

# Introducing, Designing *and* Conducting Research *for* Paramedics

ALEXANDER OLAUSSEN  
KELLY-ANN BOWLES  
BILL LORD  
BRETT WILLIAMS



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**Introducing,**  
**Designing** *and*  
**Conducting Research**  
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# Introducing, Designing *and* Conducting Research *for* Paramedics

## EDITORS

**ALEXANDER OLAUSSEN** BEmergHlth(Paramedic), BMedSc(Hons),  
MBBS(Hons), MACPara, FHEA  
Department of Paramedicine  
Monash University, Australia;  
National Trauma Research Institute, The Alfred, Australia;  
Centre for Research and Evaluation, Ambulance Victoria, Australia

**KELLY-ANN BOWLES** BSc(Human Movement Sc),  
GradDipBiostats, PhD  
Department of Paramedicine  
School of Primary and Allied Healthcare  
Monash University, Australia

**BILL LORD** BHlthSc(PreHospCare), GradDipCBL, MEd, PhD  
Department of Paramedicine  
Monash University, Australia

**BRETT WILLIAMS** BAVed, BHlthSc, Grad Cert IntensiveCareParamedicine,  
Grad Dip EmergHlth, MHlthSc, PhD, FACP  
Department of Paramedicine  
Monash University, Australia





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Preface, viii  
Contributors, x

## SECTION 1 Introduction to Research

### PART ONE Welcome to Your Research Journey

- 1 Historical Perspectives and the Emergence of Research in Healthcare, 2**  
*Talal AlShammari*
- 2 The Importance of Research for Paramedicine as a Profession, 5**  
*William J Leggio and Niamh M Cummins*
- 3 Evidence-Based Practice for Paramedicine, 8**  
*Kelly-Ann Bowles*
- 4 How to Use this Book, 11**  
*Kelly-Ann Bowles, Alexander Olausson, Brett Williams and Bill Lord*

### PART TWO Starting at the Start

- 5 How to Determine What Topic to Research, 13**  
*Niamh M Cummins*
- 6 Asking the Answerable Question, 16**  
*Navindhra Naidoo*
- 7 What to do Before You Start, 20**  
*Brendan Shannon and Alexander Olausson*
- 8 Theoretical and Conceptual Frameworks for Paramedicine Research, 23**  
*Alan M Batt and Madison Brydges*
- 9 Overview of Research Designs and the Hierarchy of Evidence, 26**  
*Cameron M Gosling*
- 10 Thinking About Ethics in Research, 29**  
*Paul Simpson and Susan Furness*

## SECTION 2 Preparing the Research

### PART THREE Finding What has Already been Done

- 11 Literature Review Process and Production Software, 34**  
*Bronwyn Beovich and Alexander Olausson*
- 12 Sourcing the Available Evidence (Primary, Secondary and Tertiary Evidence), 39**  
*Cameron M. Gosling and Ross Iles*
- 13 Appraising and Critiquing the Evidence from Anecdotal, Observational and Experimental Studies Relevant to Paramedic Clinical Practice, 42**  
*Ted Brown and Luke Robinson*
- 14 Structured Reviews: Scoping, Rapid, Narrative and Umbrella Reviews, 51**  
*Paul Simpson and Robin Pap*
- 15 Cochrane Reviews and Systematic Reviews (Including Meta-Analyses and Meta-Synthesis), 57**  
*Erin Smith and Paul A Jennings*

### PART FOUR Methodological Considerations

- 16 Moral Principles and Ethical Considerations, 61**  
*David Reid*
- 17 Data Collection and Storage, 66**  
*Emily Andrew and Ziad Nehme*
- 18 Reliability and Validity in Quantitative and Qualitative Research, 69**  
*Richard Armour and Brett Williams*
- 19 Sampling, 74**  
*Kelly-Ann Bowles*
- 20 Power and Sample Size Calculations, 78**  
*Kelly-Ann Bowles*
- 21 Assessing Bias, 81**  
*Richard Armour and Brett Williams*
- 22 Culturally Inclusive Considerations in Paramedicine Research, 86**  
*Tom Davidson and Gemma Howlett*

## SECTION 3 Explaining the What (Quantitative)

---

### PART FIVE Quantitative Research Designs

- 23 Case Reports and Case Series, 92**  
*Ben Meadley*
- 24 Cross-Sectional Studies, 95**  
*Jennie Helmer*
- 25 Case-Control Studies, 97**  
*Alexander Olausson*
- 26 Cohort Studies and Registry Studies, 100**  
*Hideharu Tanaka, Ryo Sagisaka, Koshi Nakagawa and Shota Tanaka*
- 27 Randomised Controlled Trials, 103**  
*Ziad Nehme and Karen Smith*
- 28 Experimental Studies Other than Randomised Controlled Trials, 107**  
*Andrew Fu Wah Ho, Audrey L Blewer and Marcus Ong*

### PART SIX Statistics/Quantitative Analysis

- 29 Data Collection Tools/Approaches for Quantitative Research, 112**  
*Nigel Rees*
- 30 Types of Quantitative Data (Continuous, Categorical, Distributions, Skewness), 115**  
*Yilin Ning, Nan Liu and Marcus Eng Hock Ong*
- 31 Descriptive Statistics, Missing Data and Testing Assumptions, 119**  
*Yu-Tung Chang*
- 32 Confidence Intervals,  $p$ -values, Effect Size and Statistical Significance, 121**  
*Alexander Olausson and Gerard O'Reilly*
- 33 Inferential Statistics: T-Tests, Regression Analysis and Adjustments (Mediation Versus Moderation), 124**  
*Alaa Oteir*
- 34 An Introduction to Survival Analysis, 127**  
*Gerard M O'Reilly*

## SECTION 4 Explaining the Why (Qualitative)

---

### PART SEVEN Qualitative Research Designs

- 35 Phenomenology, 132**  
*William J Leggio*
- 36 Action Research Methodology for Out-of-Hospital Care Researchers, 135**  
*Sam Willis*
- 37 Case Study, 139**  
*Ibrahim Althagafi, Lindsay Smith, Dale Edwards and Douglas Paton*
- 38 Ethnography: A Process and Product, 142**  
*Louise Reynolds*
- 39 Grounded Theory: An Interpretation of Social Reality, 145**  
*David Long*

### PART EIGHT Qualitative Analysis

- 40 Data Collection Methods for Qualitative Research, 149**  
*Brendan Shannon*
- 41 Data Management in Qualitative Research, 151**  
*Brendan Shannon*
- 42 Types of Qualitative Data, 154**  
*Belinda Flanagan*
- 43 Developing Themes, 157**  
*Belinda Flanagan*

## SECTION 5 Other Ways to Answer the Question

---

### PART NINE Combining Research Methods and Other Designs

- 44 Mixed Methods Design, 162**  
*Natalie Anderson*
- 45 Consensus Group Methods—The Delphi Technique, 166**  
*Liam Langford*
- 46 Consensus Group Methods—The Nominal Group Technique, 171**  
*Liam Langford*
- 47 Cost-Effectiveness Research, 175**  
*Jonathan Foo, You You, Kieran Walsh and Stephen Maloney*

## SECTION 6 Sharing New Knowledge

---

### PART TEN Disseminating and Implementing Research

- 48 Writing and Getting Your Research Published, 180**  
*Brett Williams and Peter O'Meara*
- 49 Research Dissemination and Bibliometrics, 184**  
*Bronwyn Beovich*
- 50 The Implementation (Translation) Process, 187**  
*Leon Baranowski*
- 51 Grant Writing and Team Building, 190**  
*David Reid*

### PART ELEVEN The Future of Paramedicine Research, Summary and Conclusion

- 52 Setting Up the Future of Paramedicine, 194**  
*Walter Tavares*
- 53 Summary, Recommendations and Conclusions, 197**  
*Alexander Olausson, Kelly-Ann Bowles, Bill Lord and Brett Williams*
- Index, 198

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# PREFACE

Paramedicine is an established profession in some countries, and an emerging profession in others. Entry-to-practice education is increasingly university-based, and the amount of discipline-specific evidence underpinning paramedicine is rapidly expanding, with a unique classification for paramedicine research recently approved in Australia and New Zealand. Other jurisdictions like United Kingdom are also following suit when it comes to the true acknowledgment of paramedicine as its own area of research, and this vital step will, without a doubt, have positive international implications.

A cornerstone underpinning a profession is having its own unique body of knowledge or theory. A critical step in building a body of knowledge is generating and publishing high-quality scientific work in peer-reviewed journals. This research typically arises from the identification of clinical, operational or professional questions that need to be answered in order to inform practice and policy.

A recent review completed by some of the editors of this book found that only 12% of the top 100 most-cited articles relating to paramedicine were led by paramedics. This is a lost opportunity, because not only are paramedics the eyes and ears directly experiencing issues that need improvement or further investigation to understand the problem (and thus research by extension), they are also the heads and hands that will be implementing the new evidence. However, paramedics have traditionally had less opportunities to lead research when compared to other health and medical professionals. This lack of research confidence and 'know-how' are the first barriers we need to overcome in the development of a strong paramedic research community.

The aim of this book is to introduce paramedics and out-of-hospital clinicians to the principles and practice of research, in the hope it will support understanding of the importance of scientific enquiry, educate paramedics about the importance of research and evidence-based practice, and inspire paramedics to undertake research or even consider research as a career opportunity.

A unique textbook for research in paramedicine – compared to the many generic resources that exist – is required because many of the core concepts in research have special challenges when carried out in the paramedic practice setting. We also believe that a dedicated book like this will be more engaging and assist your learning and understanding through the use of real-life out-of-hospital topics and trials.

There is more to paramedicine than, for instance, deciding on whether or not epinephrine is indicated in cardiac arrest. Equally important topics include the wellbeing and education of paramedics, as well as expanding the role of paramedic-led healthcare. All these topics require different research approaches, which is why we have covered several methodologies in this book.

We have split this book up into more than 50 chapters to function as a rapid-reference manual. We have deliberately kept the chapters succinct to enhance the conceptual understanding, avoiding details that may be unnecessarily complex. Each chapter is instead supplemented by a list of further readings and suggested resources for the reader to explore in further detail. So, in short, this book should serve as the first step in your research journey.

## SUGGESTED AUDIENCE

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The primary audience of this book is the paramedic or out-of-hospital clinician who is looking to start their research journey or expand their current research knowledge. As the area of paramedicine research is developing, we are finding more paramedics and out-of-hospital clinicians are broadening their education and developing their own research skills. This may be occurring in structured academic courses, or may be through a self-directed expansion to one's own knowledge. Regardless of the approach to this new skill development, the pathway into research can be very daunting. With so much information available, it can be difficult for a new researcher to know where to start. This book is designed with that trepidation and confusion in mind. There is no presumption of knowledge before you open it. For some, this book may reinforce some of their current knowledge, while expanding their horizons to other research approaches. Either way, this book should offer every reader the opportunity to gain a basic understanding of the diverse aspects of research.

## ACKNOWLEDGMENTS

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Paramedicine research is well known for its networks and collaborative approach. The development of this book is no different. As can be seen by reviewing the contributor's names and locations, this book represents the four corners of the globe, showing the diverse and expansive skill set of paramedicine researchers internationally. These people

have given their time and expertise for the development of the next generation of paramedicine researchers. All have contributed to this book because they understand the exciting time that paramedicine research is currently in, and they hope that their contribution will help develop research passion in paramedics for years to come.

We hope that you will find this resource useful and look forward to reading your completed research in print. Your contribution to the body of paramedicine evidence will not only help patients and paramedics in all pertinent areas, but also leave a legacy of a foundational stone in the evolution of paramedicine.

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# CONTRIBUTORS

**Talal AlShammari PhD**

Department of Emergency Medical Care, College of Applied Medical Sciences, Imam Abdulrahman bin Faisal University, Saudi Arabia

**Ibrahim Althagafi BParamedic,  
MSci(DisasterMedManagement), PhD candidate**

College of Health and Medicine, School of Nursing, University of Tasmania, Australia

**Natalie Elizabeth Anderson RN, BA, BHSc,  
MSc(Hons), PhD**

Faculty of Medical and Health Sciences, University of Auckland, New Zealand;  
Auckland City Hospital Emergency Department, New Zealand

**Emily Andrew BSc(Biomedical), MBiostat,  
PhD candidate**

Department of Epidemiology and Preventive Medicine, Monash University, Australia;  
Centre for Research and Evaluation, Ambulance Victoria, Australia

**Richard Armour BParamedPrac, MSc,  
MParamedicine(CriticalCare)**

Ambulance Victoria Australia;  
Monash University, Australia

**Leon Baranowski MSc(AdvPract), MEd(ClinEd)**

British Columbia Emergency Health Services, Canada;  
Justice Institute of British Columbia, Canada

**Alan M Batt PGCME, MSc, PhD, FHEA**

Department of Paramedicine, Monash University, Australia;  
Paramedic Programs, Fanshawe College, Canada

**Bronwyn Beovich BAppSc, MChSc**

Department of Paramedicine, Monash University, Australia

**Audrey L Blewer MPH, PhD**

Department of Family Medicine and Community Health, Department of Population Health Sciences, Duke University School of Medicine, United States;  
Department of Health Services and Systems Research, Duke-NUS Medical School, Singapore

**Ted Brown BScOT(Hons), GCHPE, OT(C), OTR,  
MRCOT, MSc, MPA, PhD, FOTARA, FAOTA**

Department of Occupational Therapy, School of Primary and Allied Health Care, Faculty of Medicine, Nursing and Health Sciences, Monash University, Australia

**Madison Brydges MA, PhD candidate**

Department of Health Aging & Society, McMaster University, Hamilton, Canada

**Yu-Tung Chang PhD(HealthPromotion&HealthEd)**

Taiwan Society of Paramedicine, Taiwan

**Niamh M Cummins BSc, MSc, PhD**

School of Medicine, University of Limerick, Ireland;  
Irish Paramedicine Education and Research Network (IPERN), Ireland

**Tom Davidson MCPara, BSc(Hons), MSc, PhD  
candidate, HEA fellow**

Centre of Excellence in Paramedic Practice, Institute of Health, University of Cumbria, United Kingdom

**Dale G Edwards BHLthSci(Paramedic),  
GradCertEd(Workplace Training and Assessment),  
Med(Curriculum Design), EdD, FACPara**

Paramedicine Program, Tasmanian School of Medicine, University of Tasmania, Australia

**Belinda Flanagan AssocDipSci(Ambulance),  
BApplSci(Nurs), GradCertProfLearning, MPH,  
Mid, PhD**

Tasmanian School of Medicine, University of Tasmania, Australia

**Jonathan Foo BPhysio(Hons), PhD**

Department of Physiotherapy, School of Primary and Allied Health Care, Faculty of Medicine, Nursing and Health Sciences, Monash University, Australia;  
Society for Cost and Value in Health Professions Education, Australia

**Susan Furness BEmergHlth(Paramedic), PhD**

Department Rural Community Health, La Trobe Rural Health School, Australia

**Cameron McRae Gosling BAppSc(HM),  
Grad Dip(Ex Rehab), MAppSc(Research), PhD**  
Department of Paramedicine, Monash University, Australia

**Jennie S Helmer Advanced Care Paramedic, MEd**  
School of Population and Public Health, University of British  
Columbia, Canada;  
Paramedic Academy, Justice Institute of British Columbia,  
Canada;  
British Columbia Emergency Health Services, Canada

**Andrew Fu Wah Ho MBBS, MMED, MPH**  
Department of Emergency Medicine, Singapore General  
Hospital, Singapore;  
Pre-hospital and Emergency Research Center, Duke-NUS  
Medical School, Singapore

**Gemma Howlett BSc(Hons), MSc, MCPara,  
PhD candidate, HEA Senior Fellow**  
University of Cumbria, United Kingdom

**Ross Anthony Iles BPhysio(Hons),  
GradDipWorkDisabilityPrevention, PhD**  
School of Public Health and Preventive Medicine,  
Monash University, Australia

**Paul Andrew Jennings BNur, GradCertAdvNsg,  
GradCertBiostat, GCHPE, MCLinEpi, PhD**  
Ambulance Victoria, Australia;  
Department of Paramedicine and Department of  
Epidemiology and Preventive Medicine, Monash  
University, Australia

**Liam Langford BHSci(Paramedic), GradCertHEd,  
MPublicHealth**  
Australasian College of Paramedicine, Australia

**William J Leggio, Jr NRP, EdD**  
Office of the Chief Medical Officer, Austin/Travis County  
EMS System and City of Austin, United States

**Nan Liu PhD**  
Centre for Quantitative Medicine and Programme, Health  
Services and Systems Research (HSSR), Duke-NUS  
Medical School, Singapore

**David Nicholas Long AdvDip ParaSc,  
BHlthSc(Pre-HospCare), BEd(Hab),  
GradCertAcadPrac, PhD, FHEA**  
Paramedic Science, School of Health and Medical Sciences,  
University of Southern Queensland, Australia

**Stephen Maloney BPhysio, MPH, MBA, PhD**  
Department of Physiotherapy, School of Primary and Allied  
Health Care, Faculty of Medicine, Nursing and Health  
Sciences, Monash University, Australia;  
Society for Cost and Value in Health Professions Education,  
Australia

**Ong Eng Hock Marcus MBBS, MPH, FRCS**  
Department of Emergency Medicine, Singapore General  
Hospital, Singapore;  
Health Services and Systems Research (HSSR), Duke-NUS  
Medical School, Singapore

**Ben Meadley DipParamedSci, BAppSci,  
GradCertAeromed, GradDipEmerg Health,  
GradDipIntensiveCareParamed, PhD, FACPara**  
Department of Paramedicine, Monash University, Australia;  
Ambulance Victoria, Australia

**Navindhra (Navin) Naidoo NDip(AEC), HDipEd,  
BTech(EMC), MPH, PhD (Forensic Medicine)**  
School of Health Sciences, Western Sydney University,  
Australia;  
Australasian College of Paramedicine, Australia

**Koshi Nakagawa MEM, EMT-P**  
Graduate School of Emergency Medical System, Kokushikan  
University, Japan

**Ziad Nehme BEmergHlth(Paramedic)(Hons), PhD,  
ASM, FACPara**  
Department of Epidemiology and Preventive Medicine,  
and Department of Paramedicine, Monash University,  
Australia;  
Centre for Research and Evaluation, Ambulance Victoria,  
Australia

**Yilin Ning PhD**  
Centre for Quantitative Medicine (CQM), Duke-NUS  
Medical School, United States

**Peter Francis O'Meara BHA, GradCertAgHlthMed,  
MPP, PhD**  
Department of Paramedicine, Monash University, Australia;  
The Paramedic Network, Australia

**Gerard M O'Reilly MBBS, MPH, MBiostat, AStat,  
PhD, FACEM**  
School of Public Health and Preventive Medicine, Monash  
University, Australia;  
Emergency and Trauma Centre, The Alfred, Australia;  
National Trauma Research Institute, The Alfred, Australia

**Alaa O Oteir PhD**

Department of Allied Medical Sciences, Faculty of Applied  
Medical Sciences, Jordan University of Science  
and Technology, Jordan;  
Department of Paramedicine, Monash University, Australia

**Robin Pap BTEchEMC, NDipEMC, HDipHET,  
MScMed(EmergMed)**

Western Sydney University, Australia

**Douglas Paton PhD**

College of Health and Human Sciences, Charles Darwin  
University, Australia

**Nigel Rees BSc(Hons), MSc, QAM, PhD, FCpara**

Welsh Ambulance Service NHS Trust, Wales

**David Reid DipHlthSci, BSci(Paramedical Science),  
GradCert HSM, GAICD, MHM(Hons),  
MACPara, PhD**

School of Medical and Health Sciences, Edith Cowan  
University, Australia

**Louise Reynolds BHSc, MPH, PGCertHE, PhD, FACP**

Victoria University, Australia

**Luke Robinson BOccTherapy(Hons), PhD, FHEA**

Department of Occupational Therapy, School of Primary and  
Allied Health Care, Faculty of Medicine, Nursing  
and Health Sciences, Monash University, Australia

**Ryo Sagisaka PhD, EMT-P**

Department of Integrated Science and Engineering  
for Sustainable Societies, Chuo University, Japan;  
Research Institute of Disaster Management and EMS,  
Kokushikan University, Japan

**Brendan Shannon BEmergHealth(PMed)(Hons),  
PhD candidate**

Department of Paramedicine, Monash University, Australia

**Paul Simpson AdvDipParamedScience(ICP),  
BHSc(PrehospCare), BEd(PD/H/PE),  
GradCert(PaedEmerg), GradCert(ClinEd),  
MScM(ClinEpi), PhD**

Western Sydney University, Australia

**Erin Claire Smith BhlthInfoManagement, MPH,  
MClinEpi, PhD**

Dentistry and Health Sciences, Faculty of Medicine,  
Melbourne University, Australia

**Karen Smith BSc, PhD**

Centre for Research and Evaluation, Ambulance Victoria,  
Australia;  
Department of Epidemiology and Preventive Medicine,  
Department of Paramedicine, Monash University,  
Australia

**Lindsay Mervyn Smith RN, BHLthSci, GradCertUniL&T,  
MNS, PhD**

School of Nursing, University of Tasmania, Australia

**Hideharu Tanaka MD, PhD**

Graduate School of Emergency Medical System, Research  
Institute of Disaster Management and EMS, Kokushikan  
University, Department of Sports Medicine, Kokushikan  
University, Japan

**Shota Tanaka BS, ATC, EMT-P**

Research Institute of Disaster Management and EMS,  
Kokushikan University, Japan

**Walter Tavares ACP, PhD**

Department of Paramedicine, Monash University, Australia;  
The Wilson Centre and Temerty Faculty of Medicine,  
University Health Network, University of Toronto,  
Canada;  
Institute of Health Policy, Management and Evaluation  
(IHPME), Dalla Lana School of Public Health, University  
of Toronto, Canada;  
York Region Paramedic and Senior Services, Community  
Health Services Department, Regional Municipality of  
York, Canada

**Kieran Walsh MB, FRCPI**

BMJ Learning and Quality, BMJ, London, United Kingdom;  
Society for Cost and Value in Health Professions Education,  
Australia

**Sam Willis BSc(ParamedicSci)(Hons), MAEd(research),  
PhD candidate**

Curtin University, Australia

**You You PhD**

Institute of Economics of Education and Institute of Medical  
Education, Peking University, China;  
Society for Cost and Value in Health Professions Education,  
Australia

# The Importance of Research for Paramedicine as a Profession

*William J Leggio and Niamh M Cummins*

## LEARNING OUTCOMES

1. Identify professional aspects of paramedicine influenced by research
2. Describe the intersections of research and the paramedicine profession
3. Demonstrate an understanding of the importance of research for paramedicine as a profession

## INTRODUCTION

The publication of this book focused on research for paramedicine, authored by leading international researchers, likely serves as a pinnacle for our profession across developed and developing countries. Research remains a professional gap in paramedicine regardless of the level of sophistication of the system or level of practice. There are examples of completed national emergency medical services (EMS) research agendas aimed to influence the profession by highlighting research gaps and opportunities to better understand the profession and patient care.<sup>1-5</sup> There are similar examples advocating for international<sup>6</sup> or national research agendas,<sup>7</sup> and strategies related to research<sup>8</sup> or evidence-based guidelines<sup>9</sup>.

Historically, paramedicine has relied on 'heirloom knowledge' or on evidence generated by other health professions. Though there are certainly a few notable exceptions, paramedicine researchers remain a small but growing community. Paramedicine researchers are producing peer-reviewed scholarly contributions; however, many EMS and out-of-hospital publications are frequently still led or completely authored by non-paramedic clinicians such as physicians or nurses.<sup>10</sup>

One way for the profession to grow autonomy beyond that enjoyed when providing out-of-hospital patient care is by leading original research. Through research, the profession can evaluate evidence and determine practice decisions rather than relying on researchers from different clinical disciplines to lead such efforts. This is not to

dismiss the importance of collaboration and interprofessional approaches to conducting research as paramedicine itself serves many functions between medicine, public safety and public health. The growth and appreciation for research in paramedicine that culminated in the publication of this book hopefully represents a critical mass for the profession to demonstrate a basis and value for its practice, clinician education and performance of service providers.

The following are examples of the broad-ranging impact of a research-rich environment on key aspects of the paramedic profession.

## RESEARCH-INFORMED PRACTICE AND PATIENT OUTCOMES IN PARAMEDICINE

Research-informed practice is a key component of modern healthcare, and health services benefit from research through an overall improvement in the quality of patient care and increased patient safety. Demonstrating improved quality of patient care requires research using patient outcome data and development of evidence-based practice (EBP). Although discussed more in Chapter 3, a strong research culture is vital in EBP; however, this has developed more slowly in paramedicine. Providers broadly document the response to out-of-hospital interventions, but the concept of researching the quality of patient care and patient outcomes does extend beyond out-of-hospital data. The continuum of care the patient receives during the same encounter is also vitally important. This separation in

research may be attributed to the fact that research is more challenging in the out-of-hospital setting; however, paramedicine is both dynamic and innovative and is rapidly evolving.

## RESEARCH AND CLINICIAN EDUCATION IN THE PARAMEDIC PROFESSION

Traditionally, education in paramedicine had been vocational 'on the road' training which meant there had been less focus on research and evaluation skills. Internationally, many jurisdictions have progressed to a higher education model and research literacy has developed significantly in paramedicine. However, to be recognised as healthcare professionals on an equal footing with nursing, medicine and other allied health professions it is necessary for paramedics and learners to become more than just research consumers. This likely requires a deepened education pedagogy for both initial and continued education strategies related to research-informed practice and research competencies. In order to bridge the evidence-practice gap, paramedicine as a profession needs to focus on knowledge generation, knowledge translation and evidence implementation.

## RESEARCH, PROFESSIONALISATION AND THE PERFORMANCE OF SERVICE PROVIDERS

Fostering a learning culture is foundational for service providers to support the role of research in the paramedicine profession. Just as clinicians have a role in being more than research consumers, so do service providers. This includes researching best practices in retaining staff, increased job satisfaction and workforce safety as just a few examples. Service providers also have roles in researching the translation of both clinical and operational evidence into practice and they also need to support, mentor and cultivate paramedicine researchers. Accountability to outcomes and implementation of clinical and operational evidence likely requires service providers to support quality assurance and performance improvement activities. Quality assurance research is one function service providers have in assessing consistency of care and quality of clinical decisions, as two examples. Systems thinking and performance improvement provide service providers with frameworks and approaches to improve variance and processes influencing clinical and operational outcomes.

## CONCLUSION

The importance of research and knowledge translation for paramedicine as a profession cannot be understated. Key

reasons for building research capacity in the paramedic profession include improving outcomes for patients, enhancing job satisfaction and confidence for clinicians, and optimising performance, efficiency and staff retention for EMS providers. There is a need for increased research in the profession and particularly for research which is paramedic driven and led. This will enable paramedics to evolve beyond being research consumers through becoming research generators and research implementers of their own profession. This may require an evolution of roles in the profession and particularly a clearly defined career pathway for researchers in paramedicine. To bridge the evidence-practice gap will require multiple methodological approaches and expertise in observational and experimental research methods including collection and analysis of quantitative and qualitative data. This chapter has just highlighted broad reasons for the importance of increasing paramedicine research rather than attempting to craft an exhaustive list. Reading this book and published EMS literature will provide insights to the totality of the gaps in our professional body of research. In terms of professionalisation, paramedics can become masters of their own destiny, and research is key to achieving this goal.

## REVIEW QUESTIONS

1. What are your thoughts on shifting the paramedicine profession from research consumers to generators and implementers?
2. What strengths and weaknesses do paramedics have that will facilitate the building of research capacity within the profession?
3. In your opinion, what research topics should be prioritised for paramedicine as a profession?

## SUGGESTED FURTHER READING

The National EMS Research Agenda Writing Team. National EMS Research Agenda [Internet]. National Highway Traffic Safety Administration; 2001 Dec. Report No.: DTN 22-99-H-05100. Online. Available: [https://www.ems.gov/pdf/National\\_EMS\\_Research\\_Agenda\\_2001.pdf](https://www.ems.gov/pdf/National_EMS_Research_Agenda_2001.pdf)

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# Overview of Research Designs and the Hierarchy of Evidence

*Cameron M Gosling*

## LEARNING OUTCOMES

1. Understand levels of evidence and how the choice of design influences its strength
2. Identify and describe types of observational and experimental research designs

## INTRODUCTION

The paramedicine researcher has many quantitative research design options to investigate the problem at hand. Often it is about a best-fit design to answer your research question, rather than the perfect design. The hierarchy of evidence provides an opportunity for novice researchers to understand the strength of designs selected and balance against the inherent biases within those designs before proceeding.

## HIERARCHY OF EVIDENCE PYRAMID

The pyramid shown in Figure 9.1 is a graphical representation of the 'trade-off' between the quality of the evidence generated by each quantitative research design and the bias that would be found in each of those research designs. As the pyramid ascends towards a peak, the bias in research design declines; however, this evidence increases in quality as the designs become more robust. The greatest available evidence is for meta-analyses and systematic reviews of randomised controlled trials, increasing the confidence that significant results indicate causal relationships.

## CASE STUDY/CASE SERIES

These studies are sometimes called a case report, and are often seen with new and emerging events, such as the early emergence of the COVID-19 virus. Case studies are

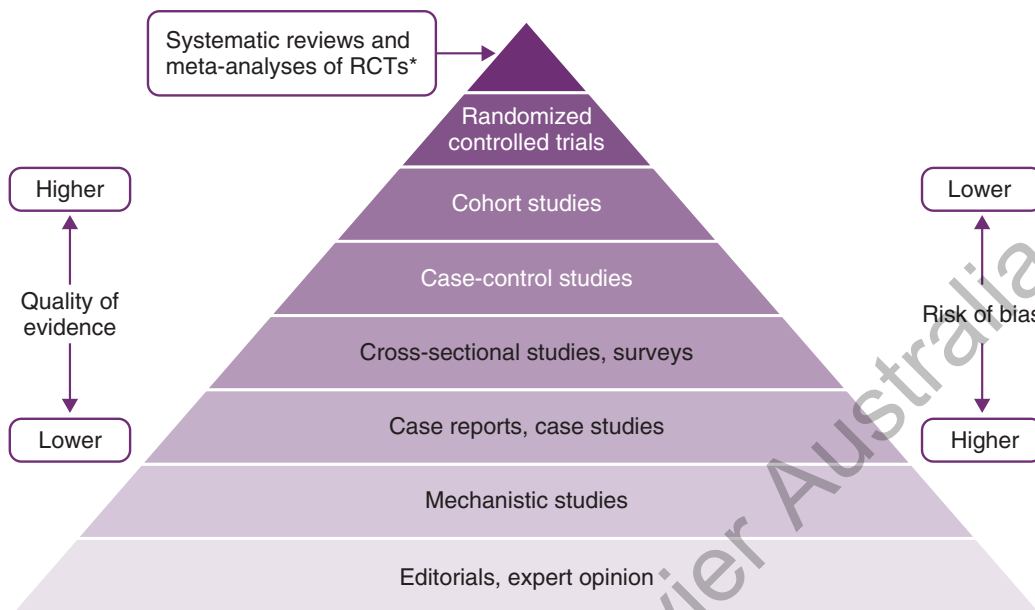
detailed reports by one or more health professionals on the profile of a single patient and/or adverse event, particularly those that are rare in nature. Alternatively, a case series is a report on a series of patients with an outcome of interest. In these studies, there is generally no comparison group and they are deemed to be hypothesis generating. More detailed information, including relevant examples, can be found in Chapter 23.

## ECOLOGICAL STUDY

An ecological, or correlation, study is where the units of analysis are populations or groups of people, rather than individuals. These designs are often used to compare disease frequencies between different populations during the same period of time, or between the same population at different time periods.

## CROSS-SECTIONAL STUDY

Cross-sectional designs are similar to ecological, but we are now looking at individuals instead of populations. In a cross-sectional study, the units of analysis are individuals and are utilised to measure prevalence of disease and measures of exposure. Both disease and exposure can be assessed at the same point in time in a cross-sectional study. These study designs are good for establishing prevalence, which is the proportion of individuals with the outcome of



**Figure 9.1** Hierarchy of evidence pyramid. \*Meta-analyses and systematic reviews of observational studies and mechanistic studies are also possible. RCTs (randomised controlled trials). (Source: Yetley EA, MacFarlane AJ, Greene-Finestone LS, Garza C, Ard JD, Atkinson SA, et al. Options for basing Dietary Reference Intakes (DRIs) on chronic disease endpoints: report from a joint US-/Canadian-sponsored working group. *The American Journal of Clinical Nutrition*. 2017 Jan;105(1):249S–285S. Online. Available: <https://doi.org/10.3945/ajcn.116.139097>)

interest at a particular point of time. Questionnaires taken at one time point are often cross-sectional studies. Further information on cross-sectional study designs is provided in Chapter 24.

### CASE-CONTROL STUDY

A case-control study design is an effective method for the investigation of rare diseases or outcomes. These designs compare the occurrence of possible causes of an outcome in cases (someone who develops a condition) and controls (someone who does not develop the condition) where data of that outcome is collected at one point in time. The exposures experienced by the participants are collected at a previous point in time. In this respect, these designs are retrospective as the investigator is looking backward from the disease or outcome to identify possible causes. This design is often used in research looking at factors that may lead to cancer risk factors, where the researcher will compare factors in people who have developed cancer with people who have not developed cancer. Chapter 25 provides further insights into the use of case-control designs.

### COHORT STUDY

A cohort study design can be observational and analytical. These designs ‘allow nature to take its course’ where the cohort with a common characteristic is followed. These study designs may also use a control, or comparison, group and data may be tracked prospectively or retrospectively. The incidence of an outcome is compared in participants selected on the basis of a shared characteristic between those exposed and those not exposed to a risk factor during the study time. Participants are then followed up to identify whether or not they have developed the outcome of interest. Cohort designs can provide good evidence of cause-and-effect relationships and are described in more detail in Chapter 26.

### RANDOMISED CONTROLLED TRIAL (RCT)

The effects of an intervention are measured by comparing the outcomes in the group you have intervened with (experimental group) with that of the group you haven’t intervened with (control group). RCTs are the ‘gold standard’ design for studying cause-and-effect relationships and are

the cornerstone of evidence-based medicine. RCTs use tightly controlled study environments to limit external influences where participants are allocated to treatment/intervention or control/placebo groups using a random mechanism. Participants have an equal chance of being allocated to an intervention or control group. RCTs are covered in more detail in Chapter 27.

## SYSTEMATIC REVIEWS AND META-ANALYSES

A systematic review is a methodology designed to identify, review, appraise and assimilate all available evidence on a research question. A systematic review may be narrative or analytical in nature, but is approached using a systematic method aimed at minimising bias. A meta-analysis generally uses the pooled results of RCTs to derive an overall conclusion for a defined question. The strength of these designs is the expansive search strategy, assessment of study quality and the more precise estimate of the effect of the intervention on the outcome of interest. Systematic reviews and meta-analyses are discussed in Chapter 15.

## CONCLUSION

The type of design selected by a researcher is dependent on the structure of the research question. Once the question

has been established, it is imperative a design is selected that maximises the quality of evidence collected while minimising any inherent biases. Other aspects should be considered when selecting the best design for your research, including ethical consideration. A useful tool to remember as a researcher is the hierarchy of evidence pyramid, which provides an easily referenced visual schema to aid in methodological selection.

## REVIEW QUESTIONS

1. In your clinical work you have noticed that a small number of your patients are responding in an unusual way to medications in the month after an out-of-hospital cardiac arrest. What may be an initial way for you to share this finding with your colleagues?
2. A current clinical practice guideline feels dated and is possibly leading to further harm for patients. What may be a good way to produce evidence to inform a clinical practice guideline change?

## SUGGESTED FURTHER READING

Cochrane Training. Evidence Essentials. Online. Available: <https://training.cochrane.org/essentials>.