

Table of Contents

ABSTRACT	III
TABLE OF CONTENTS	V
LIST OF TABLES.....	IX
LIST OF FIGURES	X
ABBREVIATIONS.....	XII
PUBLICATIONS AND PRESENTATIONS	XIII
ACKNOWLEDGEMENTS.....	XXI
PREFACE – INTRODUCTION AND AIMS OF THESIS.....	1
<i>Origin of research projects and details of fieldwork.....</i>	3
<i>Gap in emergency and critical care training in rural hospitals.....</i>	6
<i>Resource limitations in emergency and critical care service provision</i>	6
<i>'Participatory action research' - framework for methods used.....</i>	7
CHAPTER OUTLINE	9
CHAPTER 1: OVERVIEW OF ORGANOPHOSPHORUS PESTICIDE POISONING	11
HIGHLIGHTS	12
INTRODUCTION.....	13
EPIDEMIOLOGY.....	14
PATHOPHYSIOLOGY	14
CLINICAL FEATURES.....	16
DIFFERENTIAL DIAGNOSIS.....	19
INVESTIGATIONS	19
<i>RBC-AChE.....</i>	21
<i>PChE</i>	21
TREATMENT.....	23
PROGNOSIS.....	29
PREVENTION.....	29
CONTROVERSIES	29
CHAPTER 2: A SYSTEMATIC COMPARISON OF RECOMMENDATIONS FOR THE MEASUREMENT OF ACETYLCHOLINESTERASE IN ACUTE ORGANOPHOSPHORUS PESTICIDE POISONING	30
ABSTRACT	31
BACKGROUND	33
METHODS	34
RESULTS	37
<i>Citation of scientific literature</i>	39
DISCUSSION	43
CONCLUSION	46
CHAPTER 3: A SYSTEMATIC COMPARISON OF RECOMMENDATIONS FOR ADVANCED LIFE SUPPORT (ALS) IN ORGANOPHOSPHORUS POISONING	48
ABSTRACT	49
BACKGROUND	51
<i>Acute ALS in OP poisoning – literature recommendations</i>	52
METHODS	54

<i>Specific Therapies in ALS framework.....</i>	59
RESULTS	59
<i>Proportion of texts with ALS framework</i>	63
<i>General recommendations for antidote therapy</i>	64
<i>Other therapies recommended.....</i>	68
<i>Airway, breathing, circulation, disability and decontamination</i>	68
<i>Disability, decontamination and post-resuscitation monitoring recommendations</i>	69
<i>Patterns of citations of supporting literature.....</i>	70
DISCUSSION.....	70
<i>Guideline for ALS in OP poisoning.....</i>	71
<i>Use of guidelines to manage case scenarios</i>	78
<i>OP management's influence on aspects of standard ALS.....</i>	80
<i>Circulation.....</i>	80
<i>Decontamination.....</i>	81
<i>Staff Safety and Personal protection</i>	81
<i>Future clinical studies</i>	82
<i>Translation of ALS guidelines in Developed and Underdeveloped EM systems – impressions from the field</i>	83
<i>Limitations</i>	84
<i>Further development of the ALS guideline.....</i>	84
CONCLUSIONS	85
CHAPTER 4: EVALUATION OF THE TEST-MATE CHE (CHOLINESTERASE) FIELD KIT IN ACUTE ORGANOPHOSPHORUS POISONING	87
ABSTRACT	88
INTRODUCTION.....	89
MATERIALS AND METHODS	90
RESULTS	97
DISCUSSION.....	101
<i>Limitations</i>	103
<i>Future research directions.....</i>	103
CONCLUSIONS	104
CHAPTER 5: EFFECT OF ACETYLCHOLINESTERASE (AChE) POINT-OF-CARE TESTING IN OP POISONING ON KNOWLEDGE, ATTITUDES AND PRACTICES OF TREATING PHYSICIANS IN SRI LANKA	105
ABSTRACT	106
BACKGROUND	108
METHODS	109
<i>Selection of Doctors.....</i>	109
<i>Intervention</i>	110
<i>Study endpoints:.....</i>	113
RESULTS	116
<i>Knowledge</i>	117
<i>Attitudes: AChE in OP poisoning management</i>	118
<i>Scenario Analysis: Ordering AChE at different time points in admission.....</i>	123
<i>Scenario analysis: Ordering AChE and guidance of oxime therapy</i>	126
<i>Scenario Analysis: Early discharge and ordering AChE</i>	127
<i>Other reasons for ordering AChE based on comments</i>	130

DISCUSSION	131
<i>Difficulty in interpretation of results: Pitfalls in AChE monitoring.....</i>	132
<i>Lack of specific decision rules for AChE guidance.....</i>	132
<i>Clinical correlation of AChE, and outcome.....</i>	133
<i>Study intervention provided without education or training.....</i>	134
<i>Limitations</i>	135
<i>Less "AChE test experience" than expected.....</i>	135
<i>Mixed methods approach for future research on use of POC tests.....</i>	136
CONCLUSIONS	137
CHAPTER 6: THE EFFECTIVENESS OF A 'TRAIN-THE-TRAINER' MODEL OF RESUSCITATION EDUCATION FOR RURAL PERIPHERAL HOSPITAL DOCTORS IN SRI LANKA	138
ABSTRACT	139
INTRODUCTION.....	141
MATERIALS AND METHODS	143
<i>Training the trainers</i>	143
<i>Peripheral Hospital Resuscitation Workshops (Training Intervention).....</i>	145
<i>Outcomes.....</i>	147
<i>Knowledge assessment: MCQ test.....</i>	147
<i>Skills assessment: performance in a cardiac arrest scenario</i>	148
<i>Assessment of compression and ventilations</i>	149
<i>Assessment of initial approach and steps of CPR</i>	149
<i>Statistical analysis</i>	150
RESULTS	151
<i>MCQ Assessment.....</i>	154
<i>Scenario Assessment</i>	156
<i>Resuscitation Logbook.....</i>	162
DISCUSSION.....	162
<i>Improvement in Compressions and Ventilations.....</i>	163
<i>Retention of knowledge and skills over time.....</i>	165
<i>Study limitations.....</i>	167
<i>Future research directions.....</i>	171
<i>Train the trainer resuscitation education: complex intervention</i>	171
CONCLUSIONS	172
<i>Supporting Information</i>	173
CHAPTER 7: CONCLUSIONS	174
SUMMARY OF CONTRIBUTIONS.....	175
<i>AChE POC testing in resource limited secondary referral hospitals</i>	175
<i>Resuscitation training in rural peripheral hospitals.....</i>	176
CONCEPTUAL FRAMEWORKS & RESEARCH STRATEGY.....	180
<i>Health services research and training as knowledge translation.....</i>	180
<i>'Participatory action research' framework for methods</i>	182
<i>Benefits for local participants and systems</i>	185
FUTURE DIRECTIONS	187
<i>AChE in guiding management.....</i>	187
<i>Resuscitation training in OP poisoning</i>	188

REFERENCES	192
APPENDICES.....	210
APPENDIX A PUBLICATIONS	210
<i>Appendix A1 Organophosphorus and Carbamate Agents (Anticholinesterase pesticide poisoning).....</i>	210
<i>Appendix A2 Evaluation of the Test-mate ChE (Cholinesterase) field kit in acute organophosphorus poisoning</i>	220
<i>Appendix A3 Effect of acetylcholinesterase (AChE) point-of-care testing in OP poisoning on knowledge, attitudes and practices of treating physicians in Sri Lanka.....</i>	233
<i>Appendix A4 The effectiveness of a “Train the trainer” model of resuscitation education for rural peripheral hospital doctors in Sri Lanka</i>	248
<i>Appendix A5 Knowledge translation in international emergency medical care.....</i>	265
APPENDIX B SUPPLEMENTARY MATERIAL FOR KNOWLEDGE, ATTITUDES AND PRACTICE STUDY ...	271
<i>Appendix B1 Protocol for study intervention.....</i>	271
<i>Appendix B2 Survey.....</i>	275
APPENDIX C SUPPLEMENTARY MATERIAL FOR TRAIN-THE-TRAINER STUDY	282
<i>Appendix C1 Resuscitation training intervention – overview of workshops.....</i>	283
<i>Appendix C2 Instructor workshop ('training the trainers') – course outline</i>	289
<i>Appendix C3 Resuscitation Training "Instructor Manual".....</i>	291
<i>Appendix C4 Peripheral hospital resuscitation workshop – course content and outline</i>	339
<i>Appendix C5 Supporting material for trainers & checklists of performance.....</i>	340
<i>Appendix C6 MCQ test used at assessments.....</i>	347
<i>Appendix C7 Script for resuscitation scenario & picture of assessment room</i>	356
<i>Appendix C8 Marking schedule for video assessment.....</i>	360

List of Tables

TABLE 1-1 CLINICAL SYNDROMES AND MANIFESTATIONS OF ANTICHOLINESTERASE POISONING.....	17
TABLE 1-2 ANTIDOTES FOR POISONING WITH ANTICHOLINESTERASE INSECTICIDES	26
TABLE 2-1 COVERAGE OF TOPICS RELATED TO RECOMMENDATIONS OF AChE MEASUREMENT IN OP POISONING MANAGEMENT AND FREQUENCY OF CITATIONS TO LITERATURE BY DIFFERENT TEXTS.	42
BOX 3-1 METHOD FOR DETERMINING WHETHER A TEXT WAS CONSIDERED TO PROVIDE RECOMMENDATIONS WITHIN AN “ALS FRAMEWORK”;-.....	59
TABLE 3-1 QUESTIONS ANSWERED BY DIFFERENT TEXTS ACROSS A RANGE OF TOPICS COVERING ALS RECOMMENDATIONS IN ACUTE OP POISONING.	60
TABLE 3-2.1 ALS GUIDELINE FOR ACUTE OP POISONING – SEVERITY LEVEL 1.1 (CARDIORESPIRATORY ARREST).....	72
TABLE 3-2.2 ALS GUIDELINE FOR ACUTE OP POISONING – SEVERITY LEVEL 1.2 (CRITICAL ILLNESS / PERI-ARREST).....	73
TABLE 3-3.1 GUIDELINES FOR ATROPOINE ALS OF OP POISONING.....	75
TABLE 3-3.2 GUIDELINES FOR BENZODIAZPINES ALS OF OP POISONING.....	76
TABLE 3-3.3 INDICATIONS FOR INTUBATION AS PART OF ALS IN OP POISONING.....	76
TABLE 3-3.4 GUIDELINES FOR OXIMES IN OP POISONING	77
TABLE 4-1 CLINICAL CATEGORIES OF RBC-AChE ACTIVITY.	96
TABLE 4-2 PATIENT CHARACTERISTICS OF STUDY GROUP, NUMBER OF CHOLINESTERASE TESTS, AND SPECIFIC OP AGENTS INGESTED.	97
TABLE 4-3 DISTRIBUTION OF RBC-AChE RESULTS ACCORDING TO CLINICAL CATEGORY.	99
TABLE 5-1 SURVEY RESPONDENT CHARACTERISTICS.....	116
TABLE 5-2 ATTITUDES TOWARDS OXIME THERAPY AND AChE TESTING.	120
TABLE 6-1 DEMOGRAPHICS AND BASELINE CHARACTERISTICS OF THE STUDY POPULATION.....	154
TABLE 6-2 MEAN SCORES AND 95% CONFIDENCE INTERVALS FOR MCQ ASSESSMENT.	154
TABLE 6-3 THE EFFECT OF TRAINING ON VARIABLES OF RESUSCITATION SKILLS AS RECORDED BY THE LAERDAL MANNEQUIN.	155
TABLE 6-4 PERCENTAGE OF PARTICIPANTS APPROPRIATELY PERFORMING ASPECTS OF CHEST COMPRESSION AND BAG VALVE MASK VENTILATION PRE-TRAINING, IMMEDIATELY POST-TRAINING AND AT 6 WEEK AND 12 WEEK FOLLOW UP.	156
TABLE 6-5 PERFORMANCE IN VIDEO ASSESSMENT VARIABLES BEFORE AND AFTER THE TRAINING INTERVENTION.	159
TABLE 6-6 THE NUMBER OF REAL LIFE RESUSCITATION ENCOUNTERS REPORTED IN LOGBOOKS OF STUDY PARTICIPANTS.	162

List of Figures

FIGURE 1 SCHEMA OF A TRANSLATIONAL RESEARCH MODEL FOR CLOSING THE EVIDENCE-TO-PRACTICE GAP.....	2
FIGURE 2 MAP OF SRI LANKA SHOWING THE LOCATION OF CENTRAL AND PERIPHERAL HOSPITALS IN THE NORTH CENTRAL PROVINCE(12).....	5
FIGURE 1-1 MECHANISM OF ORGANOPHOSPHORUS (OP) POISONING- SHOWING THE THREE MAIN REACTIONS THAT OCCUR; 1) REVERSIBLE INHIBITION 2) REACTIVATION AND 3) IRREVERSIBLE INHIBITION ('AGEING').....	15
FIGURE 1-2 INTERPRETATION OF BIOMARKERS USED IN THE MANAGEMENT OF ANTICHOLINESTERASE POISONED PATIENTS.....	20
FIGURE 2-1 SEARCH STRATEGY FOR INCLUSION OF TEXTS IN THIS REVIEW.....	36
FIGURE 2-2 COVERAGE OF TOPICS ON AChE RECOMMENDATIONS FOR GUIDING CLINICAL MANAGEMENT.....	38
FIGURE 2-3 COVERAGE OF TOPICS ON AChE BIOCHEMISTRY AND PITFALLS IN MEASUREMENT AND INTERPRETATION OF ASSAYS	40
FIGURE 2-4 EVALUATION OF CITATIONS QUOTED IN CHAPTER ON OP POISONING, SHOWING A) THE TOTAL NUMBER OF CITATIONS PER TEXT, B) THE NUMBER OF CITATIONS BY TYPE OF TEXT, AND C) THE PROPORTION OF RECOMMENDATIONS FOR DIFFERENT DOMAINS OF OP POISONING THAT REFER TO EVIDENCE.	41
FIGURE 3-1 CASE SCENARIOS DEPICTING A RANGE OF SEVERITY OF ACUTE OP POISONING PRESENTATIONS REQUIRING ACUTE ALS.....	53
FIGURE 3-2 SEARCH STRATEGY FOR INCLUSION OF TEXTS IN THIS REVIEW.....	57
FIGURE 3-3 RESUSCITATION GUIDELINES IN OP MANAGEMENT TEXTS SHOWING A) THE PROPORTION OF TEXTS WRITTEN IN AN ALS FRAMEWORK, USING AN INSTRUCTIVE FORMAT B) WHICH ANTIDOTES INCLUDED IN ALS FRAMEWORK, AND C) THE PRIORITY AND GIVEN TO ATROPINE OVER OXIMES IN THE ALS FRAMEWORK	62
FIGURE 3-4 RECOMMENDATIONS FOR SPECIFIC THERAPIES IN OP POISONING SOURCED FROM ALL TEXTS	65
FIGURE 3-5 REVIEW OF LITERATURE RECOMMENDATIONS REGARDING AIRWAY, BREATHING AND CIRCULATION COMPONENTS OF ALS IN OP POISONING RESUSCITATION	66
FIGURE 3-6 REVIEW OF LITERATURE RECOMMENDATIONS REGARDING THE DISABILITY, DECONTAMINATION AND STAFF SAFETY ASPECTS OF ALS IN OP POISONING RESUSCITATION. POST RESUSCITATION MONITORING RECOMMENDATIONS ARE ALSO DISPLAYED.....	67
FIGURE 4-1 STUDY PROTOCOL SHOWING FREQUENCY OF BLOOD TESTING FOR ACETYLCHOLINESTERASE.....	92
FIGURE 4-2 SCATTER DIAGRAM SHOWING RBC-AChE ACTIVITY DETERMINED BY THE TEST-MATE CHE FIELD KIT PLOTTED AGAINST ACTIVITY DETERMINED BY THE REFERENCE TEST.....	98
FIGURE 4-3 BLAND ALTMAN PLOTS SHOWING THE DIFFERENCE MEASUREMENT BETWEEN THE TEST-MATE CHE AND REFERENCE TEST RESULTS PLOTTED AGAINST THE MEAN OF BOTH METHODS FOR A) RBC-AChE AND B) PChe (*AFTER ADJUSTMENT TO U/ML OF WHOLE BLOOD).	100

FIGURE 4-4 SCATTER DIAGRAM SHOWING THE TEST-MATE PCHE ACTIVITY ARE PLOTTED AGAINST THE REFERENCE TEST PCHE ACTIVITY (*AFTER ADJUSTMENT TO U/ML OF WHOLE BLOOD).	101
FIGURE 5-1 FLOWCHART SHOWING DISTRIBUTION OF SURVEYS AND RESPONSE RATE.	111
FIGURE 5-2 SHOWS THE METHOD OF MAKING AChE LEVELS FROM OP POISONED PATIENTS AVAILABLE TO TREATING CLINICIANS (STUDY INTERVENTION).	112
FIGURE 5-3 KNOWLEDGE SCORES FOR QUESTIONS (BASED ON ANSWERS TO TRUE/FALSE STATEMENTS).....	117
FIGURE 5-4 ATTITUDES TOWARDS AChE TESTING IN ORGANOPHOSPHORUS MANAGEMENT.	119
FIGURE 5-5 ATTITUDES TOWARDS OXIME DOSE (A) AND DURATION (B) IN A CASE OF SEVERE OP POISONING, SHOW BY LEVEL OF AChE TEST EXPERIENCE.	122
FIGURE 5-6 PROPORTIONS OF RESPONDENTS ORDERING AChE OVER TIME ACCORDING TO THE CLINICAL SCENARIO.....	124
FIGURE 5-7 ASSOCIATION OF ORDERING AN AChE TEST WITH THE EARLY DISCHARGE OF A MILDLY POISONED PATIENT WHO HAS A) INITIALLY RECEIVED OXIMES, OR B) INITIALLY NOT RECEIVED OXIMES.	128
FIGURE 5-8 PROPORTION OF SURVEY RESPONDENTS PROVIDING CLARIFYING COMMENTS IN SCENARIOS OF A) SEVERE POISONING, WITH OXIME THERAPY, B) MILD POISONING, WITHOUT OXIME THERAPY.....	129
FIGURE 6-1 FLOWCHART SHOWING THE NUMBER OF PARTICIPANTS RECRUITED TO THE STUDY, RECEIVING THE TRAINING INTERVENTION AND RECEIVING FOLLOW UP MCQ ASSESSMENTS.	152
FIGURE 6-2 FLOWCHART SHOWING THE NUMBER OF PARTICIPANTS RECRUITED TO THE STUDY, RECEIVING THE TRAINING INTERVENTION AND RECEIVING FOLLOW UP SCENARIO ASSESSMENTS.	153
FIGURE 6-3 GRAPHS PLOTTING PERCENTAGE OF PARTICIPANTS ACHIEVING CLINICALLY RELEVANT BENCHMARKS (THOSE ACHIEVING BENCHMARK/TOTAL NUMBER IN STUDIED);	157
FIGURE 6-4A SHOWS PROPORTION OF PARTICIPANTS CARRYING OUT THE FOLLOWING RESPONSES FROM THE VIDEO ASSESSMENT COMPONENT OF THE SCENARIO (THOSE PERFORMING TASK/TOTAL NUMBER STUDIED);	160
FIGURE 6-4B SHOWS PROPORTION OF PARTICIPANTS WHO CORRECTLY PERFORMED I) OPENING OF THE AIRWAY (EITHER HEAD TILT, CHIN LIFT OR JAW THRUST), II) AN OBSTRUCTION CHECK, III) A BREATHING CHECK, AND IV) USED AN APPROPRIATE FACEMASK TECHNIQUE	161
FIGURE 7-1 PHOTOS SHOWING PARTICIPATION BETWEEN THE RESEARCH TEAM AND THE HOSPITAL STAFF WHILST CONDUCTING HEALTH SERVICES RESEARCH ON THE USE OF POC AChE TESTS IN A RURAL SECONDARY REFERRAL HOSPITAL.	183
FIGURE 7-2 PHOTOS SHOWING THE COLLABORATION AND PARTICIPATION BETWEEN THE RESEARCHERS AND LOCAL HEALTH SERVICE AND POLICYMAKERS (I.E. THE NORTH CENTRAL PROVINCE PROVINCIAL DEPARTMENT HEALTH SERVICE, NCP-PDHS) IN TRAIN-THE-TRAINER RURAL HOSPITAL RESUSCITATION STUDY.	184

Abbreviations

AChE	Acetylcholinesterase
ACLS	Advanced cardiac life support
ALS	Advanced life support
ANOVA	Analysis of variance
BLS	Basic life support
CBPR	Community-based participatory research
CPR	Cardiopulmonary resuscitation
DVD	Digital video disc
ETU	Emergency treatment unit
ECG	Electrocardiogram
ER	Emergency Room
GEE	Generalised estimating equations
HO	House officer
ILCOR	International liaisons committee on resuscitation
ICU	Intensive care unit
KT	Knowledge translation
LOQ	Limits of quantification
MCQ	Multiple choice question
MO	Medical officer
OP	Organophosphorus pesticide
OPD	Outpatient department
PAR	Participatory action research
PChE	Plasma cholinesterase, psuedocholinesterase or butyrylcholinesterse
PEFR	Peak expiratory flow rate
PGIM	Post graduate institute of medicine
POC	Point-of-care
RBC-AChE	Red blood cell acetylcholinesterase
RCT	Randomised controlled trial
SACTRC	South Asian clinical toxicology research collaboration
SHO	Senior House Officer
TTT	Train-the-trainer
WHO	World health organisation

Publications and Presentations

Papers embodied in this thesis: contributions and acknowledgements

Chapter 1

1. Rajapakse BN, Buckley NA (2012) Organophosphorus and Carbamate Agents (Anticholinesterase Pesticide Poisoning). In: David S, Brown A, Nelson, Banerjee, Anantharaman V, editors. Textbook of Emergency Medicine. Delhi, India: Wolters Kluwer Health (Lippincott, Williams and Wilkins).

Contributions:

BR and NB conceived and designed the study together. BR performed the literature review, and drafted the manuscript. NB provided guidance and edited the manuscript.

Chapter 4

2. Rajapakse BN, Thiermann H, Eyer P, Worek F, Bowe SJ, Dawson AH, Buckley NA. (2011) Evaluation of the Test-mate ChE (cholinesterase) field kit in acute organophosphorus poisoning. Ann Emerg Med 58: 559-564 e556.

Contributions:

BR and NB conceived the study and designed the protocol. NB and AD obtained research funding. BR and AD undertook recruitment of participating centres. BR contributed to the collection of the clinical data, and BR, HR, FW contributed to collection of the laboratory data. All authors were involved in the data analysis and interpretation. SB provided statistical advice regarding the study design and data analysis. BR drafted the manuscript and all authors contributed substantially in its revision. BR takes responsibility for the paper as a whole.

Acknowledgements in the publication:

I would like to express gratitude for the individuals who consented to participate in this study, the local physicians Dr S Jayamanna, Dr Samarakoon, Dr S Mendis, Dr

Jeganathan, who collaborated with the project, as well as all the staff of the South Asian Clinical Toxicology Research Collaboration (SACTRC) for their support.

I would also like to thank and acknowledge all the research assistants from SACTRC who were responsible for data collection and clinical auditing, and in particular Dr Vinothan Sunderalingam, Dr Manjula Wijeratne who coordinated data entry and Dr Voleena Dissanayake for data collection on ex-vivo studies. I am grateful to the trial co-ordinators Mr Umesh Chathuranga, Mr Lalith Senarathna, Mr Ashrofdeen, Mr F Mohamed for coordination of data collection, clinical auditing and sample handling.

Finally, I would like to acknowledge Dr Martin Bland for his advice on the statistical analysis and Dr Julian Haigh, Dr Richard Gordon, and Dr Jonathon Hofmann for their useful comments.

Chapter 5

3. Rajapakse BN, Neeman T, Buckley NA. Effect of acetylcholinesterase (AChE) point-of-care testing in OP poisoning on knowledge, attitudes and practices of treating physicians in Sri Lanka. BMC Health Serv Res. 2014;14:104.

Contributions:

BR and NB jointly designed the study. BR carried out the methodology, analysis and drafted the manuscript. NB helped with the analysis and revised manuscript drafts. TN advised on statistical aspects of the analysis and manuscript drafts. All authors read and approved the final manuscript.

Acknowledgements in the publication:

I would like to acknowledge the doctors who consented to participate in this study, the senior physicians and administrators Shaluka Jayamanna, MBBS, MD, Senarath Bandara Samarakoon, MBBS, MD, and Kapila Wickramanayake MBBS MIPH, for their

collaboration, and all the staff at the South Asian Clinical Toxicology Research Collaboration (SACTRC) for their support, especially the research assistants who aided the survey distribution and data entry.

I also thank the trial coordinators, Umesh Chathuranga, BSc (Pharmacy), Lalith Senarathna, M Med Sci (Clin Epi), Mohammed Ashrofdeen, BPharm, and Fahim Mohamed, BPharm MAppMgt (Health) for their role in data collection and clinical auditing.

Chapter 6

4. Rajapakse BN, Neeman T, Dawson AH (2013) The effectiveness of a 'train the trainer' model of resuscitation education for rural peripheral hospital doctors in sri lanka. PLoS ONE 8(11): e79491.

Contributions:

BR Conceived and designed the study, performed the experiments, analyzed the data and wrote the manuscript.

AHD also contributed towards the analysis by facilitating the research assistants and other infrastructure. He also made intellectual contributions and revised the Manuscript

TN provided statistical advice and revised the manuscript.

Acknowledgements in the publication:

I thank Dr W Attapattu, Dr D De Silva, and Dr P Bandara from the Provincial Director of Health Services, North Central Province Sri Lanka, and all medical staff at rural hospitals in North Central Province; staff at the South Asian clinical toxicology research

collaboration (SACTRC) including Professor N Buckley, Mr L Senarathna Professor I Gawarammana, Mr F Mohammed;

I am grateful for the hard work and dedicated efforts of the research assistants without whom the data collection and analysis would not have been successful; Dr A Perera, Dr A Adikari, Dr P Senevirathne, Dr V Dissanayake, Dr S Jayaweera, Dr S Wanigasekera.

I would like to acknowledge and thank the trained trainers who conducted the peripheral hospital workshops; Dr D.S.A.Jayasinghe, Dr S.P.Kamal, Dharmawansa, Dr C.Weerasinghe, Dr I.M.G.M.B.Ilangasinghe, Dr M Uyangoda, Dr W.M.C.W Abeykoon, Dr M.P Amarasinghe, Dr D.L.A Dissanayake.

Special thanks goes to support people who facilitated the “Instructor course”; Dr A Gunaratne, Dr P Palihawadana, Dr L Padmasiri, Dr M Rasnayaka, Mr D Woodyard, Dr M Vasnaik, Dr S Murty, Dr J Spedding, Dr C Page, Dr C Nickson, Dr S Bhagia, Dr S Ranasinghe, Dr S Sogian, Dr T Heely-Ray, Mr P Antoniazzi, Dr S Littleton, and Dr A Karunarathna; Appreciation also goes to Dr P Larsen, Dr C Pozner, Professor Rezvi Sheriff, and Dr N Lenora for their ideas and support.

Finally, I also thank the UK Resuscitation Council for giving us permission to reprint parts of their course manual.

Other publications during PhD candidature**Published in indexed journals**

5. Arnold LK, Alomran H, Anantharaman V, Halpern P, Hauswald M, Malmquist P, Molyneux E, Rajapakse B, Ranney M, Razzak J (2007) Knowledge translation in international emergency medical care. *Acad Emerg Med* 14: 1047-1051.

Other publications

6. Rajapakse B (2006) "Poisoning in Paradise" - an Emergency Medicine registrar's experience. *Newsletter of the International Emergency Medicine Special Interest Group of Australasian College of Emergency Medicine (ACEM)* 3: 4-7.
7. Rajapakse B (2007) Developing EM in Sri Lanka. *Newsletter of the International Emergency Medicine Special Interest Group of ACEM* 3.
8. Rajapakse B (2008) Emergency Medicine in Sri Lanka – A closer look at current hospital systems and future development. *Bulletin of Sri Lankan Society of Critical Care and Emergency Medicine*: 16-17.

Presentations International and National conferences during PhD candidature

Oral presentations (by invitation)

1. Rajapakse BN. Developing Emergency Medicine Challenges to Service & Teaching. Abstract book, 27th Anniversary Academic Sessions – Post Graduate Institute of Medicine (PGIM), Colombo, Sri Lanka, 2007

2. Rajapakse BN. The Development of Emergency Medicine in Sri Lanka. Abstract book, Inaugural Conference for Emergency Medicine in the Developing World, Emergency Medicine Society of South Africa (EMSSA), Conference, Cape Town, October 2007.

3. Rajapakse BN. Teaching Emergency Medicine in the Developing world. Abstract book, Inaugural Conference for Emergency Medicine in the Developing World– Emergency Medicine Society of South Africa (EMSSA), Cape Town, October 2007

4. Rajapakse, BN. Update in the management of Organophosphate Pesticide Poisoning. Abstract book, 13th International conference on Emergency Medicine (ICEM), Singapore, June 2010.

5. Rajapakse, BN. Adjustments in Emergency Medicine practice when moving from Australia to Sri Lanka. Abstract book, 13th International conference on Emergency Medicine (ICEM), Singapore, June 2010.

6. Rajapakse BN, Senarathna L, Dawson A. Education in rural peripheral hospitals. Abstract book, North American Congress of Clinical Toxicology (NACCT) – Tropical Toxicology Symposium. Denver, Colorado, October 2010.

7. Rajapakse BN. Current concepts and controversies in OP management. Abstract book, 27th Annual Scientific Meeting, Australasian College of Emergency Medicine (ACEM), Canberra, November, 2010.
8. Rajapakse BN. International Emergency Medicine – A Trainee Perspective. Abstract book, 28th Annual Scientific Meeting, Australasian College of Emergency Medicine (ACEM), Sydney, November, 2011.

Oral presentations

8. Rajapakse BN, Thiermann H, Eyer P, Worek F, Bowe S, Buckley NA. Validation of the 'Testmate Che 460' Bedside Kit in the determination of red blood cell acetylcholinesterase and plasma cholinesterase in organophosphorus, carbamate and unknown pesticide poisoning. Abstract book, 7th congress of the Asia Pacific Association of Medical Toxicologists (APAMT), Chandigarh, India, 2008.

Poster presentations

1. Rajapakse BN, Eddleston M, Dawson AH, Eyer P, Worek, F, Mohamed F, Buckley NA. RBC-Acetylcholinesterase as a predictor of Intubation in Organophosphate Poisoned Patients. Abstract book, 5th congress of the Asia Pacific Association of Medical Toxicologists (APAMT), Colombo, Sri Lanka, 2007.
2. Rajapakse BN. The impact of the introduction of an Emergency Treatment Unit on the outcome of acutely poisoned patients presenting to a Sri Lankan General Hospital. Abstract book, 6th congress of the Asia Pacific Association of Medical Toxicologists (APAMT), Bankok, Thailand, 2007.
3. Rajapakse BN, Sato T, Mohammed F, Buckley NA. Patterns of beta-glucuronidase in pesticide self- poisoning. Abstract book, 7th congress of the Asia Pacific Association of Medical Toxicologists, Chandigarh, India, 2008.

4. Rajapakse BN. The use of a bedside acetylcholinesterase measurement kit ('Testmate ChE') in the diagnosis of a difficult case of anticholinesterase pesticide poisoning. Abstract book, 26th Annual Scientific Meeting, Australasian College of Emergency Medicine (ACEM), Melbourne, 2009.

5. Rajapakse BN, Dawson AH. The effectiveness of a 'train the trainer' system of resuscitation education for peripheral hospitals in Sri Lanka. Abstract book, 26th Annual Scientific Meeting, Australasian College of Emergency Medicine (ACEM), Melbourne, 2009.

Funding support for this thesis

This research I conducted was funded by an international collaborative research grant from the Wellcome Trust/National Health and Medical Research Council, Australia (GR071669). The Wellcome Trust had no involvement in the design and conduct of the studies; in the collection, management, analysis, and interpretation of the data; or in the preparation, review, or approval of any of the articles that were published.

Conflicts of interest

None declared

Acknowledgements

My sincere gratitude goes to my two supervisors, Professor Nick Buckley and Professor Andrew Dawson, for their support and guidance. I am grateful to Andrew, an impressive research collaborator, technophile and general mastermind who taught me the value of self-reliance; and Nick Buckley, a gifted writer, who impressed upon me the importance of telling a clear story in scientific writing. I would also like to acknowledge their respective families for allowing me the extra time that I spent with these two individuals, and especially to Nick's family, for welcoming me into their home on more than one occasion.

I would like to thank and acknowledge my wonderful family who have supported and inspired me so much; my father who provided the 'inspiration for perspiration', my mother who taught me to be kind to myself and others, my supportive brothers and their families, Yosanta, Sandra and Luca, and Suresh and Rachel. Thank you also to my 'second' families in Sri Lanka; Archie, Loku Thathi and Kusum Nanda, Chiranthi Nangi and Thilini Akki in Kandy, and Geethaka and Ruvini in Colombo – I am forever grateful for your support, care, food and shelter that sustained me through the fieldwork.

Thanks to Lalith Senarathna, who was a research colleague, special friend and cultural guide to Sri Lanka, a place I left at 6 months of age. Thank you to the SACTRC team who welcomed me when I came to Sri Lanka, who were also like a family away from home; Aroona, Mark, Nayomi, Dilani, Nilupa, Fahim, Uncle, Shihana, Prabash, Umesh, Vishni, Shahmy and Sandamali (and others who cannot all be named). Thank you also to Salla and Celie, two of the many Scandinavian researchers who came to Sri Lanka and added their cultures to our interesting office mix.

I am very grateful for all my trusty research assistants; including Voleena, Amal, Sameera, Sanjeeva, Manori and Prabash; and Vinothan and Manjula in the AChE project, and all the others who I worked with over the fieldwork period. Thank you also to the lead clinicians such as Dr Shaluka Jayamanna in Polonnaruwa, and Dr Dhammadika De Silva, Dr P Bandara and Dr W Attapattu from the PD office in Anuradhapura, and to my friend Dr Ayanthi Karunaratne. My gratitude goes out especially to all the trainers who worked in the train-the-trainer project, and to all the doctors who were involved in my two research projects carried out in the NCP.

Thank you to the other special people whom I met along the way, and who inspired me, and helped me in the journey; Kent Olson, Chuck Pozner, Lakshman Karaliiedde, Rezvi Sherrif, Mudyanse Rasnayake, Kamani Wanigasuriya, Nilmini Wjesuriya, Dushyanthi Jayasekera, Christie Weeramantry, Mr Lionel Sirisena, Venerable Mahinda, Bhikkuni Kusuma, Nayomi Munaweera, Suresh David, Darren Roberts, Romesh Singam, Indika Gawarammana, Michael Eddleston, Quinton Temby, Trevor Vickers, Sean Perera, Teresa Neeman, Mihirini De Soyza, Jarad Martin, Steve Bowe, Melita Long, Zoe Rodgers, Sue Hertzberg, Chris Curry, Gerard O'Reilly, Serena Ayers and Alison Jones. Thanks also to Sanjay Bhagia, who guided me in simulation training, and Julianne Hammond, who helped me focus on the positive whilst persevering with my goals!

I am grateful also for all those who housed and fed me as I travelled to Australia from Sri Lanka including Vish, Northeilassa, Shamani, Keith, and 'Bella', and for the staff at the RPA Drug Health research office, especially Sarah Hutchinson for being so kind and welcoming, and to Beth White, Kylie Lee and Sarah Masters for their friendship in the final stages of the write-up, and to Kath Weston for her help with the final revisions.

Last, but not least, a heartfelt thank you goes to my partner, Sanna, who supported me through difficult years of combined PhD study and emergency medicine training. Thanks for your understanding and for being a source of light in my life.

Despite this extensive summary, there are countless others whom I would like to thank and acknowledge, but they must sadly remain “nameless” in this exposition.

The final acknowledgement, and perhaps most important one, is to the patients themselves and the doctors who looked after them. Many of these hospital doctors let me study them despite their busy schedules, whilst working hard to improve the lives of pesticide poisoned patients. The following story is dedicated to the patients and the doctors of rural Sri Lanka.