clinical rotations, during which students apply the knowledge gained in Phase 1 to critically appraise clinical practices relevant in a hospital setting. Here they identify the use of evidence-based guidelines, and lead and participate in clinical team Journal Clubs. In order to encourage further specific learning for individual students within the context of their speciality hospital rotations, students complete RCA assessment tasks which focus on the critical appraisal of drug advertisements and patient-oriented evidence that matters. This assessment choice has routinely inspired students to organise their own special interest groups to undertake additional study within specific clinical research areas.

Phase 3 *(12-months, regional/rural community-based clinical placements)* all students undertake a research project while on their 12-month clinical placement, culminating with a manuscript style project report and a conference style poster presentation. The research project aims to consolidate and expand on the research and critical appraisal skills introduced in earlier phases of the RCA program. The projects are supervised and mentored by UOW academics and clinicians, and supported by practical online research resources. The majority of the research projects relate to community issues and national health priority areas.

Phase 4 *(six-months, advanced elective training and preparation for medical internship)* involves students working independently to complete a case study or a professional practice reflection as part of the capstone assessment task, independent of research-academic supervision or mentoring. This is reported in a format suitable for submission to a journal and also as a conference-style oral presentation. This capstone project is a reflective and critical evaluation of evidence-based practice in the clinical environment.

What is the program achieving?

**National Recognition of the RCA Program**

The RCA program has attracted national and international interest, and received a Program Award for University Teaching from the Australian Awards for University Teaching (AAUT) in 2016, as well as an Australian Office of Learning and Teaching (OLT) citation award in 2015. The program surpasses the AMC curriculum standard – to encourage, prepare and support student engagement in medical research, by engaging individual students with all aspects of research throughout their entire medical course.

**Improvement in student engagement and capacity for research**

Student evaluations after the redesigned RCA program was first implemented in 2011 indicated strong agreement that their learning was being supported, that there were clear learning objectives and that they were overall satisfied with the RCA teaching program.

In addition, we have evidence that our RCA program has contributed to statistically significant increases in nine of the ten research areas highlighted in *Figure 3* (below). The only research area which did not improve was applying for research funding, which is not taught as part of the program.
Positive Impact on Community Placements

As mentioned above, the majority of the research projects relate to community issues and national health priority areas. An audit of the topics of medical student research projects over a 10-year period indicated that 70% aligned with the Australian Institute of Health priority areas\textsuperscript{12} and approximately 20% focused exclusively on rural health-related topics. Engaging in health-related research projects while on regional and rural placements has raised the profile of our students in their placement communities and has, at times, resulted in the translation of research findings into practice (e.g. development of patient information resources; changes to GP prescribing practices; the increased uptake of interpreter services in a regional Emergency Department).

Research Capacity Building of Medical Graduates

Our RCA program has been successful in graduating medical students who are research aware and research competent, enhancing their capacity to undertake research of their own and to practice evidence-based medicine. To date, over 800 of our medical student research projects have been successfully completed, with at least 60 of them being published in peer-reviewed journals and presented at national/international conferences.

The program demonstrates the possibility of providing a meaningful and sustainable total research experience during medical school and a strong base for life-long learning and evidence-based medicine practice. It has also inspired a number of our graduates to pursue higher research degrees (PhDs and research Masters) in different fields, such as rehabilitation and palliative care. Other graduates have gone on to conduct research and publish papers based on their specialty training programs.

Figure 3: Research experience scores of three consecutive medical student cohorts (n=221) pre and post completion of their Phase 3 research projects\textsuperscript{13}
Goals for the future

With a view to fostering more clinician interest in research and achieving RCA program sustainability, we have forged strong links with university-wide research groups and external providers, including the Illawarra Shoalhaven Local Health District (ISLHD), the Australian Health Service Research Institute (AHSRI), the Centre for Health Research Illawarra Shoalhaven Population (CHRISP) and the Illawarra and Southern Practice-based research network (ISPRN). These collaborative partnerships will play a key role in the sustainability and continued success of the RCA program. We also anticipate that these partnerships will help to encourage research capacity building for clinicians external to the University, who may be new to research and would benefit from being mentored or supervised by experienced academics from the University.

Acknowledgements

We wish to acknowledge the contribution of RCA staff over the years: Professor Peter McLennan; Professor John Bushnell; Associate Professor Kathryn Weston; Dr Warren Rich; Dr Pippa Burns; Ms Shelley Crowther; Dr Susan Thomas; Dr Megan Kelly.

References

Using team-based learning to teach evidence-based medicine – University of Sydney

<table>
<thead>
<tr>
<th>University Affiliation</th>
<th>University of Sydney</th>
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<tbody>
<tr>
<td><strong>Title of the Program</strong></td>
<td>Rapid Evidence for Practice modules, Doctor of Medicine (MD)</td>
</tr>
<tr>
<td><strong>Team Members</strong></td>
<td>Deonna Ackermann (<em>Clinical Epidemiology, School of Public Health, University of Sydney.</em>)</td>
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<td>Sharon Reid (<em>Clinical Epidemiology, School of Public Health, University of Sydney.</em>)</td>
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<td>Annette Burgess (<em>Education Office, Sydney Medical School, University of Sydney.</em>)</td>
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<td></td>
<td>Fiona Blyth (<em>Clinical Epidemiology, School of Public Health, University of Sydney.</em>)</td>
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<tr>
<td><strong>Date the project commenced</strong></td>
<td>2020</td>
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</table>

**Why was the program undertaken?**

Prior to introducing its new research framework in 2020, the University of Sydney Medical School taught evidence-based medicine (EBM) as a one-week intensive program scheduled late in Year 1. Content was delivered through mandatory face-to-face lectures and small group practical workshops. However, feedback suggested that students could not engage with the large amount of content delivered in traditional lectures and, while the critical appraisal workshops were well received, students had not retained content from the lectures and were not ready to apply it. Many students reported that they did not see the practical and clinical relevance of EBM.

EBM and research methods are core components in medical education curricula globally. Best methods for effective teaching of EBM have not been definitively determined, however two key strategies have emerged for optimising curriculum delivery. First, clinical integration of EBM teaching is likely to bring about changes in student skills, attitudes and behaviour. Second, blended interactive approaches, when compared with traditional didactic methods, have been shown to be more effective in improving student attitudes towards, and increasing self-reported use of, EBM in clinical practice. Additionally, the blended learning approach has associated efficiencies, such as freeing up in-class time for student participation in active learning, and cost-effectiveness of delivery, which leads to improved value for institutions with repeated iterations.

Team-based learning (TBL) has gained popularity in medical education, in line with the expansion of student-centred learning strategies, including flipped learning approaches and peer-assisted learning. TBL uses active, collaborative learning strategies to provide an authentic experience of approaching a clinical problem. TBL classes have been shown to provide an enhanced learning environment where students can build on basic knowledge and apply what has been learnt. The classic TBL framework is illustrated in *Figure 1*. 


<table>
<thead>
<tr>
<th>Phase 1: Preparation</th>
<th>Students read study material or view pre-recorded lectures independently.</th>
</tr>
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<tbody>
<tr>
<td>Phase 2: Readiness Assurance</td>
<td>Learners complete an individual readiness assurance test (IRAT) to assess their understanding of facts and concepts learnt in Phase I. The same test is administered to teams of 5 to 7 learners. The team forms a consensus about each answer in this group readiness assurance test (TRAT).</td>
</tr>
<tr>
<td>Phase 3: Application</td>
<td>Students work in teams to apply Phase 1 and 2 knowledge to real-world complex problems.</td>
</tr>
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</table>

Figure 1: TBL framework

In 2020, The University of Sydney Medical School launched a new curriculum and course structure for its four-year graduate MD program, with Research, Evidence and Informatics established as a vertical theme. The aims of the revised EBM curriculum were to ensure student competency in EBM learning outcomes, emphasise the clinical relevance of EBM, and improve student engagement and application of EBM teaching. The new program shifted EBM teaching from didactic face-to-face lectures to interactive, student-centred and clinically integrated modules.

We used a modified TBL framework to develop Rapid Evidence for Practice (REP) modules that would provide students with EBM knowledge and skills, and prepare them to apply evidence within short timeframes – simulating real world clinical contexts.

How was the program implemented?

In the revised curriculum, EBM teaching is integrated into the Back to Basics (B2B) block, a nine-week term in Year 2, which introduces students to a range of clinical specialties, from paediatrics to aged care, following the human lifespan. This formal coursework program also provides foundational knowledge of research methods prior to students undertaking projects in a dedicated 14-week MD Research Project Block in Year 3.

EBM content is informed by the Australian Medical Council (AMC) guidelines and a set of core competencies developed for health professionals. The course design allows for a rapid change to online only format, if necessary, due to the uncertainty created by the Covid-19 pandemic regarding face-to-face teaching options. A logic model is used as a guide in developing, implementing and evaluating REP modules (Table 1).
Table 1: REP modules Logic Model

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Activities</th>
<th>Participation</th>
<th>Outcomes</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student time</td>
<td>REP modules comprising: Online videos Readiness quiz Forum REP activity Feedback session</td>
<td>Readiness quiz submission Zoom attendance Canvas data analytics Decision map submission</td>
<td>Student acceptance of REP modules. (Student survey) Feasibility of REP modules. (Staff review, participation data) Increased EBM knowledge and skills: (Decision Map meet expected standards Students’ performance in REI questions in KAT exam)</td>
<td>Learning objectives met (Document review) Student acceptance Higher engagement Students better prepared for MD project Students are prepared for practice</td>
</tr>
</tbody>
</table>

Four REP modules were developed, with each module focussing on a specific EBM study design in the following sequence: Randomised Controlled Trials, Systematic Reviews, Observational studies, Diagnostic Test Evaluations. An REP module development guide was created for each module (see Appendix, Table 2), detailing learning objectives, content suggestions, activities and assessment tasks, and ensuring consistency in structure.

The REP module structure (Figure 2) comprises online informational content, an individual readiness quiz, a forum featuring a guided critical appraisal, and a student team-based rapid appraisal and application of a published article to a clinical scenario.

Based on our previous experience of students not recognising the clinical importance of EBM and requiring considerable additional support to complete application tasks, we expanded the readiness assurance phase of REP modules to include an additional live forum. The forum features a panel session with real world clinician researcher experiences, a guided critical appraisal task led by our teaching team, and an opportunity for questions and discussion providing students with targeted appropriate knowledge and skills to apply in the subsequent REP activity.

Preparatory phase – 2 hours, online

1. Series of short videos provide information on basic concepts.
2. Students read the journal article for the REP activity.

Readiness assurance phase – 3 hours, online and/or face to face

3. Individual Readiness quiz (RQ).
4. Forum - Panel session with clinician researchers who discuss their research involvement, career path and how they use evidence in patient management.
5. Forum - Critical appraisal walkthrough. Interactive, practical session where students are guided through a rapid appraisal of a journal article.
Application phase – 2 hours, online and/or face to face

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<tbody>
<tr>
<td>7.</td>
<td>REP activity - Working in teams of 4-5, students use critical appraisal skills to solve a clinical problem.</td>
</tr>
<tr>
<td>8.</td>
<td>REP activity - Facilitator feedback on student responses. Summary of session.</td>
</tr>
<tr>
<td>9.</td>
<td>REP activity - Assessment: submission of a team Decision Map.</td>
</tr>
<tr>
<td>10.</td>
<td>Feedback - Individual and year group feedback on Decision Map.</td>
</tr>
</tbody>
</table>

**Figure 2: REP module structure**

In REP activities, students are given a clinical scenario and a relevant journal article, and they work through a series of questions with facilitator clarification of challenging questions. A summary of the session is then provided to the cohort. After the REP activity, students finalise and submit as a team a Decision Map (see Appendix, Figure 3), which illustrates how evidence, clinical knowledge and patient values intersect. General feedback on the Decision Map is provided to the cohort and direct feedback is provided to teams if a rubric element does not meet the expected standard.

**What is the program achieving?**

**Evaluation methods**

In May 2021, Year 2 medical students completed a REP module on randomised controlled trials (RCTs). A mixed methods approach to evaluation included:

1. Curriculum document analysis to assess content coverage of core EBM competencies.
2. Student acceptance assessed using a questionnaire distributed immediately following the REP activity.
3. Review of student participation and task completion using learning management system analytics (see Appendix).

**Document review**

Online videos, forum critical appraisal PowerPoint presentations and REP activity tasks were reviewed to determine the extent of their alignment with learning objectives specific to the RCT module and EBM competencies. The document review indicated that learning objectives specific to the RCT module were covered adequately. EBM competencies – including asking a focussed clinical question, applying the PICO framework to research questions, critical appraisal of a journal article and the application of research results to a clinical problem – were met. While acquiring appropriate evidence could be included within the REP module framework, we did not do so, due to time allocation constraints within the Back to Basics Block. Students have a separate lecture and access to library modules on literature searching.

**Student experience of the REP module.**

In total, 55/258 (21%) of participants completed the post-module questionnaire. Student responses to closed items regarding their experience of REP modules are presented in Figure 3 (see Appendix). The overall response was positive, with 81% of students agreeing or strongly agreeing that they were satisfied with this method of teaching. Responses to items 1–2 indicate that the preparation stage worked well, with 91% agreeing that short online videos were their preferred method of acquiring basic knowledge and 83% completing the pre-readings. Responses to items related to the readiness
assurance phase were similarly positive, with 79% agreeing that the RQ improved understanding of concepts and 83% agreeing that the critical appraisal walk-through prepared them for the REP activity. Notably, 91% of students agreed that REP helped them develop a way to use evidence to approach clinical questions.

Students’ responses to open-ended questions are illustrated in Table 3 (what students valued) and Table 4 (what could be improved) in the Appendix. Students valued the overall structure of REP modules due to the staged transition from knowledge acquisition to practice to application: “The stepwise approach to learning. The process has been very methodical and logical”. In addition, each component was valued for its role in the process. Short online videos were perceived as an effective method of delivering basic content: “The online videos are really good, easy to listen to and understand and not too long. They give a really good foundation of concepts that get reiterated in the activities”. The readiness assurance phase was valued as a practice task and REP activities were valued as real-life simulations: “It is good to have the chance to appraise an article and put the theory into practice in a manner very similar to how it would be in real life.” In addition, REP modules were perceived by students as being useful for their future career: “Very useful for me as I engage in the latter years of my training.”

Suggested improvements included avoidance of repetition of basic content in the readiness assurance phase and changes to the clinician researcher presentations, which some students did not perceive as relevant: “The lectures with research examples do not benefit my learning. I feel like the information they give only apply to that one research project and nothing else”. Students also suggested expanded Q&A sessions, more practice activities, shorter duration of classes (two hours) and avoidance of replication of administrative tasks.

Task completion

All student groups submitted their Decision Maps and only one student from the cohort of 258 did not complete the RQ.

Discussion

We evaluated the REP module on RCTs embedded in Year 2 based on content, student participation and acceptance. Students found the TBL structure effective for their learning, enabling application of new knowledge to clinically relevant problems that may be encountered in their future careers. Student participation in the RCT REP module activities was high, with 100% completion of the outcome assessments.

Some challenges we faced related to the introduction of a new teaching intervention, including the need for clarity regarding new terminology and scheduling of tasks. A welcome video explaining REP modules was created, all activities were included in students’ calendars and the assessment page detailed a timetable for the release of learning materials and due dates. There was some duplication of administrative tasks for students, which will be improved. Staff found it challenging to identify journal articles of an appropriate difficulty level for medical students that allowed them to focus on appraisal and application of EBM concepts and skills. Students have different levels of prior experience in critical appraisal, suggesting the need for additional targeted training in future iterations.

The REP framework has successfully shifted our EBM and research methods teaching from didactic face-to-face lectures to interactive and clinically integrated modules. Students build on basic knowledge with practice activities and gain real-world experience in the rapid appraisal and application of EBM to clinical problems. The REP activity is an authentic task which promotes student
collaboration, reflection and communication, with support from expert input. It provides students with the experience of small group learning in a large group setting, reducing the number of teaching sessions and facilitators required. In addition, REP modules can be run completely online, which provided a safeguard during the Covid-19 pandemic.

References
### Table 2: RCT Module development guide

<table>
<thead>
<tr>
<th>INTERVENTION STUDIES (B2B WEEKLY THEME - ADULT ACUTE)</th>
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</thead>
<tbody>
<tr>
<td><strong>Learning Objectives:</strong> At the end of this REP module on RCTs students should be able to:</td>
</tr>
<tr>
<td>• explain why randomised controlled trials are conducted;</td>
</tr>
<tr>
<td>• explain how appropriate randomisation and allocation concealment can be achieved and why this is important;</td>
</tr>
<tr>
<td>• describe the importance of blinding in RCTs;</td>
</tr>
<tr>
<td>• explain how loss to follow up can bias results;</td>
</tr>
<tr>
<td>• explain why an intention to treat analysis is important;</td>
</tr>
<tr>
<td>• critically appraise a randomised controlled trial for risk of bias;</td>
</tr>
<tr>
<td>• apply the evidence - assess applicability and individualise results; and</td>
</tr>
<tr>
<td>• communicate research methods and results.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Online Content</th>
<th>Forum</th>
<th>REP activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated time</td>
<td>2 hours of student time</td>
<td>3 hours</td>
</tr>
<tr>
<td>Delivery</td>
<td>Online (Canvas)</td>
<td>Face to face or online (Zoom)</td>
</tr>
<tr>
<td>Development Tasks</td>
<td>1. Develop a series of 5-10 minute of PowerPoint lectures (slides and script). These will be recorded for online use.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Identify RCT for REP activity and provide as reading.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Identify other reading material if you think appropriate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Develop Readiness Quiz to be completed online. (RQ = 5 MCQs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Identify panel speakers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Expert experience</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MD project possibilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• B2B theme</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Develop panel discussion points.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Critical appraisal walk-through: Develop clinical scenario and identify paper</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Develop student activities as detailed below.</td>
<td></td>
</tr>
<tr>
<td>Content suggestions</td>
<td>1. What is an RCT?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Randomisation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Allocation Concealment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Baseline characteristics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Blinding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Loss to Follow up</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Intention to treat analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Panel discussion AND/OR keynote speaker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Introduction to critical appraisal Guided appraisal of one paper. Efficacy of paracetamol for acute low-back pain: a double-blind, randomised controlled trial. Activity/Worksheet/small group discussions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Q&amp;A session</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Integrate additional content from theme of week if possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Identify RCT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Develop appropriate clinical scenario</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Develop student tasks using provided REP session guideline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Develop task in Kuracloud</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Provide model answers/Decision Map rubric and exemplar.</td>
<td></td>
</tr>
<tr>
<td>Blooms Taxonomy</td>
<td>remember, understand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>remember, understand, apply, analyse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>remember, understand, apply, analyse, evaluate, create</td>
<td></td>
</tr>
<tr>
<td>Assessment</td>
<td>Readiness Quiz</td>
<td>Decision Map</td>
</tr>
</tbody>
</table>
1. CLINICAL SCENARIO
   P
   I
   C
   O

2. RESEARCH STUDY
   P Inclusion criteria
   I Exclusion criteria
   C
   O Primary
   Secondary

3. Comment on relevance - Does the study provide a direct enough answer to your clinical question in terms of patient, intervention, and outcomes?

EVIDENCE
1. Comment on each ROB question and make a judgement.
2. Summarise the results. (Primary outcome and patient relevant secondary outcomes)

APPLY AND INDIVIDUALISE
1. Is the treatment feasible for the patient – consider cost and setting?
2. What are our patient’s potential benefits and harms from the therapy?
3. What are your patient’s likely values and expectations for both the outcome we are trying to prevent and the adverse effects we may cause?

Clinical Decision: Describe the results to your patient
Short online videos are my preferred method for learning basic knowledge.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>62%</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I was well prepared for participation. (e.g. read the assigned pre-readings)  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>56%</td>
<td>11%</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

Reviewing the Readiness Quiz questions allowed me to correct mistakes and improved my understanding of concepts.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>35%</td>
<td>44%</td>
<td>16%</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

Presentations from clinician researchers provided valuable and helpful real-world examples of research in practice.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>16%</td>
<td>51%</td>
<td>11%</td>
<td>20%</td>
<td>2%</td>
</tr>
</tbody>
</table>

The forum critical appraisal walk-through prepared me to engage in REP session activities.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>56%</td>
<td>5%</td>
<td>11%</td>
<td></td>
</tr>
</tbody>
</table>

REP activities helped me develop a way to use evidence to approach clinical questions.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>24%</td>
<td>67%</td>
<td>9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All team members made an effort to participate in discussion.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>49%</td>
<td>35%</td>
<td>2%</td>
<td>15%</td>
<td></td>
</tr>
</tbody>
</table>

Immediate feedback from a content expert helped increase my confidence.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>24%</td>
<td>49%</td>
<td>24%</td>
<td>2%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Overall, I am satisfied with this approach to teaching EBM.  

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>62%</td>
<td>13%</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4: Student experience of the REP module*
## Table 3: Valued aspects of REP modules

<table>
<thead>
<tr>
<th>Emerging Themes</th>
<th>Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td></td>
</tr>
<tr>
<td>The content was perceived as relevant</td>
<td></td>
</tr>
<tr>
<td>The level of difficulty was appropriate</td>
<td>Information was relevant and aimed at our level of understanding</td>
</tr>
<tr>
<td>The content was perceived as being useful for future career</td>
<td>I often found that I would be quite slow getting through research papers and this rapid-fire approach is very useful for me as I engage in the latter years of my training.</td>
</tr>
<tr>
<td>A framework for critical appraisal was valued</td>
<td>Can see myself using this strategy as a clinician in the future</td>
</tr>
<tr>
<td>Effective overall REP module structure</td>
<td></td>
</tr>
<tr>
<td>Students valued the structure of REP modules as knowledge was built, consolidated, and then applied</td>
<td>The stepwise approach to learning. The process has been very methodical and logical</td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
<td></td>
</tr>
<tr>
<td>Short online videos were perceived as an effective method of delivering basic content</td>
<td>The online videos are really good, easy to listen to and understand and not too long. They give a really good foundation of concepts that get reiterated in the activities.</td>
</tr>
<tr>
<td>Concise</td>
<td>Videos were succinct and explained information well.</td>
</tr>
<tr>
<td>Quality of video</td>
<td>The online videos were very concise and well made.</td>
</tr>
<tr>
<td>Clarity of explanations</td>
<td></td>
</tr>
<tr>
<td><strong>Readiness assurance</strong></td>
<td></td>
</tr>
<tr>
<td>The readiness assurance phase was valued</td>
<td>The quiz challenged me to learn</td>
</tr>
<tr>
<td>The RQ motivated students to prepare</td>
<td></td>
</tr>
<tr>
<td>Critical appraisal walk throughs</td>
<td>Walk-through followed by practical session was good</td>
</tr>
<tr>
<td><strong>REP activities</strong></td>
<td></td>
</tr>
<tr>
<td>REP activities were valued as an opportunity to apply knowledge</td>
<td>It is good to apply our knowledge to a case scenario soon after learning the concepts.</td>
</tr>
<tr>
<td>REP activities were valued as real life simulations</td>
<td>It is good to have the chance to appraise an article and put the theory into practice in a manner very similar to how it would be in real life.</td>
</tr>
<tr>
<td><strong>Clinical Integration</strong></td>
<td></td>
</tr>
<tr>
<td>Students value clinical integration in EBM teaching</td>
<td>Realistic application of how we might use research in clinical practice</td>
</tr>
<tr>
<td><strong>Feedback</strong></td>
<td></td>
</tr>
<tr>
<td>Students value feedback via the Zoom Chat</td>
<td>It was great that the questions from Zoom chat etc were addressed quickly.</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td></td>
</tr>
<tr>
<td>Students reported that assessment tasks were appropriate</td>
<td>I also enjoyed the REP decision map, as I believe it’s extremely helpful in making us critically analyse research.</td>
</tr>
</tbody>
</table>
### Table 4: Improvements suggested by students for REP modules.

<table>
<thead>
<tr>
<th>Emerging themes</th>
<th>Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinician researcher presentations</td>
<td>The lectures with research examples do not benefit my learning. I feel like the information they give only apply to that one research project and nothing else.</td>
</tr>
<tr>
<td>Clinician researcher presentations could be more structured</td>
<td>The panel discussion of clinicians/researchers sharing their experiences could benefit from structure (e.g. Common questions, downfalls or weaknesses seen in the field). Having slides or other presentation material could help.</td>
</tr>
<tr>
<td>Repetition of basic content</td>
<td>Each concept reiterated at least 3 times (prework, forums, Kuracloud activity, recap forum), which seemed excessive.</td>
</tr>
<tr>
<td>Readiness Assurance phase</td>
<td>I believe that there could have been more practice activities, like there were in the first two weeks, rather than just the readiness quiz.</td>
</tr>
<tr>
<td>Feedback</td>
<td>An opportunity for feedback and questions would be much more beneficial in terms of learning and efficiency (than repeating basic content).</td>
</tr>
<tr>
<td>Effective use of time</td>
<td>This process was a bit repetitive from Kuracloud to Canvas submission, etc.</td>
</tr>
</tbody>
</table>
MD Research Training Pathway – University of Notre Dame Australia

University Affiliation
University of Notre Dame Australia

Title of the Program
Research Training Pathway for the MD (Fremantle)

Team Members
Professor Kathryn Hird (Developer, academic administrator of the research training pathway; research pathway tutor)
Dr Raoul Oehmen (Co-developer and academic administrator; research pathway tutor)
Dr Shelley Stone (academic administrator; research pathway tutor). A team of approximately 36 sessional tutors.

Date the project commenced
2017

Why was the program undertaken?
In 2016 the University of Notre Dame Australia School of Medicine Fremantle (UNDAF) undertook curriculum development to align the MBBS degree (Australian Quality Framework level 7 program) with the competencies required of an MD degree (Australian Quality Framework level 9E program) as well as AMC accreditation guidelines. In particular, the curriculum required additional content specific to training clinical scientists. A research training pathway was created to complement the existing curriculum, focussing on evidence-based practice and principles of epidemiology.

The Research Training Pathway is a spiralling curriculum covering all four years of the MD. It engages students from week one and requires them to undertake research training activities throughout the degree (see Figure 1, below). Learning is iterative and each assessment forms part of an overarching, continuous learning portfolio across all domains in the MD.

UNDAF MD: Research training pathway

Figure 1: UNDAF MD: Research training pathway
In first, second and fourth years, assessments in the Research Training Pathway are graded and constitute a small but significant part of each student’s final grade for their year-long unit. In third year, students are enrolled in a separate unit: Systematic Research Inquiry. There are three graded assessments within this unit contributing to an overall ‘non-graded pass’, with the unit being a pre-requisite to progress to the final year of the MD.

The general aim of the Research Training Pathway is to ensure that all medical students understand the research process, from inspiration to publication, and possess sufficient skills for critical review of research outputs as a future clinician.

How was the program implemented?

All Research Training Pathway activities have been designed within an experiential learning paradigm and follow a backward learning design where the final outcome drives the learning objectives along the pathway. The activities are built on the principles of cognitive theory for skill acquisition, articulated and applied by Neil Mehta as “educational mantras” (personal communication Harvard Macy Foundation, 2018). The mantras state that: deep learning occurs when students do the work; frameworks built at the right level allow discussion of exceptions; more time should be spent on conceptual knowledge; a variety of activities help to build conceptual frameworks; students may not know what they don’t know, and assessments are for learning not of learning. In addition, it is important that learning tasks involve a manageable level of intrinsic load, where extraneous cognitive load is reduced so that generative load is fostered and dual coding is promoted.

In the Research Training Pathway, scaffolded learning activities provide opportunities for students to create knowledge through critical review of scientific literature, through the completion of a detailed template, by planning a blue-sky research project and, finally, by applying their knowledge in carrying out a research project from inspiration to publication. There are no lectures; students acquire information implicitly as they engage in the material. Each activity in the first three years of their research training pathway is completed in small groups. Each of the 12 groups per year is facilitated by a PhD-qualified and research-experienced tutor.

Tutors are paid on a sessional basis, thereby reducing the overall cost to the school, and many choose to work with students in all stages of the pathway. A framework has been developed to guide learning and ensure that all students have access to the same learning opportunities. Tutors are provided with detailed handbooks and attend briefing sessions prior to each activity/tutorial, for quality assurance. Students are also provided with a handbook and each activity is supplemented with bespoke learning resources.

The details of the learning activities included in the Research Training Pathway are as follows:

**Activity 1: WikiProject Medicine – six hours in orientation week.**

First year students learn to edit WikiProject Medicine pages as a vehicle to introduce them to the concepts of scientific writing, copyright, primary/secondary/tertiary sources of evidence, and the power of accessible information for education and self-care. This activity takes approximately six hours and utilises the online tutorials available on Wikipedia. Groups of three students work together to make three to four edits to a self-selected WikiProject Medicine page by the end of their orientation week (Week 1). At the commencement of semester two, the students review the status of their edits and present the statistical data reflecting: number of views, whether their edits were removed or changed, if the quality status of the WikiProject Medicine page had changed and if there had been any relevant discussion on the chat page related to their edits.
Activity 2: Journal Article Review (JAR) – six 90-minute online tutorials preceded by a 60-minute tutor briefing.

The journal article review activity involves peer learning in a small group context. Nine novel journal articles are chosen each year in accordance with several criteria – including relevance to the Problem Based Learning (PBL) topic being undertaken at the time of the tutorial and the type of research design and population involved in the research – to ensure that all students are exposed to a range of topics, design and analysis techniques.

Each student in a group of nine selects one of the available articles. That student is then required to read, review and present the essence of that article to their tutorial peers, through a five-minute presentation with a one-slide overview and a number of questions for class discussion. Students then engage their peers in the discussion of these questions/issues, typically covering aspects of the paper that they are struggling to understand. Each tutorial group uses breakout rooms on Zoom so that subgroups of two or three students can discuss each question for 10-15 minutes. The main group then provides further input to the lead student to assist them in completing their template. Each template is assessed summatively. Each student submission for a specific paper (one from each of twelve groups) is graded by a single tutor to ensure equity and to be on the alert for plagiarism.

The template requires that students engage in the publication process, methods of evaluating journal and author performance, research design, aims/research questions, hypotheses, methods, analysis and conclusions. It is a chance to ensure that all students acquire the basic information but also provides other more experienced students with opportunities to fill gaps in their knowledge. The template looks deceptively easy, however it provides a strong structure for learning and is a complex undertaking in that it needs to apply equally to a diverse range of research papers.

Activity 3: Journal Article Review (JAR) – six 90-minute online tutorials preceded by a 60-minute tutor briefing

In second year, students once again engage in a format nearly identical to that of 1st year, with the exception that the questions in the second-year journal article review template require students to engage in higher-order thinking. They are required to make inferences, critically evaluate, compare and contrast research designs, comment on ethical implications and suggest alternative strategies.

Activity 4: Systematic Research Inquiry - one orientation tutorial, six 120-minute tutorials and a tutor training session. All sessions are conducted online.

In third year, all students are enrolled in a separate unit: Systematic Research Inquiry. Students work in groups of 10 and are able to sign up to a tutor-led group, based on availability, tutor research background and student preference: tutors post a summary of their areas of interest and expertise and, via a preference system, students can select who they wish to work with.

This unit is pass/fail in nature but involves three graded assessments. Students are required to develop a blue-sky grant proposal (assessment one) and submit it on an abbreviated National Health & Medical Research Council grant template. This template requires students to develop a budget, timeline and description of the personnel required, in addition to a project research design. Students are introduced to the concept of fields of research codes (FOR); in addition, they review ethical implications of their research via the completion of the UNDA HREC ethics application, including participant information sheet, data management and consent form (assessment two). These activities are for experience only and are NOT submitted to the university HREC committee for formal review. Finally, students are required to submit a three-minute video pitch of their grant proposal (assessment three).
Activity 5: Final year research project. Approximately 140 hours.

Students interested in undertaking a research project in their final year of the MD submit a research feasibility template towards the end of Year 3. The feasibility template requires students to report details such as the names of the supervisor/s, the project aims and methods, commentary on data availability and the presence of ethics approvals. They also need to report the type of support they may need to complete the project, noting the gap between their current skills and the requirements of the project. The template provides an opportunity for the research academics to assist students in refining projects so that they can be completed within the time allocation of 140 hours and to minimise any other risks that could lead to non-completion. The responsibility for the provision, organisation and management of projects is consciously placed with the student, to provide them with opportunities to refine higher-level professional skills.

Final approval for projects depends on research merit and completion, and is provided within the first weeks of the student’s final year. Students submit their completed research project in the form of a draft research paper for a selected journal of their choice. They are required to follow the detailed instructions for authors specific to the selected journal and are marked against a rubric including measures for adherence to publication guidelines, scientific communication, research design analysis and interpretation. Each student works with a supervisory team, including an academic employed by the School of Medicine as well as community based-clinical scientists who provide the research data. Approximately 12 per cent of students elect to undertake a research project; the remainder undertake a clinical audit sharing a number of attributes with the research project option (i.e. meeting AMC requirements), but run by the Population and Preventative Health domain.

What is the program achieving?

There are two main advantages of the integrated Research Training Pathway: the first and most important involves student learning; the second is also important and involves ongoing education and upskilling for research stream tutors, many of whom undertake other duties within the school.

Firstly, all students have the opportunity to develop an understanding of scientific language and the research process in both a theoretical and applied way. Students who enter the MD with a research qualification report that their research knowledge has been enhanced and broadened. For example, many students say they previously had no understanding of qualitative methods or the financial implications of submitting an article to an open access journal. In completing the templates in first and second year, students become more confident in their ability to critically evaluate the author’s aims against the methods and analysis employed – an area that students frequently report feeling the least confident in. They also gain experience in summarising research involving a variety of research designs for their peers. Graduating students realise that “doing research” and “getting a publication” involves more than simply enthusiasm. The assessments provide them with a detailed overview of the skill sets required to undertake successful research and highlight any gaps they might need to address.

The second advantage of the program involves the professional development and teamwork experienced in the tutor briefings. Most of the tutors have remained in the program since its inception. They enjoy the ability to discuss papers with their colleagues and to share their research skills with students in small groups. In essence being a tutor in the Research Training Pathway provides ongoing professional development in current medical literature and a range of research designs and analysis techniques. The tutors bring with them a range of professional research skills and research backgrounds, including journal editors, experience in qualitative design and laboratory research, making for a rich and informative briefing session in which everyone gains skills.
A decade of socially accountable medical student research 2010
– Western Sydney University

University Affiliation
Western Sydney University (WSU)

Title of the Program
Community Research Program, WSU School of Medicine

Team Members
Wendy Hu (Professor of Medical Education & Associate Dean Learning & Innovation) Community Research Inaugural Program Convenor
Lise Mogensen (Senior Lecturer Research & Evaluation) Community Research & MD Projects Program Convenor
Brahm Marjadi (Senior Lecturer, Associate Dean Engagement) Community Research Past Program Convenor
Sabrina Pit (Adjunct Fellow WSU, Research Translation Specialist, NSW Rural Doctors Network, Honorary Senior Research Fellow, University of Sydney) Community Research Past Rural Coordinator, University Centre for Rural Health (UCRH) Lismore
Jannine Bailey (Senior Lecturer, Rural Health & Research) Community Research & MD Projects Rural Coordinator, Bathurst Rural Clinical School
Natalie Edmiston (Senior Lecturer, Rural Research) Community Research & MD Projects Rural Coordinator, UCRH Lismore
Aunty Kerrie Doyle (Professor & Associate Dean, Indigenous Health) Community Research & MD Projects Stream Lead Indigenous Health

Date the program commenced
2010

Why was the program undertaken?

In 2007, the then University of Western Sydney School of Medicine opened its doors to the first intake of undergraduate medical students, galvanised by a mission to meet the health and workforce needs of Greater Western Sydney (GWS). One of the most diverse, geographically dispersed and fastest growing outer metropolitan regions in Australia, GWS encompasses communities affected by significant disadvantage as well as some of the most highly-educated residents and high-income suburbs of Sydney, and the largest urban Aboriginal population nationally.

In 2010, the first cohort undertook the Community Medicine Group Project during Year 4 of their five-year Bachelor of Medicine and Surgery (MBBS) degree, which by then had expanded to include rural North Coast and Western NSW. In 2012, this mandatory research course component was renamed the Community Research (CR) program to better reflect its dual research and community engagement learning outcomes (see Figure 1) and equivalence to clinical placements.

In 2019, the MBBS was replaced by the Doctor of Medicine (MD) but the essentials of CR have continued as the MD Project: to learn research and scholarship by doing it, through interconnected teaching, research and service activities. The program’s evolution and sustainability are founded on an unwavering commitment to evidencing the school’s social accountability mission through community partnerships (see Figure 2), alignment with WSU research strategy, and research-informed curriculum design and implementation.
Community Research learning outcomes reflect the dual, integrated rotation – to be accountable to communities with health inequities through rigorous, collaborative and respectful research:

- Explain how the project aim and research question relate to the health issue in the community or study population
- Demonstrate an understanding of all aspects of the research process, from formulating research questions to standards of writing for publication
- Demonstrate a collaborative and respectful approach to project participants, such as health care providers, community services, clients and health care consumers.

**Figure 1: Community Research Learning Outcomes**

Through a partnership between rural communities of Northern Rivers NSW and WSU, Wollongong and Sydney medical schools, WSU students undertake their Community Research project during year-long rural placements. Students are co-supervised by local clinicians, researchers and the CR teaching team, to co-design and complete projects on health issues of local importance, leveraging contemporaneous public health issues and events such as music festivals to collect data and raise awareness. This rural CR program produces translatable evidence and is developing research capacity for the Northern Rivers, with a track record of 21 research publications and 11 conference posters and presentations, and media coverage on topics such as youth sexual behaviours, smartphone apps, voluntary pill and alcohol testing, cannabis, refugee wellbeing, depression, GP service needs, water fluoridation and vaccination (2015-2021). See Appendix for links to student projects.

**Figure 2: The North Coast Medical Education Collaboration (NCMEC)**

The WSU Medicine teaching philosophy of experiential learning is reflected in the CR program; while research principles and skills can be acquired through theoretical knowledge and evidence-based medicine critical appraisal exercises, this learning does not become “real” until students conduct research, experiencing its limits as well as the satisfaction of findings that are immediately relevant (see **Figure 3**). For example, collecting and analysing data, whether from medical records, community interviews or surveys, becomes authentic and effective learning about the impact of well-designed data collection on data quality – and thus the validity and reliability of research findings.
Self-Determination Theory was used to investigate WSU students’ research experiences, with findings informing CR design such as Relatedness to clinical practice and future careers, Competence through adequate scaffolding and just-in-time advice, Autonomy through choice of project and use of allocated time.


<table>
<thead>
<tr>
<th>HOW SELF &amp; TIME ARE MANAGED</th>
<th>HOW CAREER RELATEDNESS IS HANDLED</th>
<th>HOW BUREAUCRACY IS MANAGED</th>
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<tr>
<td><strong>EXPERIENCE</strong></td>
<td><strong>RESEARCH</strong></td>
<td><strong>FINANCIAL</strong></td>
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<td>Scheduled research time</td>
<td>Expedited ethical approval</td>
<td>Scholarships &amp; bursaries</td>
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<td>Choice of topics, supervisors</td>
<td>Scholarships &amp; bursaries</td>
<td>Hire students as research assistants when possible</td>
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<tr>
<td>Pre-existing projects</td>
<td>Scholarships &amp; bursaries</td>
<td>Hire students as research assistants when possible</td>
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<tr>
<td>Research information portals</td>
<td>Scholarships &amp; bursaries</td>
<td>Hire students as research assistants when possible</td>
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</tbody>
</table>

Figure 3: Community Research experiential learning pedagogy

**How was the program implemented?**

The CR program is delivered to all WSU medical students (about 130 per year cohort), who work in groups of three to five, supported by allocated time in a four-week block in urban sites and sequential allocation over a year-long placement in rural sites. Scaffolding is provided in Years 1, 2 and 3 by aligning CR and graduate learning outcomes and assessments with Population Health and EBM teaching in lectures, small group workshops and online modules.

During Year 3, students select from an endorsed list of projects and supervisors, submit an assessable project plan and literature review, and obtain relevant ethical approvals. Students are thus prepared and ready to conduct data collection on the first day of their Year 4 CR placement. Supported by data analysis and report writing workshops and training tailored to the project’s study design, each group completes their project and submits a 4,000-word final report in the format of a research paper. CR study designs have included quantitative surveys, qualitative interviews and focus groups, medical record reviews and audits, systematic reviews, sub-projects within community-based randomised controlled trials, and novel approaches such as geospatial mapping. All assessments are threshold, and the final report is graded by experienced supervisors and the CR teaching team for anchoring and calibration.

The CR teaching team is founded on a strong collaborative culture and participatory practice, garnering university teaching awards for the strength of its collegiality and teamwork (see Figure 4). The team comprises the program convenor and two rural coordinators, with contributions from cognisant disciplines; team members possess strong expertise in qualitative, quantitative and mixed-methods research, and all are active and community-engaged researchers – we do and teach - with CR teaching being one of their many roles.
To inspire emerging clinician researchers, WSU students and alumni have joined the team as peer teachers and role models. Team teaching is particularly important for comparable learning experiences and assessment in a state-wide distributed program.

In 2017, the CR Teaching Team, led by Dr Lise Mogensen, was recognised for the strength of its team and its participatory and collaborative approach, demonstrating through practice the dual aims of the CR program: community engagement and rigorous research. [https://www.westernsydney.edu.au/excellence_awards/awards/archive/2017_winners/learning_and_teaching_-_excellence_in_teaching](https://www.westernsydney.edu.au/excellence_awards/awards/archive/2017_winners/learning_and_teaching_-_excellence_in_teaching)

**Community Research Teaching Team**

Dr Lise Mogensen, Senior Lecturer, Medical Education, Research and Evaluation, School of Medicine (right)
Dr Sabrina Pit, Clinical Lead - Clinical and Educational Research, School of Medicine (left)
Dr Jannine Bailey, Senior Lecturer, Rural Health & Research, School of Medicine

“Engaging and educating medical students in real research, solving real world problems with disadvantaged communities in collaborations across Western Sydney and rural locations.”

**Figure 4: Recognition of Community Research Teaching Excellence**

“Doing what we teach” is reinforced by a scholarly approach to CR teaching through: reflection on teaching practice and continuous evaluation (e.g. WSU Medical Alumni Survey findings have been used to enhance and re-sequence Year 1-3 scaffolding, with subsequent improvements in student satisfaction measures); using and producing educational research; benchmarking.

WSU has initiated collaborative projects with research teachers in other medical schools, leading to publications and findings that have been implemented in the CR program, including supervisor knowledge of research ethics (with University of Wollongong), motivating students to do research (with Sydney University), and compulsory research components (with Melbourne Medical School) (see **Figure 5**).
Since 2019, regular meetings of a WSU-initiated network of research program leads, which now includes Sydney, Wollongong, UNSW, Newcastle, Melbourne, Flinders and Tasmanian medical schools, have led to assessment benchmarking activities and ongoing collaborative exchange for peer review and best practice.

Key findings from research involving WSU students and collaborators, and how they inform the design, delivery and ongoing improvement of the Community Research teaching program.

**Determining expected research skills of medical students on graduation: a systematic review.**


Findings from 41 studies showed that medical student research teaching varied greatly and where reported, had poorly aligned aims, teaching assessment and evaluation methods. Whether the aim was to teach students by “doing”, “proposing to do”, or “critiquing”, good curriculum design requires constructive alignment. These recent findings reinforce the team’s approach to MD re-design of the CR program to ensure alignment of aims, program evaluation and blueprinting of assessments to the School mission and graduate outcomes.


Findings from a survey of academic staff and clinicians eligible to supervise medical student research at Wollongong and WSU medical schools showed that only two-thirds of academic staff (67.9 %) and less than half of clinicians (47.1 %) surveyed were aware that specific consent was required to include patient medical records in a research publication. There was limited awareness of requirements for participant information and consent forms and consent for clinical trials. These findings supported the CR team’s vetting of expressions of interest to supervise medical students, and to require that ethics approval is in place before including the project on a list for students to select from.


This mixed methods study of all WSU student cohorts showed that few (7.5 %) of students had prior research experience. Experiencing the uncertainties of clinical practice during Year 3 clerkships (Pre-Clinical (48 %) vs Clinical Years (64 %), p < 0.001), and a sense of achievement through supported research activities conducted as a team (Pre- Community Research (51 %) vs Post-Community Research (66 %), p < 0.001), were associated with more positive attitudes to doing research as graduates. Applying Self-Determination Theory findings showed the importance of relevance to patient care and future career, social connectedness through teamwork, scaffolding to build confidence, and design that provides autonomy through time use and project choice in motivating students to do research. These elements were built into CR and now, MD design, through the sequencing and content of research teaching, including modules and workshops from Year 1 onwards, CR Team project proactive support and troubleshooting, and by retaining opportunities and assessing for group collaboration.

**What is the Community Research Program achieving?**

*Increased research engagement:* Community Research has become a focal point on the path toward increasing research engagement for WSU students. This compulsory component is positioned alongside additional research (e.g., embedded Honours, an intercalated year-long Bachelor of Medical Research leading to MPhil and PhD) and thus careers as clinical academics and clinician researchers (see Figure 6).
Marra’s research journey has led to a combined MBBS-PhD and aspirations to continue teaching and research as a clinician researcher. In addition to being a Problem Based Learning and Indigenous student tutor, Marra was a peer role model in presentations on research opportunities to first year students.

“As a second year medical student, I became acutely aware of ongoing developments in the fields of cancer prevention, screening and treatment. I decided to defer my medical degree and enrol in the Bachelor of Medical Research, throughout which I investigated novel screening tools for the diagnosis of thyroid cancer. Following [this] I decided to enrol in the Doctor of Philosophy (Medicine) to pursue further research...

“It was certainly worthwhile pursuing research...I acquired experience in not only how to conduct research, but also in presenting at conferences via poster and oral presentations. Since the start of my PhD, I have also had the opportunity to develop invaluable skills in scientific writing and manuscript publication...Throughout my PhD, I also came to realise my passion for teaching.

“Despite the fact that, as medical students, we are taught research methods throughout our degree, I discovered that it was not until I had the opportunity to apply this knowledge that I could identify gaps in my understanding...I aspire to be a clinician researcher in the future, with the aim of actively participating in both clinical and translational research projects.”

**Figure 6: Student Profile: Marra Aghajani, Year 4 MBBS**

**Expedited ethics review:** Another achievement of wide impact has been the creation of an expedited research ethics review and approval process (with advice from Wollongong colleagues). This process has now been replicated for WSU General Practice research, Physiotherapy research, WSU and Charles Sturt University medical education research and evaluation, and in a unique partnership with the NSW Aboriginal Health and Medical Research Council (see Figure 7).

Each year approximately 20 CR project proposals are submitted to the WSU Human Research Ethics Committee (HREC) as sub-project amendments, under an overall approval for low and negligible risk medical student research, and approved within two to four weeks. As one of their supported learning-by-doing experiences, students complete ethics amendment applications using templates for project protocols, participant information sheets and consent forms. These are submitted to WSU HREC only after CR team review and students completing any necessary revisions. This pathway has saved students and supervisors much time and effort, reinforced learning about research ethics, prevented students from being discouraged about future research involvement (as reported by early cohorts who had to obtain full ethics approvals), and encouraged projects better suited to the community engagement aims of the CR program.

https://www.ahmrc.org.au/ethics-at-ahmrc/. Relationships, respect and reciprocity in researching with Aboriginal communities are central tenets of the CR program. As part of the strategy to build research capacity and co-produce relevant research for under-served communities, the Professor of General Practice worked with the AH&MRC HREC to establish a partnership with the CR Program. This resulted in an expedited research ethics process modelled on the CR Program ethics process for low-risk, community-based student research. Projects have been completed on hypertensive disorders of pregnancy (pre-eclampsia), chronic Hepatitis B care, transport needs of older clients of Aboriginal Medical Services, and on an audit of AH&MRC research ethics applications. Subsequent Aboriginal Health projects include a virtual interview study on sleep habits with Elders, community members and GPs, and an innovative exploration of Aboriginal bush medicine through walking interviews in two Healing Gardens with an Elder. All projects were co-developed and conducted with community, and students returned reports and findings to the community.

Campbelltown Hospital Reconciliation Garden, featuring Elders Aunty Fran Bodkin and Uncle Ivan Wellington
https://youtu.be/HFLOtq-vhE

**Figure 7: Promoting Aboriginal Health Research: partnering with the Aboriginal Health & Medical Research Council of NSW (AH&MRC) Human Research Ethics Committee (HREC)**
Peer-reviewed publications: A 2017 audit revealed 44 students had published, 65 students had delivered conference presentations and 41 had manuscripts undergoing peer review. The very successful Northern Rivers (see Figure 2) Rural CR team, working with local clinicians, researchers and community partners, has alone produced 21 peer-reviewed research publications with CR students as authors, and the findings of these publications are being cited and influencing practice. Tracking research outcomes into the postgraduate years is not straightforward; similar to monitoring graduate practice locations, reporting these important outcomes calls for a unified and collaborative approach between medical schools.

Continuous improvement

Lessons from our decade of CR teaching experience, together with contemporary developments in medical education, continue to guide the program’s evolution as it is replaced by the MD Project. As a result, research skills teaching has now been re-sequenced and strengthened, and there is greater horizontal and vertical integration with Population Health, EBM, biomedical and clinical science disciplines.

MD Projects are completed by individuals rather than groups of students. While the work required of students has been moderated, CR experience shows that allocated time is crucial, so this has been increased. CR experience in recruiting supervisors and ensuring that projects are suitable for students with no research experience has led to a surplus of CR projects each year, but many more are required for the MD. The CR team – now in charge of designing and implementing MD Projects - strategically used opportunities provided by WSU partnerships with new academic health precincts in Western and South Western Sydney, the Central West and the Northern Rivers districts of NSW to increase the number and range of projects.

MD Projects now cover a comprehensive suite of student interests and professional capabilities in medicine, including biomedical, population health, medical education and rural research, Aboriginal Health and clinical quality improvement. Regardless of whether it is the clinician, patient or Aboriginal or rural community, all projects remain grounded by engagement with community and that community’s needs. For example, the WSU rural programs in Bathurst, Lismore and now Orange NSW (in partnership with Charles Sturt University) are designed to deliver comparable learning and assessment that is still relevant and contextualised to local communities. Importantly, these research programs build rural research capacity and support rural careers for future doctors.

Growth in research capacity and medical workforce are vital to maintaining the strength and continuity of the teaching team and for reciprocity when partnering with under-served communities, so that research becomes core business and is resilient in the face of COVID and other unanticipated challenges.

Ultimately, impact on graduate practice and life-long skills such as problem solving, teamwork and time management is paramount. Whether graduates are on clinical or clinical research career paths, they often report such outcomes, and that literature searching and appraisal needed to do research has helped them become more effective users of research for patient care (see Figure 8).

Since 2010, the CR program has purposively and pre-emptively adapted to shifting conditions but remained focused on teaching and producing rigorous, ethically approved research that is underpinned by the School’s social accountability mission to be relevant, embedded and of benefit to the communities that it serves.
Benji Pfister PGY5, Orthopaedic Surgery Trainee

“Community Research was fun and well supervised...and it was an awesome opportunity for us to get to know the community that we were living in...Performing research as a student was an invaluable opportunity to work on skills such as teamwork, innovation and critically appraising literature, skills that directly translate into day-to-day practice in medicine. Formulating a research project from the ground up required originality and problem solving – once again these are skills applicable to the dynamic nature of orthopaedic surgery in which I now train...the major influence that Community Research has had on my current practice is by introducing me to the critical appraisal of literature. I have improved on these skills since my days as a student and apply them on a regular basis. These appraisals allow me to judge ‘evidence’ more objectively and therefore help me apply the appropriate medicine to the applicable patient cohort...Despite the enjoyment I get from research...I remain steadfastly devoted to practicing orthopaedic surgery in a clinical role. However, I recognise the importance of future research to improve patient care, continue to develop innovation and establish working relationships with our colleagues around Australia and the world. I will continue to be involved in research throughout my career, and my positive experience at WSU has inspired me to act in an encouraging and supervisory role to junior doctors interested in research.”

Mohammad Rehmanjan PGY7, Neurosurgery and Paediatrics Trainee

“As part of the program, I did a Community Research project looking at awareness and practice of Hospital-In-The-Home (HITH) amongst General Practices. The community research project was worthwhile in that it enhanced my interpersonal skills by working with my colleagues as a team. I learnt the importance of collaboration for efficient and productive research...Our Community Research project was great in that it involved field work which further encouraged me to do clinical orientated research work. I was encouraged to continue with an Embedded Honours project as part of my medical degree and was able to incorporate basic research and publication principles into my Honours project...This was tricky at times to balance with other commitments, but it also gave me a realistic idea about the challenges of balancing work and family life as a clinician and academic. It encouraged me to prioritise tasks and it built up resilience for my career...Doing research as a student encouraged me to look at authentic sources of information and critically appraise literature when addressing clinical questions in practice...By completing research as a student, especially Embedded Honours, I have been motivated to pursue a career as a clinician and academic. I wish to pursue my interests in teaching and research yet contribute to clinical care of patients. The beauty of research is that it opens your mind and enhances your critical thinking skills...One of the greatest satisfaction one can obtain from their research work is when it translates into clinical practice.”

Figure 8: Impact on graduate practice and different career paths: Mohammad Rehmanjan and Benji Pfister
Appendix

The North Coast Medical Education Collaboration

Community Research Student Publications:


Advanced Research Program – Australian National University

University Affiliation
The Australian National University (ANU)

Title of the Program
Advanced Research Project (ARP) Program, ANU Medical School

Team Members
A/Prof Diana Perriman *(Associate Director of HDR, past co-convener of the program)*
A/Prof Krisztina Valter *(Chair of Medical Sciences Theme, past co-convener of the program)*
Dr Lillian Smyth *(Senior Lecturer in Medical Education, current convenor of the program)*

Date the project commenced
2019 Semester 1

Why was the program undertaken?

The ANU MChD degree is a post-graduate medical program with a particular focus on research. All students complete an independent research project within their two pre-clinical years: the requirement is to submit a report in the form of a scientific manuscript by the end of Year 2, based on approximately 120 hours of research in a field of the student’s choice.

Starting from its establishment in 2004, the ANU Medical School offered its students the MBBS/PhD Conjoint Program. This was a unique opportunity for medical students interested in becoming clinician researchers to graduate from medical school with a PhD. Interested students applied concurrently for a school-funded PhD scholarship and medical school entry. If successful, the candidates commenced full-time research in Year 1, deferring their medical studies for two years. After two years, according to the plan, the students commenced full-time medical school, completing their higher degree part-time while studying medicine *(Table 1, Original Model)*.

By 2015, it became clear that there were problems with this program. Students were unable to complete sufficient research in the first two years and required extensions, delaying the commencement of the MChD and extended scholarship support. More concerning was that students felt the promises to integrate the two aspects of the program and support them in gaining transferable research skills and clinical research experience were not being met.

To address these concerns, a different model was designed whereby students could commence their research in years 2 and 3 *(Table 1, Revised Model)*. However, this model did not produce the desired outcomes either, with supervisor/student relationship issues and a continued lack of research readiness on the part of those entering the program.
Table 1: Organisation of Original Conjoint MChD/PhD model and Revised Advanced Research Project (ARP) model

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<th>Year 1</th>
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<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
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<td>PhD</td>
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In 2017, the HDR team devised the Advanced Research Project (ARP) program to address the need for greater research readiness by offering a research skills pipeline prior to commencement of PhD studies. This program leverages the MChD research project by allowing students to use it as part of their PhD if they meet the prerequisites required to enter the program. These prerequisites include: having H1 honours or equivalent, a willing supervisor, achieving a higher-level pass on their research project, being awarded a PhD scholarship based on merit, and having approval from the director. In this way the ARP acts as a filter, optimising admission to the conjoint program by testing students’ ability and resolve prior to their commencing.

Although the ARP was primarily designed for prospective conjoint MChD/PhD students, all MChD students are eligible to enrol. All projects must relate to the practice of medicine, while prospective conjoint MChD/PhD candidates and their supervisors are advised that their projects should be able to be extended to a PhD program.

The objectives of the ARP are to:

- Provide students with research knowledge required for undertaking useful health and medical research
- Provide opportunities for developing and applying research knowledge and skills
- Support students to undertake excellent research during their research project course.
- Provide an instrument to accurately assess MChD student’s suitability for undertaking a conjoint MChD/PhD.

How was the program implemented?

The ARP is led by a team of active researchers, experienced in undergraduate and higher degree research supervision. The team is experienced in systematic review, and qualitative and quantitative methods to conduct social science, laboratory science and translational and clinical research, and the course leverages this combined knowledge and experience to deliver research-led education. This cross-disciplinary, mixed-methods team also serves to prepare students for the interdisciplinary nature of both medical practice and clinical research. In addition, the students themselves bring a rich array of experience; many have prior research experience including PhDs. Therefore, the peer to peer experience is crucial in promoting energy, enquiry and adaptation.

A critical element of the ARP is exposure to a broad range of approaches, not just the narrower range relevant to the student’s own project. Students are actively encouraged to experiment in their interpretation of the content and to discuss their research successes and dilemmas. In this way, a student completing, for example, a lab-based biomedical project, will gain understanding and insight into qualitative patient experience research from peers and through the taught content.
The specific course learning outcomes are to:

1. Identify research questions, and design and implement a research plan
2. Perform sophisticated, critical analysis of the literature
3. Analyse and summarise research data sets
4. Synthesise meaning from data and observations and present coherent arguments
5. Produce written research outputs (grant applications, reports, publications) to publication standards
6. Develop project management skills commensurate with the planning and undertaking of an extended research plan, including setting goals, meeting deadlines and communicating progress against agreed milestones
7. Develop persuasive written communication skills based on the judicious use of evidence to support a comprehensive research plan, as outlined in a grant proposal sufficient to cover the minimum requirements to successfully undertake the research
8. Develop capacity to provide constructive feedback through peer review of the work of others, and to respond to constructive feedback form peers, supervisor and research mentor.

The program is project-based and students complete the course in parallel with their core medical studies during the pre-clinical phase of the MChD. All students enrolled in the ANU MChD must complete a research project but the ARP differs in four ways:

- The scale of the project is larger. Typically, we expect about twice the time commitment of a regular Research Project.
- ARP students must complete a series of online lessons (KuraCloud, Lt Lifescience eLearning Platform, ADInstruments) and face-to-face tutorials (via Zoom during COVID), introducing them to key research concepts, skills and processes.
- A focus on peer review, peer mentoring and collaborative engagement with fellow students.
- It includes a critical mentorship model, wherein the students have access to advice, support and facilitation from established researchers in medical science, clinical science and social science.

The curriculum for the ARP is a live document which has evolved over several years in response to student needs, student feedback and our review of the final submissions. In 2021, the materials covered nine key areas in Year 1 and four areas in Year 2. These are summarized in the Appendix.

There are also two formative assessment items that students complete in the planning phases of their project: a critical presentation of three key papers from their literature review and how the review has informed their design; a draft introduction. These formative assessment items are useful, both in terms of the substantive task but also as vectors for peer review and collaboration. Each of these submissions receives feedback from both staff and students. Completion of these formative assessment tasks, as well as 80 percent attendance and completion of live and online lessons, is required to maintain enrolment. Students who do not meet this expectation for engagement are transferred to the regular research project stream, where they can continue the same project at a smaller scale.
What is the program achieving?

Outcomes and Evaluation

Since its inception, two cohorts of students have completed the ARP. The outcomes have been surprising, with effects beyond the original purpose.

**Enrolment**: The course has been steadily gaining enrolments as it has settled into the course landscape. A quarter of the yearly cohort are now enrolled in the advanced stream.

**Conference Presentations and publications**: Currently, we don’t have reliable data for these outcomes but are developing strategies to capture this data more rigorously. We would normally have five or six students from the entire year applying for support to attend and present at conferences, but the disruption caused by the pandemic has prevented our cohorts from participating.

**Conversion to MChD/PhD**: The program has not yet converted a student to the conjoint program. However, perhaps counter-intuitively, we consider this a success. Part of the reason this program was instituted was to ensure that the students who enrolled were able to meet the expectations of the PhD program and produce high-quality research in a timely manner. Allowing the students to engage with publishable research at an earlier stage in their studies, in a lower-stakes environment, has facilitated reflection by the students on their capacity and time commitments, and shown them not to start something that they can’t finish. Having this research experience (and possible associated publication) has given many of our students the knowledge and confidence to know whether a higher degree is something they want to aspire to in the future, as well as insights into when might be appropriate for them.

**Student evaluation**: The most exciting outcome of this program has been the enthusiasm shown by emerging clinician researchers eager for the challenges of research and excited to be part of it (feedback from students sent without request is included in the Appendix). The following quote is a great accolade and strengthens our belief in the value of the ARP: “Inclusion in the MChD’s Advanced Research stream has been a highlight of my medical education so far.”

Reflections and goals for the future

There is no doubt that this program provides a rich, student-centred experience for medical students with aspirations to become clinician researchers. Increased cohort size has necessitated more peer-to-peer feedback, prompting more debates and discussions, which we regard as a very valuable development. We envisage future development will involve structuring the course to facilitate even more peer-to-peer engagement, development of our online resources based on student feedback, and mechanisms to ensure a higher percentage of publications per student in the program.

The cost of the program has been minimal. Members of the team which teaches into the course contribute approximately 30 hours each in face-to-face teaching time, facilitation, assessment/feedback and one-to-one interviews.

Adjusting to online teaching during the Covid19 pandemic has been a reality for all medical schools. In Canberra, we have enjoyed a hiatus where we have been face-to-face for a short period in 2021. It is clear from this experience that face-to-face is preferable because it facilitates easier communication, however, the online environment has had advantages, such as easier inclusion of students with childcare responsibilities and the opportunity to record sessions for review.
Summary

The ARP has fulfilled its role as a filtering program to ensure that only research-ready students enter the conjoint MChD/PhD stream. However, it has also filled an important gap in medical education for students who want to be active researchers in their medical career, regardless of whether they undertake the conjoint program.

APPENDIX

1. Taught Curriculum (2021)

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<tr>
<th>Year 1</th>
<th>Year 2</th>
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<tbody>
<tr>
<td>Formulating Research Questions</td>
<td>Quantitative Statistics, with a focus on power and analysis planning</td>
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<tr>
<td>Literature Searching, Review &amp; Critique</td>
<td>Writing the Discussion</td>
</tr>
<tr>
<td>Study Design Principles</td>
<td>Communicating your Research</td>
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<tr>
<td>The Problem-Gap-Hook Heuristic</td>
<td>Pathways to further study/ research (e.g. HDR)</td>
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<td>Writing the Introduction</td>
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<td>Quantitative Design Approaches</td>
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2. Student Feedback

The feedback below was sent to us without request (unsolicited comments) It is arguably the most powerful evidence of the success of this initiative.

2019 – “Just wanted to send a belated message of appreciation for your work with the advanced research program and the mentorship you provided. Despite the challenges associated with research, I learnt an incredible amount over the past 18 months and couldn’t have done it without help.”

2020 – “The 2020 ARP students just wanted to send through a big thank you for all your hard work helping us in 2019 and 2020. It was a crazy year and we appreciate you still making the time for us. We all learnt a lot about our individual research topics and also learnt a lot about ourselves as researchers. We’ve put together a list of “what I learnt doing a research project” tips and tricks for future ARP students. The list is quite long – a testament to our revelations! I hope it’s helpful for future students, or even just helpful for you both to have a giggle!”
2021 – “The Advanced Research Project run by the ANU Medical School was an exciting and innovative program that allowed me to not only retain but continue developing myself as a young researcher. Through dedicated teaching staff, additional classes, extra support and a collaborative environment, we have all been supported to produce creative and high-quality research. It also fostered an environment where students, passionate about research, could come together to collaborate, share ideas and support each other through the trials and tribulations of biomedical research. It is exciting for me to look at my colleagues and wonder what wonderful contributions they will make to their chosen fields.

While uncertain about whether I wanted to pursue a pathway as a clinician scientist, I knew that I had a passion for research and after a successful honours project, I was dismayed to realise that medical school would see me lose many of the research skills I had worked hard to develop. However, the Advanced Research Program has given me the opportunity to form research networks, begin to publish my work and speak at conferences. More than this, it has equipped me with the confidence and enthusiasm to pursue a PhD. While challenging to fit in a busy medical curriculum, the program has cemented my intention to become a clinician scientist, with feet in both the clinical and research world. It compels young doctors to meet a high standard and has given us skills that will undoubtedly help with our clinical training. The program gives students the opportunity to uphold the highest traditions of scientific endeavour, of which medicine rest upon. It is also humbling and a privilege to be mentored by senior researchers that have distinguished themselves and generously share their insights with us.”

“Inclusion in the MChD’s Advanced Research stream has been a highlight of my medical education so far. It’s allowed me access to a small community of student researchers who have helped me navigate this element of the course, an opportunity that was especially welcome in 2020 during lockdown, when interaction amongst our cohort was minimal. It has also elevated the quality of my research, providing guidance in developing a project, connecting me with great supervisors and prompting me to submit work ahead of deadline.”
Why was the program undertaken?

The Scholarly Intensive Placement was one of several changes introduced to the Monash medical degree in its transition from MBBS (Hons) to Masters Degree (Extended) BMedSc/MD.

To provide context, the Monash medical degree is a large (more than 500 students/year level), geographically distributed degree operating across Monash Australia and Monash Malaysia campuses (more than 33 clinical locations in metropolitan and rural Victoria and Malaysia). Most students at Monash Australia and all students at Monash Malaysia commence directly from high school into a five-year degree (Years 1-5). Monash Australia also has a four-year graduate-entry degree (Years A-D). The final three years are clinical years and are identical for both cohorts. A full study load is 48 credit points per year.

Three major changes were made to the clinical years during the transition to the MD:

1. Introduction of a compulsory series of new, interactive online Research Methods in Medicine modules, which include a major data analysis assignment in Year 3/B.
2. A doubling of the Patient Safety Module (from six to 12 credit points) in Year 5/D
3. A compulsory new six-week, full-time 12-credit point unit called Applied Studies in Medical Research and Professional Practice in Year 5/D, replacing an elective rotation. This unit is colloquially known as the Scholarly Intensive Placement (SIP).

Consistent with the Australian Quality Framework (AQF) definition of a Masters Degree (Extended), the overarching aim of the SIP is to develop “individuals who apply an advanced body of knowledge in a range of contexts for professional practice and as a pathway for further learning”1. The SIP was designed to enable final-year students to work full-time for six weeks on a scholarly activity to gain in-depth knowledge in an area of interest, relevant to medicine. The unit was strategically placed in the final year to enhance students’ research skills, particularly their ability to search and critique the literature, immediately before they commence their lifelong journey as evidence-based medical practitioners.

We drew inspiration for the SIP program by reviewing published literature for similar research-intensive experiences for medical students at other universities (for example, ref 2-5) to identify key
success criteria. The review indicated that having an organisational research culture and protected time within a well-structured and well-supported program, with quality supervision and a degree of student autonomy and project choice, would be critical to improve student research skills, attitudes and scholarly output.\(^6\) We considered surveys of medical students about their research experiences and attitudes to research\(^7,8\) and sought input from Monash University student representatives. We also drew inspiration from a very popular Monash undergraduate unit for Bachelor of Science and Bachelor of Biomedical Science students, called Action in Research.

We knew that the project types undertaken by the SIP students needed to be broad-based, given the large student numbers and geographic distribution of the Monash MD program. We also needed project options that utilised research skills but could be overseen by supervisors who might not be research-active themselves.

We envisaged that projects would largely fall under one of three (not mutually exclusive) streams:

1. **A research stream**, where students could contribute anywhere along the pipeline of a research project – a literature review, designing a project, developing research tools (e.g. survey), data collection, data analysis or project write-up.
2. **A professional practice stream**, where students could contribute to a professional practice issue in a clinical setting (e.g. quality improvement audits, development of clinical guidelines, governance or policy documents, review of treatment and/or management options for a specific disease).
3. **An education stream**, where students could develop or evaluate educational materials for patients, the general public, other students or health professionals.

**How was the SIP program implemented?**

The SIP is led by the Director of Medical Student Research and six dedicated SIP Coordinators, responsible for recruiting supervisors, approving topics, reviewing students’ preferences and supporting SIP students and supervisors at their school. The Director and SIP Coordinators meet monthly to ensure consistency across sites, resolve unforeseen issues and identify opportunities for improvement.

No financial incentives are given to SIP supervisors but the faculty funded five 0.2 FTE SIP Coordinator roles, and administrative support is provided by current staff at each school. The cost of the program, therefore, is primarily academic salary support equating to less than $200,000 per year.

A central SIP website has been developed to provide students and supervisors with an overview of the program. Each school also has its own SIP website to promote the range of projects available at that school. Students and supervisors receive a SIP guide, and a dedicated learning management system (Moodle site) contains the SIP guides, assessment instructions and additional support resources, and links to upload assessment items. At any one time, there are 80-90 students undertaking the SIP across six clinical Schools in Australia (15 sites) and Malaysia (three main sites).

To minimise unexpected delays, SIP projects must either already have or not require ethical approval; alternatively, the development of an ethics application can form part of the SIP project itself.

**Learning Outcomes**

The learning outcomes for the SIP are:

1. Utilise specialist knowledge and skills to justify the need for a research, teaching or professional practice issue to be investigated or evaluated.
2. Devise and implement a plan for the placement and identify key outputs.
3. Review, synthesise and critically appraise clinical and scientific literature in a specific area of medical science, education or professional practice.
4. Practice and demonstrate an understanding of academic integrity, research integrity and ethical behaviour in the context of medical science and/or delivery of care.
5. Collect and categorise information related to a key question relevant to the community and to medicine.
6. Analyse and summarise information related to a key question relevant to the community and to medicine.
7. Justify and reflect upon approaches to solve a complex problem relevant to their placement.
8. Communicate critical concepts and findings to a professional audience in oral and written formats.

Assessment

The SIP assessment strategy consists of five assessment items (Items 2 and 3 are Hurdles):

1. A series of online modules on Good Research Practice, Academic Integrity and Citing and Referencing, all assessed by a quiz
2. A Student-Supervisor Learning Agreement to ensure the student understands the supervisor’s expectations, tasks to complete and what to include in the Scholarly Report
3. A 4000-word Scholarly Report about their SIP project, including a 250-word executive summary (abstract)
4. An oral presentation about their SIP project
5. A reflection on their SIP experience.

What is the program achieving?

Based on formal and informal student and supervisor feedback, the SIP has been a resounding success, despite very significant impacts from COVID-19 in its first and second years of operation.

Prior to starting the SIP in 2020, there were substantial concerns about the capacity to supervise more than 500 students per year doing short projects, but this proved to be an unfounded concern. In 2021, there have been about 230 separate supervisors, each supporting between one and six students for the year. Informal feedback from supervisors indicates that they have been very impressed with the dedication and quality of the work that the SIP students are producing. Evidence from students’ oral presentations, scholarly reports and student reflections also indicates that students are achieving the learning outcomes, learning a great deal about their topics, and reflecting on the impact of the SIP experience and how they will take their scholarly learnings forward into their clinical practice.

However, the COVID-19 pandemic did have major impacts on the SIP program in both Victoria and Malaysia. In 2020, COVID began to impact clinical placements during the second rotation for the year with the strictest lockdown in Melbourne (Victoria) lasting for four months. In Malaysia, a Movement Control Order in 2020 caused all medical students to be removed from clinical placements for about five months. To keep students meaningfully occupied during this time, many SIPs were altered to run concurrently with the limited clinical placements that were available – over an extended period rather than six-weeks full-time. The students and supervisors coped remarkably well with the rapidly changing and evolving situation, but many projects did have to be altered at short notice so they could be completed remotely.

The impact of COVID-19 on the SIP has continued to be very significant in Malaysia in 2021 but at Monash Australia, the program has reverted to six-weeks full-time for all final-year students, with relatively few projects impacted by Victorian/Melbourne lockdowns.
A selection of SIP students are profiled in internal and external media articles to promote the program, the variety of projects available and the outcomes that can be achieved from the SIP:

- Rethinking pandemic preparation and pivoting the Monash MD
- Anaesthetics audit gives student experience in pain medicine
- Medical teaching innovation yields results for infants at risk of cerebral palsy
- Migraines causing pain for the economy
- Medical student relay delivers a new Cochrane review
- Student helps develop palliative care tools

A manuscript describing the first-year evaluation of the SIP program and the impacts of COVID-19 on the program will be submitted for publication soon. It will be important to continue evaluating the SIP in future years when the impacts of COVID-19 are further reduced, however, feedback thus far indicates that the vast majority of students and supervisors have had positive and satisfying experiences and that the SIP is achieving its objectives to enhance students’ research skills, confidence to practice EBM and interest in undertaking research and other scholarly work.

References:

Re-imagining medical student research education – University of New South Wales

University Affiliation
University of New South Wales (UNSW)

Title of the Project
Year 4 Redesign, Independent Learning Project, UNSW Medicine program

Team Members
Greg C Smith (School of Medical Sciences)
Khanh Vo (Medicine Education & Student Office)
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Jane E Carland (School of Medical Sciences, St Vincent’s Clinical School)
Kerry Uebel (School of Population Health)
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Vikram Palit (School of Population Health)
Blanca Gallego Luxan (Centre for Big Data Research in Health)
Gary Velan (School of Medical Sciences, Office of Medical Education)
Brett Biles (Office of Medical Education)

Date the project commenced
June 2019

Why was the project undertaken?

For more than 15 years, a research component known as the Independent Learning Project (ILP) has been an integral component within the UNSW Medicine program.

The ILP spans Year 4 of the six-year undergraduate program and was designed to be a supervised research project in any field relevant to medicine, ranging from laboratory benchwork to fieldwork in Aboriginal and Torres Strait Islander communities to clinical audit. The intention to develop students’ research and critical evaluation skills through the project was backed up with surveys of students and supervisors undertaken regularly, to improve the research year experience (Hunt et al; Uebel et al., 2021).

In 2020, a proposal to leverage the most successful aspects of the ILP (determined by student and supervisor feedback) and to provide high-performing students with an additional qualification from the research year was approved. The main aim of these changes was to enhance the educational opportunities for students in their research year, and tailor the program to their needs and interests with the introduction of a blended research/coursework paradigm.
How was the project implemented?

Due to the nature and extent of our research curriculum redesign, an extensive consultation process was undertaken, which included all heads of schools and institutes within the Faculty of Medicine & Health, all affiliated medical research institutes and the UNSW Medical Society (student-run body). Upon approval, a series of online webinar events was run for students, research supervisors and schools to facilitate implementation of the program.

Program level enhancements – giving students a choice to build their own research program

Following a change in eligibility criteria, an increased proportion of students can now undertake a BSc (Med) Honours program. Previously, only the top 30 students were invited into the program, based on their weighted average mark. We also changed the structure of the research year by reducing the research component (previously 100%) to enable integration of a compulsory course on value-based health care in clinical practice as well as advanced coursework (Honours only). This change has allowed us to offer specialised teaching, especially in emerging research fields, that complements the research experience. For example, a student undertaking an Honours research project in personality disorders can now select an advanced course in Mental Disorders, Personality Disorders and Crime offered by the school of Psychiatry; this would both add value to the research project and allow the student to study alongside people outside the medical program.

In 2021, over 80% of Year 4 medical students selected to undertake the BSc (Med) Honours program (all eligible students selected this option). For 2022, we have further refined the Honours program to give students the choice of a research-intensive or coursework-intensive experience. As a result, students can now select from one of the following streams:

1) *ILP* – 21 hours per week of research activities over a 30-week block. This is a less demanding program and students can complete their general education requirements alongside the research project.

2) *BSc (Med) Honours - Research Intensive* - 28 hours per week of research activities over a 34-week block, plus seven hours per week of advanced coursework. Students select one course from a list of 30+ that complements their research project. For example, statistical or qualitative methods, cancer pathology, health data science, molecular pharmacology, human genetics, health leadership, workforce management.

3) *BSc (Med) Honours - Coursework Intensive* - 14 hours per week of research activities over a 34-week block, plus 21-hours per week of advanced coursework related to a predetermined specialisation. For example, in 2022, students can undertake a BSc (Med) Honours in Clinical Artificial Intelligence (AI), which consists of four advanced courses in AI\(^1\) and a research project that will complement the coursework. Students successfully completing this program will obtain a BSc (Med) Honours – Clinical AI (specialisation). Other coursework intensive streams are being developed for 2023.

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Figure 1: A schematic representation of the 3 main options available to UNSW Year 4 medical students. In Year 3, students approach potential supervisors across UNSW and our affiliated medical research institutes to negotiate a research project in Year 4. During that process, they select the stream they would like to undertake based on their interests. Please note, entry requirements for Honours are based on a minimum WAM of 65 obtained from years 1-3.

Coursework level changes – Research with Aboriginal and Torres Strait Islander peoples

As part of our research education redesign agenda, Dr Brett Biles, Director of Indigenous Health Education at UNSW, developed a curriculum on researching with Aboriginal & Torres Strait Islander peoples that all medical students must engage with during their research year. This consists of a series of online teaching modules (Aboriginal and Torres Strait Islander history; Cultural competence in Aboriginal & Torres Strait Islander Health Care; Research with Aboriginal & Torres Strait Islander peoples) and the following workshops run across the Year 4 medicine program:

I. Self-awareness, positionality and reflective health care
II. Ethical frameworks and principles in Aboriginal & Torres Strait Islander research
III. Collaboration in Aboriginal & Torres Strait Islander research.

These fundamental changes were embedded in our research program in 2021, with the overall goal of teaching the next generation of clinical researchers the importance of researching with Aboriginal and Torres Strait Islander peoples in a culturally safe and respectful way. These online modules are currently assessed via a reflection activity in the Honours program, but in 2022 this assessment will be moved to our new compulsory course Value-Based Health Care in Clinical Practice.

Coursework level changes – Using scientific methods to improve health care delivery

In 2022, a new compulsory course titled Value-Based Health Care in Clinical Practice will be integrated into the Year 4 curriculum (ILP and BSc (Med) Honours). This course aims to extend the research experience gained during ILP or Honours and enable students to apply evidence to inform their decision making in clinical practice.

Students will gain an understanding of the meaning of ‘value’ in healthcare, and how to apply research evidence to re-design models of care that improve efficiency and create value for patients. This course will equip students with the principles of quality improvement (e.g., plan-do-study-act, lean six sigma, quality management), outcomes measurement (e.g. patient-reported outcomes, health-related quality of life) and economic analysis (e.g. cost-effectiveness, opportunity costs) to lead service transformation and professional development in preparation for future medical practice.
Applying improvement methodology and drawing on their research experience, students will submit a substantial project report focusing on value-based interventions to improve Indigenous health within acute care or community settings.

In summary, the Year 4 Medicine program will enable students to develop and apply their research skills in the context of clinical practice, with a focus on Aboriginal and Torres Strait Islander health and wellbeing. Our approach of giving students with diverse research interests a variety of research options complemented by advanced coursework is intended to enable students to tailor their education in research to their needs and interests, and maximise the impact of the research year on their future career opportunities and contributions to research.

What is the project achieving?

The overall aim of our research teaching redesign project was to enable UNSW medical students to build a research program based on their interests and future goals. The program has now evolved to the point where students can select a research topic of interest (pre-clinical or clinical), the level of research undertaken (ILP, coursework or research intensive) and the courses they would like to study that can enhance their research experience. This has also allowed us greater flexibility to alter our research program by introducing new advanced coursework at any point, based on emerging fields of medical research. It also allows increased diversity of areas and topics for students to pursue.

Benchmarking and Evaluation

In 2019, a network of academic leads of MD research from Australian medical schools was initiated by Professor Wendy Hu (Western Sydney University), with the aim of exchanging and developing best practice in enhancing student research experience and program governance. As early participants, this facilitated our alignment of student learning outcomes, research and supervisor training, and assessment marking. The network continues to grow and provide benchmarking for our research teaching in medicine at a national level.

Finally, a major assessment for both the ILP and Honours year is a final research report written in the form of a manuscript suitable for submission to a peer-reviewed journal. We are currently undertaking an audit to identify published outputs from Year 4 medicine student research projects, as well as a qualitative study exploring the experiences of students and supervisors of the Year 4 program. Preliminary data demonstrates that the proportion of students who published has increased from 28% in 2007 to 50% in 2015.

References


Macquarie MD Research Program

University Affiliation
Macquarie University, Sydney Australia

Title of the Program
Doctor of Medicine (Macquarie MD) Research

Team Members
Ms Caroline Proctor (MD Research Administrator)
Associate Professor Veronica Preda (MD Clinical Lead)
Professor Frances Rapport (MD Academic Lead Australian Institute of Health Innovation)
Ms Hayley Harris (Director Educational Services)
Professor Catherine Dean (Deputy Dean Education and Employability)

Date the project commenced
Commenced in 2018 with the inaugural cohort of students into the Macquarie MD. This cohort will complete the research program and graduate in 2021.

Why was the program undertaken?
The purpose of the Macquarie MD Research Program is to develop future medical doctors who understand the role and importance of research in guiding evidenced-based medicine (EBM) practice.

The Macquarie MD Research Program is built around the overarching Macquarie MD, building on the capacity for graduates to become scholars, research-informed practitioners and applied medical scientists. Students have the opportunity to undertake research projects that align with the broad spectrum of research strengths within MQ Health and the Australian Institute of Health Innovation (AIHI), both of which promote MQ Health’s strategic goal – to undertake research that improves the delivery of healthcare and the quality of patient and broader community lives.

The stimulating research environment offered to students enrolled in the MD ensures that they will develop research skills, plan and implement a research project, and communicate their research findings and recommendations for healthcare and/or future research.

How was the project implemented?
Research knowledge and skill development is embedded throughout the Macquarie MD, culminating with the completion and presentation of a substantial research project. The program organises research training into Stage 1 (Years 1 and 2 of the course) and the completion and presentation of a research project over 18 months in Stage 2 (Years 3 and 4).

The core curriculum includes research methods, ethical considerations in research, statistics and safety. The research projects offered to students are diverse as they may come from the University Clinical Partners, any department within the Faculty of Medicine, Health and Human Sciences, MQ University Hospital and AIHI. The projects focus on making a scholarly contribution to learning health systems and may include projects related to: health systems development and delivery; infrastructure and resource use in healthcare; patient safety and quality; patient and clinician experience of service delivery; patient and professional reported determinants of health and wellbeing; medical education.

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2 MQ Health is Australia’s first university-owned teaching hospital.
Macquarie MD research processes and principles include:

- Developing a group-based research project where students work together, with each student also required to answer a related but different research question and submit individual work for assessment.
- Identifying suitable research projects six to 12 months before the projects commence.
- Allowing students to preference their research project.
- Placing responsibility for ethics approval on supervisors to ensure it is appropriate and obtained in a timely manner.
- Training staff and students on Microsoft teams, which is the primary communication channel and protected storage site for data and documents related to the research projects. For each project, the relevant students and supervisors will form a team, and access to the team will be restricted to appropriate personnel so that data retention and ethical requirements are met.
- Having academic leads for the research project units across the student cohort.
- Showcasing the research in a final symposium in which students present work to a wide audience of peers, staff, clinical partners and external groups.

MD students chose their research topic from a list of projects submitted by interested supervisors. Supervisors nominate the number of students required to complete the project and work with teams of two to four students. The supervisory teams are comprised of both academics from AIHI and Clinicians from MQ Health, to further encourage and foster interdisciplinary relationships.

With guidance from their supervisors, the students devise their own research question on the chosen topic. Over the course of 18 months, the students further explore and develop their own research project by conducting reviews, data audits and/or extensive literature searches. Ten assignments are goal-posted along the pathway of research development and marked by supervisors and moderated by the Unit Convenors, culminating in a final manuscript (to the level of a British Medical Journal (BMJ) Open paper) and a ten-minute oral presentation across the Faculty of Health and Human Sciences, Doctor of Medicine & Doctor of Physiotherapy.

**How the students are introduced to the range of research designs**

At the end of Year 2, students are introduced to research methodology, alongside patient safety and quality work. Students have a core research curriculum, over a five-week block, to give them a foundation for their research tasks. The subsequent three research units build on their application in each topic area of choice. Due to the variety of topics, students explore different research methodologies applicable to their individual tasks then work with their supervisory teams, presenting and interpreting work as qualitative and quantitative data.

**Number of academic staff and students involved**

Approximately 60 students participate in the program per annual intake. The academic staff are interdisciplinary, from across the Macquarie University campus. The average number of supervisory staff required is around 60 staff per cohort, however the actual supervisory staff numbers are fluid as they depend on several factors (exact number of students, and how many students each supervisor takes for each project). Along with core supervisory staff, there are other departments across the University which are also invested in the MD Research Program:

- Advisory Group and Executive Committee, comprising members across diverse integrated areas from within Macquarie University and MQ Health.
- Ethics / Library / Statisticians / Learning and Development Team.
To avoid delays and falling short of student research commitments, ethics needs to be obtained by the supervisors before the projects are selected. Studies ideally avoid live data capture and, where possible, focus on clinical settings, audits, clinical reviews for patient safety and quality improvement.

**Learning outcomes:** The research units have been designed around a capability framework: four graduate capabilities, each with two capability aspects (see Figure 1).

<table>
<thead>
<tr>
<th>Is a ... (Capability)</th>
<th>Who is... (Aspect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SCIENTIST AND SCHOLAR</td>
<td>1.1 An applied medical scientist</td>
</tr>
<tr>
<td></td>
<td>1.2 A Scholar and research informed practitioner</td>
</tr>
<tr>
<td>2. CLINICAL PRACTITIONER</td>
<td>2.1 An effective personal and digital communicator</td>
</tr>
<tr>
<td></td>
<td>2.2 A patient-centred and safe clinician</td>
</tr>
<tr>
<td>3. ENGAGED GLOBAL CITIZEN</td>
<td>3.1 A socially and culturally versatile practitioner</td>
</tr>
<tr>
<td></td>
<td>3.2 A public health and systems aware practitioner</td>
</tr>
<tr>
<td>4. PROFESSIONAL</td>
<td>4.1 A team worker</td>
</tr>
<tr>
<td></td>
<td>4.2 An ethical and reflective practitioner</td>
</tr>
</tbody>
</table>

*Figure 1: Macquarie MD Graduate capabilities and aspect*

Research-specific learning outcomes, learning activities and assessments are designed to develop and align with the capabilities.

**Assessment**

Coarse grading is used throughout the Macquarie MD for all assessment tasks. A variety of assessment tasks are used for the MD research program: oral, written and logbook reflections. The final oral presentation is marked by internal and external examiners.

Most tasks will assess two or more Capability Aspects (see Figure 1, above), with a focus and Generic Capability Aspects. Students will receive a coarse grade and feedback for the Capability Aspects assessed in that particular assessment task. The coarse grades used in the Macquarie MD are outlined in Figure 2, below.
<table>
<thead>
<tr>
<th>Coarse grade</th>
<th>Grade descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>P+</td>
<td>This grade is used when the student addresses the assessment criteria at a standard that exceeds what is normally considered satisfactory for students at the <strong>end of the relevant stage</strong> of the Macquarie MD.</td>
</tr>
<tr>
<td>P</td>
<td>This grade is used when the student addresses the assessment criteria at a standard that is satisfactory for students at the <strong>end of the relevant stage</strong> of the Macquarie MD. One or two criteria may not be met, but the standard is still considered to be satisfactory.</td>
</tr>
<tr>
<td>P-</td>
<td>This grade is used when the student addresses the assessment criteria at a standard that is barely satisfactory for students at the <strong>end of the relevant stage</strong> of the Macquarie MD. This grade represents a low or conceded pass.</td>
</tr>
<tr>
<td>F</td>
<td>This grade is used when the student has failed to achieve the minimum assessment requirements or failed to address the most important aspects. This grade represents a clear and substantial failure, indicating a level of performance significantly below that expected for the <strong>end of the relevant stage</strong> of the Macquarie MD.</td>
</tr>
</tbody>
</table>

**Figure 2: Macquarie MD Coarse Grading framework**

The Macquarie MD also uses Entrustable Professional Activities (EPAs), see **Appendix**.

**What is the Program achieving?**

**Student evaluation:** Each cohort of students evaluate the program via a university central survey.

**Reflections on how program has evolved so far:** Every indication to date has been that the MD Research program has met and exceeded all expectations. All the assessments within the MD Research Program have been reworked in alignment with feedback from supervisors. The AMC favourably reviewed our program in 2020.

Our first cohort of MD students, who commenced in 2018, completed the 18-month MD Research Program by presenting the results of their research at the Doctor of Medicine & Doctor of Physiotherapy Research Symposium on 25 June 2021. This half-day event saw 98 students from both courses present their research project in front of their peers and a panel of internal and external examiners from other universities and Macquarie. Due to COVID-19, this event was moved from face-to-face to Zoom, which proved a successful and dynamic virtual platform. The external supervisors were very forthright in praising the level of scholarly presentation and professionalism of the students.

**Goals for future:** We would like to be in a position of developing students’ capability to select their own research project by selecting a research team/professor they would like to work with.

**Impact of Covid-19**

- A major consequence of Covid has been that the students are unable to go to India, which has curtailed some of our planned research partnerships but overall has not affected delivery.
- Some projects that rely on clinical data capture have had to reshape their research questions.
- Planned live delivery of course work and the final research symposium was moved to an online platform.
- The final year group presentations at the research symposium 2021 was the virtual space, adapted for COVID.
### APPENDIX

<table>
<thead>
<tr>
<th>Can be trusted at the end of Year 2 of the Program to... (Stage 1 EPAs)</th>
<th>Can be trusted at graduation, at the level appropriate to an intern ... (G EPAs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1 EPA 1: Gather information from a medically stable patient with a common clinical presentation.</td>
<td>G EPA 1: Gather a history and perform a physical examination.</td>
</tr>
<tr>
<td>Stage 1 EPA 2: Integrate information gathered from a patient to construct a reasoned and prioritised differential diagnosis as well as a preliminary plan for common clinical presentations and diagnoses.</td>
<td>G EPA 2: Synthesise available information to prioritise a differential diagnosis and develop a management plan that includes appropriate medication, and/or other therapies.</td>
</tr>
<tr>
<td>Stage 1 EPA 3: Communicate information relevant to a patient’s care with other members of the health care team.</td>
<td><strong>G EPA 3: Form clinical questions and use medical literature and research methodologies to retrieve information and resources to advance patient care.</strong></td>
</tr>
<tr>
<td>Stage 1 EPA 4: Provide the health care team with resources to improve an individual patient’s care or collective patient care.</td>
<td>G EPA 4: Recognise a patient requiring urgent or emergent care and initiate evaluation and management.</td>
</tr>
<tr>
<td>Stage 1 EPA 5: Perform required procedures.</td>
<td>G EPA 5: Obtain informed consent for clinical encounters, tests and procedures, and perform common procedures for an intern.</td>
</tr>
<tr>
<td></td>
<td>G EPA 6: Recommend and interpret common diagnostic and screening tests.</td>
</tr>
<tr>
<td></td>
<td>G EPA 7: Report a clinical encounter orally, and document patient assessment and management (e.g., findings, orders, prescriptions and adverse incidents).</td>
</tr>
<tr>
<td></td>
<td>G EPA 8: Collaborate as an Intern in an interprofessional team by giving or receiving handovers, making referrals, and requesting expert consultations.</td>
</tr>
<tr>
<td></td>
<td>G EPA 9: Share information about the patient’s care, including diagnosis and management plan, with a patient.</td>
</tr>
</tbody>
</table>

*Figure 3: The Macquarie MD Entrustable Professional Activities list*
Entrustable Professional Activities

The Macquarie MD also uses Entrustable Professional Activities (EPAs) to assess students. Each EPA is a fundamental clinical task that a student could be entrusted to perform by a clinical /research supervisor. EPAs are assessed by seeking an experienced assessor’s recommendation for the level of supervision the student would require when performing the EPA with real healthcare/research teams in the future using the following coarse scale:

Available (A)  the supervisor needs only to be available to assist the student if called on to do so.
React (R)      the supervisor will need to be close by and ready to react to the student’s performance on the task if needed.
Direct (D)     the supervisor will need to direct the student’s work on the EPA task closely.
Explain (E)    the supervisor will need to explain what is involved in the EPA task to the student.

There are 5 Stage 1 EPA and 9 Graduate EPAs in the Macquarie MD, as illustrated in Figure 3, with G EPA 3 assessed in the Research Component and an R Level expected.