EVALUATION OF A BEHAVIOUR CHANGE INTERVENTION TARGETING EVIDENCE-BASED MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE

Submitted by

Peta Drury

A thesis submitted in total fulfilment of the requirements of the degree of

Doctor of Philosophy

School of Nursing, Midwifery and Paramedicine

Faculty of Health Sciences

Australian Catholic University

Research Services

PO Box 968, North Sydney

NSW 2059

August 2014

STATEMENT OF AUTHORSHIP

This thesis contains no material extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No parts of this thesis have been submitted towards the award of any other degree or diploma in any other tertiary institution.

No other person's work has been used without due acknowledgment in the main text of the thesis.

All research procedures reported in the thesis received the approval of a Human Research Ethics Committee.

Name Peta Drury

Date

ACKNOWLEDGEMENTS

I would like to thank Professor Sandy Middleton, my primary supervisor and my associate supervisors, Associate Professor Elizabeth McInnes and Dr Jennifer Hardy.

Thank you to my employer, the Australian Catholic University, for awarding me an Australian Postgraduate Award and a six-month secondment to the National Centre for Clinical Outcomes Centre (NaCCOR). Substantial time away from my full-time academic position facilitated completion of this research programme.

Various funding bodies require acknowledgement. I would like to thank the Australian Diabetes Society (ADS) and the College Consortium Fund of the College of Nursing for the grants to undertake the medical record audits to determine management of fever, hyperglycaemia and swallowing dysfunction in New South Wales stroke units.

TABLE OF CONTENTS

STATEMENT OF AUTHORSHIP ..... **I**

ACKNOWLEDGEMENTS ..... **II**

TABLE OF CONTENTS ..... **III**

LIST OF TABLES ..... **XI**

LIST OF FIGURES ..... **XIII**

LIST OF BOXES ..... **XIV**

ABBREVIATIONS ..... **XV**

GLOSSARY OF TERMS ..... **XVII**

INTRODUCTION AND OVERVIEW ..... **XVIII**

CHAPTER 1: BACKGROUND **1**

1.1 INTRODUCTION 1

1.2 RESEARCH BACKGROUND AND SIGNIFICANCE 1

1.3 BACKGROUND: QUALITY IN ACUTE STROKE CARE (QASC) TRIAL 3

1.3.1 Method: QASC Trial 3

1.3.2 QASC Acute Stroke Unit Recruitment 3

1.3.3 QASC Patient Recruitment 4

1.3.4 QASC Randomisation 4

1.3.5 The QASC Clinician Behaviour Change Intervention 5

1.3.6 QASC Analysis 6

1.3.7 QASC Results 7

1.4 RELATIONSHIP OF THE CANDIDATE'S THREE STUDIES TO THE QASC TRIAL 7

1.4.1 Study 1: Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Hospital Admission for Acute Stroke in New South Wales, Australia (Short Title 'Baseline Audit') 7
1.4.2 Study 2: Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey (Short Title 'NUM Study') 8
1.4.3 Study 3: Quality in Acute Stroke Care (QASC): Process Evaluation of an Intervention to Improve the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke (Short Title 'Process Evaluation') 8
1.5 CHAPTER SUMMARY 11
CHAPTER 2: LITERATURE REVIEW 12
2.1 INTRODUCTION 12
2.2 LITERATURE REVIEW STUDY 1: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA 14
2.2.1 Why is it Important to Manage Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke? 17
2.2.1.1 Review of studies investigating the effect of fever on outcomes following stroke 18
2.2.1.2 Review of studies investigating the treatment of fever with paracetamol following stroke 20
2.2.1.3 Review of studies investigating the effect of hyperglycaemia on outcomes following stroke 21

2.2.1.4 Review of studies investigating the treatment of hyperglycaemia with insulin following stroke 22
2.2.1.5 Review of studies investigating the effect of swallowing dysfunction on outcomes following stroke 23
2.2.1.6 Review of studies investigating swallowing screening following acute stroke 25
2.2.1.7 Summary of the evidence investigating fever, hyperglycaemia and swallowing dysfunction following acute stroke 26
2.2.2. How Should Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke Be Managed According to National and International Guideline Recommendations? 32
2.2.2.1 Guideline recommendations for the management of fever following stroke 32
2.2.2.2 Guideline recommendations for the management of hyperglycaemia following stroke 33
2.2.2.3 Guideline recommendations for the management of swallowing dysfunction following stroke 33
2.2.3 Prior Investigations into the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Stroke in NSW, Australia, Stroke Units 37
2.2.4 Literature Review Summary Study 1 (Baseline Audit) 38
2.2.5 Changing Clinician Behaviour 39
2.2.5.1 Theoretically informed interventions 39
2.2.5.2 The development of the QASC behaviour change intervention 40

2.2.5.3 The effect of multifaceted interventions on clinician behaviour change 43
2.2.5.4 The effect of printed educational materials on clinician behaviour change 43
2.2.5.5 The effect of tailored interventions on clinician behaviour change 44
2.2.5.6 The effect of educational meetings on clinician behaviour change 44
2.2.6 Summary of Evidence Investigating Behaviour Change Interventions 45
2.3 LITERATURE REVIEW STUDY 2: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY 47
2.3.1 Nurse Leadership and Its Influence on the Process of Implementing Evidence-Based Practice 49
2.3.2 Attitudes and Beliefs and Their Influence on the Process of Implementing Evidence-Based Practice 50
2.3.3 Organisational Learning and Its Influence on the Process of Implementing Evidence-Based Practice 50
2.3.4 Organisational Readiness for Change 53
2.3.5 Literature Review Summary Study 2 (NUM Study) 53
2.4 LITERATURE REVIEW STUDY 3: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE 56
2.4.1 Purpose of Process Evaluations 58
2.4.2 Process Evaluation Design 58

2.4.3 Reporting Process Evaluations 59

CHAPTER 3: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA 68

3.1 PROLOGUE 68

3.2 ABSTRACT 70

3.3 INTRODUCTION 71

3.4 METHOD 76

3.4.1 Participants 76

3.4.2 Outcome Measures 77

3.4.3 Data Collection 77

3.4.4 Data Analysis 78

3.5 RESULTS 79

3.5.1 Management of Fever 82

3.5.2 Management of Hyperglycaemia 84

3.5.3 Management of Swallowing Dysfunction 88

3.6 DISCUSSION 90

3.6.1 Management of Fever 90

3.6.2 Management of Hyperglycaemia 91

3.6.3 Management of Swallowing Dysfunction 92

3.7 CONCLUSIONS 94

CHAPTER 4: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY 95

4.1 PROLOGUE 95

4.2 ABSTRACT 96
4.3 BACKGROUND 97
4.3.1 Individual Traits Associated with Research Utilisation 98
4.3.2 Organisational Traits Associated with Research Utilisation 99
4.4 METHODS 101
4.4.1 Participants 101
4.4.2 Survey Administration 101
4.4.3 Survey Instrument 102
4.4.4 Data Analysis 104
4.5 RESULTS 105
4.5.1 Self-Reported Leadership Ability 106
4.5.2 Organisational Learning 107
4.5.3 Attitudes and Beliefs towards EBP 108
4.5.4 Readiness to Accept Change 112
4.6 DISCUSSION 116
4.7 CONCLUSIONS 118

CHAPTER 5: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE 119

5.1 PROLOGUE 119
5.2 ABSTRACT 120
5.3 BACKGROUND 122
5.4 METHOD 125
5.4.1 Trial Design and Participants 125

5.4.2 Outcome Measures 125
5.4.3 Data Collection 126
5.4.4 Statistical Analysis 126
5.5 RESULTS 127
5.5.1 Fever Protocol Adherence 133
5.5.2 Sugar Protocol Adherence 135
5.5.2.1 Protocol adherence among patients without known diabetes 139
5.5.2.2 Protocol adherence among patients with known diabetes 142
5.5.3 Swallow Protocol Adherence 144
5.6 DISCUSSION 148
5.7 CONCLUSION 152
CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS 153
6.1 CONCLUSIONS AND RECOMMENDATIONS STUDY 1: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA 155
6.1.1 Study 1: Implications for Practice 156
6.2 CONCLUSIONS AND RECOMMENDATIONS STUDY 2: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY 156
6.2.1 Study 2: Implications for Practice 157
6.3 CONCLUSIONS AND RECOMMENDATIONS STUDY 3: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER,

HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE 158
6.3.1 Study 3: Implications for Practice 159
6.4 SUMMARY 160
REFERENCES 161
APPENDICES 176
APPENDIX A: ETHICS APPROVAL 176
APPENDIX B LIST OF PAPERS ACCEPTED/SUBMITTED FOR PUBLICATION ARISING FROM THE RESEARCH PROGRAMME 176
APPENDIX C LIST OF REFEREED ABSTRACTS AND CONFERENCE PRESENTATIONS ARISING FROM THE RESEARCH PROGRAMME 188
APPENDIX D: QASC TRIAL FEVER INTERVENTION 192
APPENDIX E: QASC TRIAL HYPERGLYCAEMIA INTERVENTION (Relevant to patients with a history of diabetes) 195
APPENDIX F: QASC TRIAL HYPERGLYCAEMIA INTERVENTION (Relevant to patients with no known history of diabetes) 196
APPENDIX G: QASC TRIAL SWALLOW INTERVENTION 197
APPENDIX H: MEDICAL RECORD PRE- AND POST-INTERVENTION AUDIT TOOL AND DATA DICTIONARY 198
APPENDIX I: STUDY 2 NURSE UNIT MANAGER SURVEY 221

LIST OF TABLES

Table 2.1: Search Methods for Study 1..... 15

Table 2.2: Fever, Hyperglycaemia and Swallowing Dysfunction and Their Association with Stroke Outcomes: Summary of the Evidence 28

Table 2.3: Treatment of Fever, Hyperglycaemia and Swallowing Dysfunction Following Stroke: Summary of the Evidence 30

Table 2.4: Behaviour Change Interventions: A Summary of the Evidence 41

Table 2.5: Search Methods for Study 2……...49

Table 2.6: Five Major Underlying Organisation Characteristics and Management Practices That Are Key Conditions Essential to Allow Learning to Take Place and Build Learning Organisations 52

Table 2.7: Leadership, Attitudes and Beliefs and Their Influence on Research Utilisation..... 55

Table 2.8: Search Methods for Study 3……...58

Table 2.9: Mapping of the Reporting Framework (adopted by the candidate) to Two Selected Process Evaluations 66

Table 3.1: Demographic and Clinical Characteristics of Patients Admitted to NSW Stroke Units..... 81

Table 3.2: Fever Processes of Care Measures 83

Table 3.3: Hyperglycaemia Processes of Care Measures 85

Table 3.4: Hyperglycaemia Processes of Care Measures among Patients with Known Diabetes and Patients without Known Diabetes 87

Table 3.5: Swallowing Dysfunction Processes of Care Measures 89

Table 4.1: Characteristics of Nurse Unit Managers 106

Table 4.2: Mean Self-Reported Leadership Practices Inventory Subscales Scores 107

Table 4.3: Organisational Learning Subscales Scores 108

Table 4.4 Self-Reported Attitudes and Beliefs towards EBP..... 110

Table 4.5: Organisations' Readiness to Accept Change 113

Table 5.1: Demographic and Clinical Characteristics of the Post-Intervention Cohort Behaviour Change 131

Table 5.2: Fever Protocol Adherence 134

Table 5.3: Sugar Protocol Adherence 137

Table 5.4: Sugar Protocol Adherence among Non-Known Diabetic Patients 140

Table 5.5: Sugar Protocol Adherence among Known Diabetic Patients 143

Table 5.6: Swallow Protocol Adherence..... 146

LIST OF FIGURES

Figure 1.1: Candidate's Three Studies Conducted as Part of the QASC Trial 10

Figure 2.1: Compartments of Infarct Development..... 18

Figure 5.1: CONSORT Flow Diagram 129

LIST OF BOXES

Box 1.1: 2007 National Stroke Foundations Clinical Guideline Recommendations Pertaining to the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke 2

Box 1.2: QASC Primary Outcomes: 90 Days after Hospital Admission 3

Box 2.1: International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction 35

Box 2.2: Key Information Required when Reporting Process Evaluations 53

Box 3.1: International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction 73

Box 3.2: QASC Trial Clinical Treatment Protocols 76

Box 5.1: Outcome Measures for Fever Protocol 123

Box 5.2: Outcome Measures for Sugar Protocol 124

Box 5.3: Outcome Measures for Swallow Protocol 125

ABBREVIATIONS

ADS	Australian Diabetes Society
ANZCTR	Australia New Zealand Clinical Trial Registry
ASU	Acute stroke unit
AuSCR	Australian Stroke Clinical Registry
BI	Barthel Index
CIs	Confidence intervals
CRCT	Cluster randomised controlled trial
CT	Computerised tomography
ED	Emergency department
EBP	Evidence-based practice
EPOC	Effective Practice and Organisation of Care
FeSS	Fever, sugar, swallow
GIST	Glucose Insulin Stroke Trial
ICC	Intra-cluster correlation co-efficient
IQR	Interquartile range
IV	Intravenous
LPI	Leadership Practices Inventory
MCS	Mental component summary
mRS	Modified Rankin Scale
NaCCOR	National Centre for Clinical Outcomes Centre
NBM	Nil by mouth
NHMRC	National Health and Medical Research Council
NIHSS	National Institutes of Health Stroke Scale
NSAIDS	Nonsteroidal anti-inflammatory drugs
NSF	National Stroke Foundation

NSW	New South Wales
NUM	Nurse unit manager
OCSP	Oxfordshire Community Stroke Project
OLS	Organisational Learning Survey
OR	Odds ratio
PACI	Partial anterior circulation infarct
PCS	Physical component summary
PR	Per rectum
QASC	Quality in Acute Stroke Care
RCT	Randomised controlled trial
SC	Subcutaneous
SSS	Scandinavian Stroke Scale

GLOSSARY OF TERMS

Dysphagia	Difficulty, or partial inability to swallow
Fever/ Febrile	Temperature ≥ 37.5 °C
Hyperglycaemia	Glucose level > 11 mmol/L
Stroke	Neurological symptoms lasting > 24 hours with or without recovery
Swallow assessment	A comprehensive swallow assessment conducted by a speech pathologist
Swallow screen	A swallow test conducted by a non-speech pathologist before the speech pathologist assessment
Swallowing surveillance	A comprehensive swallow assessment conducted by a speech pathologist and/or a swallow test conducted by a non-speech pathologist

INTRODUCTION AND OVERVIEW

Introduction

Stroke is Australia's second highest cause of death and a leading cause of adult disability (1-3). Several factors influence morbidity and mortality after ischaemic stroke, including fever, hyperglycaemia and swallowing dysfunction (4-8). Early detection and treatment of these three physiological variables should be a priority (4-8). National and international guidelines (9-13) provide recommendations for the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke; however, only a small proportion of Australians receive evidence-based care (14-18). Prior studies have identified that the distribution alone of guidelines will not change clinician behaviour (19); thus, further research is required to identify effective behaviour change interventions to promote the uptake of guideline recommendations and evidence-based practice.

This thesis presents three studies conducted by the candidate as part of the Quality in Acute Stroke Care (QASC) cluster randomised controlled trial (CRCT) conducted from July 2005 to October 2010 in 19 stroke units located in New South Wales (NSW), Australia. The aim of the QASC trial was to develop, implement and evaluate a multifaceted behaviour change intervention to promote stroke guideline recommendations and evidence-based management for fever, hyperglycaemia and swallowing dysfunction within the first three days following hospital admission for acute stroke. The QASC multifaceted behaviour change intervention comprised evidence-based clinical treatment protocols (referred to as the fever (Fe), sugar (S) and swallow (S) [FeSS] protocols), supported by team-building workshops (to identify local barriers to change) and site-based education and support. The QASC trial resulted in

significantly improved patient outcomes in intervention stroke units, explained in full later in this thesis (1).

As part of the QASC trial, the candidate conducted three studies. Specifically, the aim was to (i) establish monitoring and treatment practices within NSW stroke units for fever hyperglycaemia and swallowing dysfunction **prior to the implementation of the QASC intervention**; (ii) investigate NSW stroke unit nurse unit managers' (NUMs) perceptions of self-leadership ability, organisational learning, attitudes and beliefs towards evidence-based practice (EBP), and organisational readiness for change also **prior to the implementation of the QASC intervention;** and (iii) conduct a process evaluation parallel to the QASC trial to assist in the interpretation of the QASC patient outcome results **at the conclusion of the trial**.

Thesis Overview

Chapter 1: Background

This thesis comprises six chapters. Chapter 1 provides an overview of the QASC trial by way of background and establishes the relationship of the candidate's three studies to this large trial.

Chapter 2: Literature Review

Chapter 2, the literature review, provides a summary of the evidence specific to each of the three studies. For this reason, the literature review is divided into three sections.

Literature Review Study 1 (Section 1): Management of fever, hyperglycaemia and swallowing dysfunction following hospital admission for acute stroke in New South Wales, Australia

Section 1, which corresponds to Study 1 (short title 'Baseline Audit'), summarises the evidence for, firstly, ***why*** it is important to manage fever, hyperglycaemia and swallowing dysfunction following stroke and, secondly, the evidence for ***how*** each of these variables should be managed according to national and international guideline recommendations. Following this review, it became evident that fever, hyperglycaemia and swallowing dysfunction in the acute stage following stroke all result in increased morbidity and mortality (4-8). Although clinical practice guidelines were developed both nationally (13, 14) and internationally (9-13) to convey this evidence to clinicians and consumers, prior to the commencement of the QASC trial there had been no investigations into clinician compliance with guideline recommendations specific to: monitoring and treatment of fever, monitoring and treatment of hyperglycaemia, and swallowing screening by non-speech pathologists (although swallow assessment by speech pathologists previously has been examined) (13). On the basis of this review, it was evident that further investigations into in-patient monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following stroke diagnosis were warranted to establish if current management of these three physiological variables were in accordance with the latest evidence.

Literature Review Study 2 (Section 2): Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey

Section 2, which corresponds to Study 2 (short title 'Nurse Unit Manager [NUM] Study'), summarises the evidence pertaining to leadership, organisational learning, attitudes and beliefs towards EBP and organisational readiness to accept change, all of which had been cited in the literature as either individual or organisational traits that may influence the implementation and sustainability of EBP (20-26). Following this review, it became evident that further investigations/ studies investigating these domains would be of value for future randomised controlled trials (RCTs) wishing to implement a practice change.

Literature Review Study 3 (Section 3): Quality in Acute Stroke Care (QASC): Process evaluation of an intervention to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke

Corresponding to the candidate's third study (short title 'Process Evaluation'), the final section of the literature review is an outline of the purpose and design of process evaluations conducted alongside RCTs. Two prior process evaluations that had met the published criteria for quality and that had significantly added understanding to a RCT are reviewed. Following this review the candidate concluded that although process evaluations are essential to help in the interpretation of trial patient outcome results, very few quantitative process evaluations have ever been conducted leaving many RCTs unable to explain their patient outcome results. The candidate also concluded that process evaluations may not be able to explain fully, but may only shed some light on the main trial findings.

Chapter 3: Study 1 (Baseline Audit)

In Chapter 3, the candidate presents Study 1, which was conducted prior to the implementation of the QASC intervention. The aim of this first study was to identify in-patient monitoring and treatment practices for fever, hyperglycaemia and swallowing dysfunction following stroke and to determine whether stroke care in NSW stroke units was consistent with evidence-based recommendations. Retrospective medical record audits were undertaken using prospectively recruited patient data for those patients admitted to a NSW acute stroke unit (ASU) between July 2005 and October 2007. All instances of fever (temperature ≥ 37.5 °C) and hyperglycaemia (finger-prick blood glucose > 11 mmol/L) and ensuing relevant treatments occurring in the first 72 hours following stroke unit admission were recorded as well as swallow screens conducted by non-speech pathologists within the emergency department (ED) or within 24 hours of admission to the stroke unit. Records were available for 718 (98%) QASC consenting patients. Results pertaining to the management of fever (temperature ≥ 37.5 °C) indicated less than 20% (n = 138) of patients had regular temperature monitoring every four hours during the first 72 hours of stroke unit admission; 29% (n = 204) of patients had a temperature reading ≥ 37.5 °C; 22% (n = 44 of 204) of whom were administered paracetamol to treat fever. For the management of hyperglycaemia (finger-prick glucose level > 11 mmol/L) findings indicated less than 15% (n = 102 of 718) of patients had regular finger-prick glucose monitoring every six hours within the first 72 hours of stroke unit admission; for those who had at least one finger-prick glucose reading within the first 72 hours of stroke unit admission (n = 412, 57%), 23% (n = 95 of 412) of patients had a finger-prick blood glucose reading > 11 mmols/L; and 31% (n = 29 of 95) of patients were administered insulin to treat their high blood glucose level. The results pertaining to the management of swallow dysfunction indicated that 22% of patients

underwent a swallowing screen (n = 156, 22%) performed by a non-speech pathologist either in the ED or within 24 hours of stroke unit admission.

The results from Study 1 indicated that the management of fever and hyperglycaemia in NSW stroke units was suboptimal. Of concern, the majority of acute stroke patients were under-monitored and under-treated for fever and hyperglycaemia. In addition, although international guidelines recommend every stroke patient have a swallow screen, 78% of patients did not have their swallowing status assessed by a non-speech pathologist in the ED or within 24 hours of stroke unit admission. These findings indicated that clinician behaviour change was urgently required to improve guideline compliance and ensure optimal outcomes for stroke patients.

Chapter 4: Study 2 (NUM Study)

In Chapter 4, the candidate presents Study 2, which was also conducted prior to the implementation of the QASC intervention. The aim of this second study was to determine knowledge of individual and organisational traits within stroke units participating in the QASC trial that may have impeded or facilitated the successful uptake of the QASC intervention and EBP. A survey was administered to Nurse Unit Managers (NUMs) from stroke units participating in the QASC trial. The survey measured NUMs' views of self-leadership ability (as measured by the Leadership Practices Inventory [LPI]) (27); organisational learning (as measured by the Organisational Learning Survey [OLS]) (21); attitudes and beliefs towards EBP; and organisational readiness for change. Surveys were returned from 19 (100%) NUMs. The results of the study indicated the mean values of the LPI of all subscales were predominantly in the upper third of the possible range between 6 and 60, indicating that

NUMs of NSW stroke units provided a high level of leadership on all five subscales on the LPI. The mean score across all five learning capabilities of the OLS were above the midpoint of 4 on the seven-point scale, indicating the presence of a culture of learning. NUMs' attitudes and beliefs towards EBP were positive (median 80, interquartile range [IQR] 80–95 [0 = extremely unwelcoming to 100 = extremely welcoming]), although colleagues were perceived to be less welcoming (median 70, IQR 60–80 [0 = extremely unwelcoming to 100 = extremely welcoming]). NUMs agreed (medium 3, 2–3.5 [1 = strongly disagree to 5 = strongly agree]) that using evidence in practice places another demand on already overloaded nurses.

The results from Study 2 indicated that a high level of leadership skills and a positive culture of learning were likely to support the implementation of the FeSS protocols and evidence-based care following acute stroke. However, the findings from this study also highlighted that NUMs may not be in a position to address organisational barriers, such as insufficient resources and time constraints that could impede EBP. The view that EBP places additional demands on already overloaded nurses was of concern and may also impede evidence uptake. Barriers to change identified in this study may not be unique to stroke units.

Chapter 5: Study 3 (Process Evaluation)

In Chapter 5, the candidate presents the third and final study, a process evaluation. Patient outcome results from the main trial showed that, irrespective of stroke severity, patients admitted to intervention stroke units that received the QASC intervention were 15.7% more likely to be alive and independent at 90 days after admission (1). Process evaluations are studies conducted alongside or parallel to randomised controlled trials to

help enlighten and understand the main study (QASC) results (28). The aim of the process evaluation was to examine nurse protocol adherence by measuring the proportion of patients managed according to the FeSS protocols. Retrospective medical record audits were undertaken for prospectively recruited patients from 19 stroke units participating in the trial. Auditors were blind to the trial group allocation. Data from 1804 patients (718 pre-intervention; 1086 post-intervention) showed that significantly more patients in the intervention group received care according to the fever (n = 186 of 603, 31% v. n = 74 of 483, 15%, $p < 0.001$), sugar (n = 22 of 603, 3.7% v. n = 3 of 483, 0.6%, p = 0.01) and swallow protocols (n = 241 of 603, 40% v. n = 19 of 483, 4.0%, $p \leq 0.001$). Significantly more patients from intervention stroke units received four-hourly temperature monitoring (n = 222 of 603, 37% v. n = 90 of 483, 19%, p = 0.001) and six-hourly glucose monitoring (194 of 603, 32% v. 46 of 483, 9.5%, $p < 0.001$) within 72 hours of admission to a stroke unit, and a swallowing screen (242 of 522, 46% v. 24 of 350, 6.8%, $p \leq 0.0001$) within the first 24 hours of admission to hospital. There was no difference between the groups in the treatment of fever with paracetamol (22 of 105, 21% v. 38 of 131, 29%, p = 0.78) nor hyperglycaemia with insulin (40 of 100, 40% v. 17 of 57, 30%, p = 0.49).

The results from Study 3 indicated that the QASC intervention had a positive effect on clinician behaviour change and resulted in better protocol adherence in intervention stroke units, which goes some way towards explaining the main QASC trial findings of improved patient 90-day outcomes. Although the monitoring behaviour of clinicians significantly improved, the treatment of fever, hyperglycaemia and swallowing dysfunction remained suboptimal following the implementation of the QASC

intervention and further investigations to identify barriers to treatment of these care elements in acute stroke patients is required.

Chapter 6: Conclusions and Recommendations

In the final chapter, Chapter 6, the candidate reviews the findings from the three studies and presents a summary of the results. Methodological limitations of the studies are revisited and summarised in anticipation that future research will improve upon these aspects. Recommendations for further research are then presented.

CHAPTER 1: BACKGROUND

1.1 INTRODUCTION

This thesis presents three studies conducted as part of the Quality in Acute Stroke Care (QASC) cluster randomised controlled trial (CRCT) (13). The aim of this chapter is to (a) provide an overview of the QASC trial by way of background and (b) establish the relationship of the candidate's three studies to this large trial.

1.2 RESEARCH BACKGROUND AND SIGNIFICANCE

Fever, hyperglycaemia and swallowing dysfunction in the early post-stroke period are associated with significant increases in morbidity and mortality (4-6) (7, 8) and early detection and treatment of these three physiological variables should be a priority (13). Hence, the National Stroke Foundation (NSF) Clinical Guidelines for Stroke Management (13, 14) recommend monitoring and treatment for fever and hyperglycaemia and that all stroke patients undergo swallowing screening prior to receiving food, fluids or medications (29). At the commencement of the trial, the NSF 2007 guideline recommendations were available to clinicians; they are presented in Box 1.1.

Prior studies have identified that the distribution alone of guidelines will not change clinician behaviour (19) thus further research is required to identify effective behaviour change interventions to promote the uptake of guideline recommendations. The aim of the QASC trial was to develop, implement and evaluate a behaviour change intervention to promote guideline recommendations (Box 1.1) and evidence-based management for fever, hyperglycaemia and swallowing dysfunction following stroke within NSW, Australia, stroke units.

Box 1.1: 2007 National Stroke Foundations Clinical Guideline Recommendations Pertaining to the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke

Monitoring of Fever and Hyperglycaemia

Guideline Recommendation 4.7: Physiological Monitoring

Patients should have their neurological status (e.g. Glasgow Coma Scale), vital signs (including pulse, blood pressure, temperature, oxygen saturation, and glucose levels) and respiratory pattern monitored and documented regularly during the acute phase, the frequency of such observations being determined by the patient's status.

Treatment of Fever

Guideline Recommendation 4.11: Pyrexia

Antipyretic therapy, comprising regular paracetamol and/or physical cooling measures, should be used routinely where fever occurs.

Treatment of Hyperglycaemia

Guideline Recommendation 4.9: Glycaemic Control

On admission, all patients should have their blood glucose level monitored and appropriate glycaemia therapy instigated to ensure euglycaemia, especially if the patient is diabetic.

Monitoring and Treatment of Swallowing Dysfunction

Guideline Recommendation 6.2.1: Dysphagia

a) Patients should be screened for swallowing deficits before being given food, drink or oral medications. Screening should be undertaken by personnel specifically trained in swallowing screening. Personnel specifically trained in swallowing screening using a validated tool should undertake screening.
b) Swallowing should be screened as soon as possible but at least within 24 hours of admission.
d) Patients who fail the swallowing screening should be referred to a speech pathologist for a comprehensive assessment.

1.3 BACKGROUND: QUALITY IN ACUTE STROKE CARE (QASC) TRIAL

The QASC trial was conducted from July 2005 to October 2010 in 19 NSW, Australia, stroke units. The effect of the QASC behaviour change intervention on clinician behaviour change and patient outcomes was rigorously evaluated using a CRCT design (30). While the main QASC trial does not form part of the candidate's thesis it is explained in full below for context. The relationship between the QASC trial and the candidates thesis is explained in Section 1.4.

1.3.1 Method: QASC Trial

The QASC study, a single-blind CRCT, tested the effectiveness of the intervention on 90-day outcomes listed in Box 1.2.

Box 1.2: QASC Primary Outcomes: 90 Days after Hospital Admission

QASC primary outcomes: 90 days after hospital admission (1)

- Death or dependency [dependency: modified Rankin Scale (mRS) ≥ 2]
- Functional dependency [Barthel Index (BI)]
- Mean SF-36 mental component summary (MCS) score
- Mean physical component summary (PCS) score

1.3.2 QASC Acute Stroke Unit Recruitment

All Category A and B stroke units in NSW (n = 20) were eligible to participate in the QASC trial. At that time (in 2005), Australian hospitals were classified into one of four categories (A, B, C or D) based on criteria including the structure of stroke services, the

processes of care available and the clinical profile of patients. The majority of stroke units in NSW (n = 20) were classified as Category A or B. Category A and B hospitals had access to more comprehensive acute-care services, such as on-site computerised tomography (CT) scanning and intensive care/high dependency beds. Category A hospitals also had on-site neurosurgery.

1.3.3 QASC Patient Recruitment

Patients were eligible for recruitment to the QASC trial if they were aged over 18 years, had a clinical diagnosis of stroke, arrived in the stroke unit within 48 hours following onset of symptoms, and were able to give informed consent (alternatively, this may have been given by a relative). Patients were ineligible to participate if they required care for palliation only. The QASC inclusion criteria were deliberately broad and the exclusion criteria minimal in order to maximise generalizability of the results. The inclusion/exclusion criteria were explicity developed around patients that would most benefit (i.e. acute stroke unit patients – when the penumbra can still be salvaged).

Prior to randomisation a pre-intervention cohort was recruited (30 July 2005 to 30 October 2007) to provide a baseline sample before implementation of the intervention. A second post-intervention patient cohort (from 4 February 2009 to 25 August 25 2010) was recruited to provide a follow-up sample after intervention implementation.

1.3.4 QASC Randomisation

Stroke units were randomised by an independent statistician from the Ottawa Health Research Institute, Canada, who was not otherwise connected with the QASC trial.

1.3.5 The QASC Clinician Behaviour Change Intervention

The QASC intervention groups were provided with **evidence-based clinical treatment protocols (Appendix D, E, F, G), initiated by nurses,** for the management of **fe**ver, hyperglycaemia (**s**ugar) and **s**wallowing dysfunction (also referred to as the FeSS protocols). A review of national guideline recommendations pertaining to the management of fever, hyperglycaemia and swallowing dysfunction highlighted that standardised recommendations for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke did not exist. Three panels of clinical experts (one for each focus) agreed upon specific monitoring and treatment targets for these three physiological variables. These specific monitoring and treatment targets formed the FeSS protocols (Appendix D, E, F, G).

Two **multidisciplinary team-building on-site workshops** (31-33) to support the implementation of the treatment protocols were conducted at the intervention stroke units. The first workshop targeted senior clinical stroke unit members (medical director, NUM, stroke unit co-ordinator [clinical nurse consultant], stroke fellow/registrar, director of speech pathology) to identify barriers within the stroke unit and also in the broader hospital context. During Workshop 1, feedback was sought on the FeSS protocols and discussed. Any necessary local modifications were undertaken by the QASC researchers. At the second workshop, the modified FeSS protocols were presented to a multidisciplinary audience comprising bedside nurses and the stroke unit speech pathologists to identify any additional barriers within the stroke unit. Further revisions to the clinical treatment protocols were made where recommended.

In those units allocated to the intervention group, the QASC project officer (a registered nurse) also delivered **unit-based education and support** (34). To ensure complete coverage of clinical personnel, each stroke unit was offered two identical education sessions scheduled at different times. The aim of these sessions was to educate clinicians about the clinical treatment protocols. A standardised PowerPoint presentation and accompanying handouts were made available for further use to the stroke unit nurse educator responsible for education of nurses on each stroke unit as identified at the first multidisciplinary workshop. The nurse conducted further education events as required to ensure all nursing staff, including night staff, were educated about the elements of the clinical treatment protocols. Finally, **longitudinal engagement through support and feedback** was provided by the QASC project officer on an ongoing basis for the duration of the intervention. The QASC project officer and QASC chief investigator established personal links with the stroke unit co-ordinator at all stroke units and others identified as key champions (35) at the first multidisciplinary workshop.

The control stroke units only received an abridged version of the *NSF Clinical Guidelines for Acute Stroke Management* (13). This abridged version contained the recommendations pertaining to the management of hyperglycaemia, fever and swallowing dysfunction only.

1.3.6 QASC Analysis

All analyses were done by intention-to-treat and all outcomes were adjusted for pre-intervention data and for clustering within stroke units (1).

1.3.7 QASC Results

Of 20 eligible stroke units, 19 (95%) participated in the QASC trial. Of 6564 eligible patients, data were obtained from 1694 patients; 687 patients pre-intervention and 1009 post-intervention. Of the post-intervention cohort, 558 patients were allocated to the intervention group and 451 patients were allocated to the control group. Patient outcome results showed that, irrespective of stroke severity, intervention stroke unit patients in comparison to control group patients were significantly less likely to be dead or dependent (mRS ≥ 2) at 90 days ($p = 0.002$; adjusted absolute difference 15.7% [95% CI, 5.8–25.4]); had a better SF-36 mean physical component summary score ($p = 0.002$; adjusted absolute difference 3.4 [95% CI, 1.2–5.5]); had no improvement in mortality ($p = 0.36$); and had no improvement in functional dependency (Barthel Index) ($p = 0.44$) (1).

1.4 RELATIONSHIP OF THE CANDIDATE'S THREE STUDIES TO THE QASC TRIAL

Figure 1.1 presents the candidate's three studies conducted as part of the QASC trial. Each of the candidate's three studies is explained in more detail below.

1.4.1 Study 1: Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Hospital Admission for Acute Stroke in New South Wales, Australia (Short Title 'Baseline Audit')

The candidate's first study, conducted prior to the implementation of the QASC intervention, was an examination of the evidence-practice gap for the management of fever, hyperglycaemia and swallowing dysfunction. Specifically, Study 1 investigated in-patient monitoring and treatment practices for fever, hyperglycaemia and swallowing

dysfunction, across 19 NSW stroke units, and determined clinician compliance with NSF guideline recommendations (13). Study 1 also provided pre-intervention baseline data for the candidate's third study (a CRCT) to determine the effect of the QASC intervention on clinician behaviour change (Figure 1.1).

1.4.2 Study 2: Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey (Short Title 'NUM Study')

The candidate's second study (Chapter 4), also conducted prior to the implementation of the QASC intervention, investigated NUMs' perceptions of organisational and individual traits within NSW stroke units participating in the QASC trial that may have impeded or facilitated the uptake of the QASC protocols (Appendix 1). Specifically the candidate's second study investigated NUMs perceptions of: self-leadership ability, organisational learning, attitudes and beliefs towards EBP, and organisational readiness for change (Figure 1.1) all of which had been identified in the literature to influence the uptake and sustainability of EBP.

1.4.3 Study 3: Quality in Acute Stroke Care (QASC): Process Evaluation of an Intervention to Improve the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke (Short Title 'Process Evaluation')

The QASC randomised controlled trial of a multifaceted evidence-based intervention for improving the in-patient management of fever, hyperglycaemia and swallowing dysfunction in the first three days following stroke resulted in patients from the intervention group being 15.7% more likely to be alive and independent at 90 days after admission. Many randomised controlled trials (RCTs) are unable to explain how their

intervention worked (or did not work) (28, 36). Process evaluations are studies that are conducted parallel to or following intervention trials to help in the interpretation of the main study (QASC) results (28). The candidate's third study (Chapter 5), a process evaluation, investigated clinician adherence with the QASC clinical treatment protocols (FeSS protocols) to assist in the understanding of the QASC trial patient outcome results (Figure 1.1).

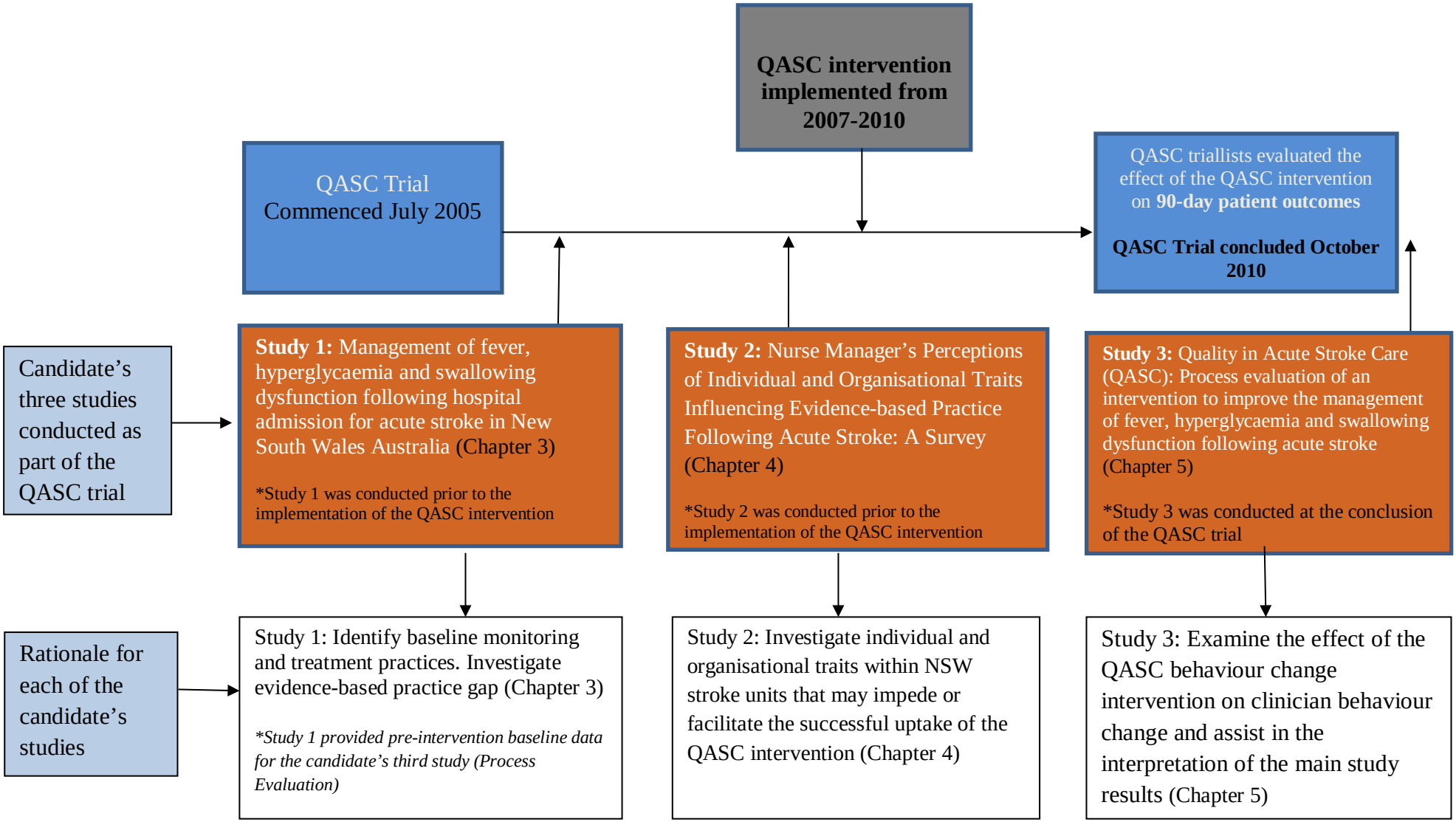


Figure 1.1: Candidate's Three Studies Conducted as Part of the QASC Trial

1.5 CHAPTER SUMMARY

This chapter has introduced the QASC trial and the candidate's three studies conducted as part of this large trial. The second chapter (Literature Review) provides a summary of the evidence relevant to the scope and conduct of the studies included in this thesis.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Three different literature reviews were conducted relative to each study and for this reason the literature review has been divided into three sections.

Aim of the Review

The overall purpose of the literature review was to: a) assess evidence for the effectiveness of management and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke (relevant to study 1); b) assess evidence for the effectiveness of behaviour change interventions to promote the uptake of evidence (relevant to study 1); c) assess the evidence for individual and organisational barriers and enablers to change (relevant to study 2) and; d) provide a summary of prior process evaluations conducted alongside RCTs (relevant to study 3).

Article Selection

Articles were included in the review if they: a) were published after 2000, unless no post-2000 evidence sources specific to the research focus/question were found: b) investigated management and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke; c) investigated behaviour change interventions to promote the uptake of evidence; c) investigated individual and organisational barriers and enablers to change; c) investigated process evaluations conducted alongside RCTs and; c) were published in a scientific journal or clinical practice guideline.

Studies Included in this Review

The types of studies comprising this review included: systematic reviews and meta-analyses; randomised controlled trials and; cohort studies (retrospective and prospective).

Databases used in Search for Relevant Studies

The literature review was conducted using searches of five databases including: CINAHL; MEDLINE; EMBASE; The Cochrane Library and; PubMed.

International stroke guideline recommendations was also gathered form the following reputable institutions: Stroke Foundation (strokefoundation.com.au) and; National Guideline Clearinghouse (www.guideline.gov).

Specific search method details related to each study are summarised at the beginning of each study's literature review and the search outcomes for each study are detailed in the remainder of this chapter.

SECTION 1

2.2 LITERATURE REVIEW STUDY 1: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA

The candidate's first study, conducted prior to the implementation of the QASC intervention, was an examination of the evidence-practice gap for the management of fever, hyperglycaemia and swallowing dysfunction. Specifically, Study 1 investigated in-patient monitoring and treatment practices for fever, hyperglycaemia and swallowing dysfunction, across 19 NSW stroke units, and determined clinician compliance with NSF guideline recommendations (13). Study 1 also provided pre-intervention baseline data for the candidate's third study (a CRCT) to determine the effect of the QASC intervention on clinician behaviour change. Relevant to Study 1 this first section of the literature review summarises: (a) the evidence supporting the association of fever, hyperglycaemia and swallowing dysfunction following acute stroke with increased morbidity and mortality; (b) national and international guideline recommendations specific to the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke; (c) prior investigations by the NSF of Australia measuring adherence to guideline recommendations; and (d) the evidence pertaining to behaviour change interventions to promote EBP. The search methods for Study 1 are summarised in Table 2.1.

Table 2.1: Search Methods for Study 1

Focus of Literature Search	Date of Last Search	Keywords	Inclusion Criteria	Databases Searched	Period of Search
Study 1 (Baseline Audit)					
What is the effect of fever on outcomes in patients with acute stroke? Does treatment of fever with paracetamol improve outcomes in patients with acute stroke?	10 April 2013	Pyrexia, fever, hyperthermia, paracetamol, stroke outcomes	Meta-analysis/ systematic reviews of trials and cohort studies; randomised controlled trials; cohort studies (retrospective and prospective)	CINAHL, MEDLINE, EMBASE, The Cochrane Library, PubMed	2000 to April 2013
What is the effect of hyperglycaemia on outcomes in patients with acute stroke? Does treatment of hyperglycaemia with insulin improve outcomes in patients with acute stroke?	11 April 2013	Hyperglycaemia, glucose, insulin, stroke outcomes	Meta-analysis/ systematic reviews of trials and cohort studies; randomised controlled trials; cohort studies (retrospective and prospective)	CINAHL, MEDLINE, EMBASE, The Cochrane Library and PubMed	2000 to April 2013

Table 2.1 (Cont'd): Search Methods for Study 1

Focus of Literature Search	Date of Last Search	Keywords	Inclusion Criteria	Databases Searched	Period of Search
Study 1 (Baseline Audit (Cont'd)					
What is the effect on outcomes of dysphagia in patients following acute stroke? Does swallowing surveillance following acute stroke improve patient outcomes?	12 April 2013	Aspiration, dysphagia, screening, stroke outcomes	Meta-analysis/ systematic reviews of trials and cohort studies; randomised controlled trials; cohort studies (retrospective and prospective)	CINAHL, MEDLINE, EMBASE, The Cochrane Library and PubMed	1995 to April 2013
What behaviour change interventions promote clinician behaviour change and the uptake of clinical practice guideline recommendations? What behaviour change interventions promote clinician behaviour change and the uptake of EBP?	14 April 2013	Evidence-based practice, clinician behaviour change, behaviour change interventions, clinical practice guidelines	Meta-analysis/ systematic reviews of trials and cohort studies; randomised controlled trials; cohort studies (retrospective and prospective)	CINAHL, MEDLINE, EMBASE, The Cochrane Library and PubMed	2000 to April 2013

2.2.1 Why is it Important to Manage Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke?

A stroke occurs when a part of the brain is deprived of its blood supply, depleting the cells of oxygen and causing their subsequent death. There are two main types of stroke: **ischaemic stroke;** and **haemorrhagic stroke**. An ischaemic stroke occurs when an artery becomes blocked and a haemorrhagic stroke results when an artery bursts (37).

Within minutes after an ischaemic insult, there is a region of irreversibly damaged tissue. This is named the "core" of the stroke. Surrounding this necrotic core is a region of tissue that can be still salvaged but is receiving inadequate blood flow. The tissue will undergo a series of pre-programmed biologic steps called the ischemic cascade that will eventually lead to death of the cells within the "ischemic penumbra." The majority of acute stroke management is centered around salvaging the penumbra. If the penumbra also dies the core of the stroke is extended leading to worse outcomes following stroke (Figure 2.1) (38).

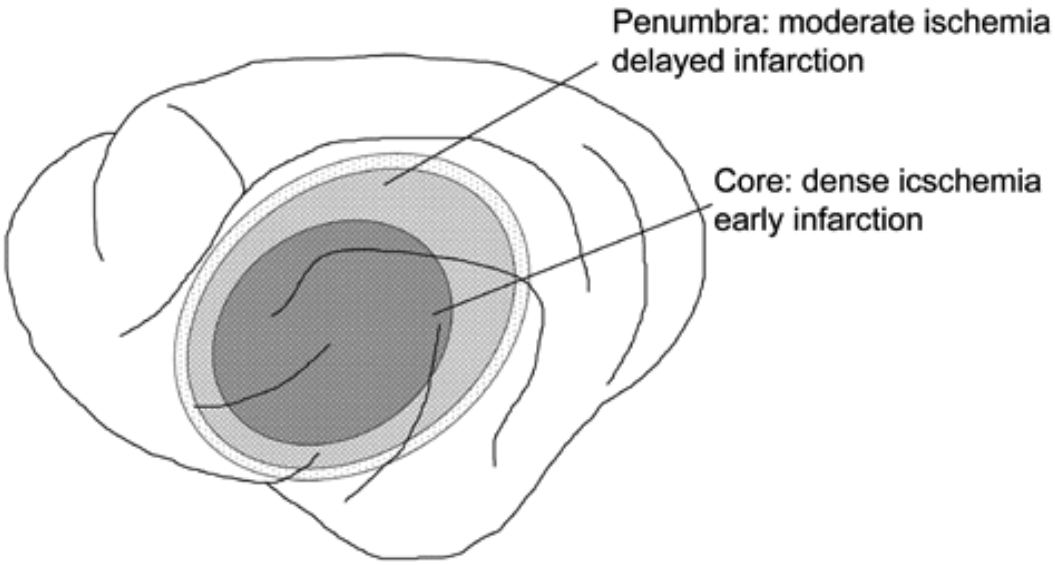


Figure 2.1: Compartments of Infarct Development (37)

In the first few days of an acute stroke, temperature above 37.5 °C occurs in 12–50% of patients (39-42), hyperglycaemia occurs in more than 40% (particularly among patients with a history of known diabetes) (43, 44). It has been postulated that both fever and hyperglycaemia following acute stroke can further compromise blood supply to penumbral areas of the brain and extend the core of the stroke. Hence, specific actions should be taken to prevent and treat fever and hyperglycaemia in the immediate phase following stroke. Dysphagia (difficulty with swallowing) occurs in 37–78% of patients with acute ischaemic stroke (8) and results in increased incidence of aspiration pneumonia and even death.

2.2.1.1 Review of studies investigating the effect of fever on outcomes following stroke

Since the year 2000, three meta-analyses (4, 45, 46) and one large cohort study (47) have been published investigating the *effect* of fever on outcomes following stroke (Table 2.2).

The most recent meta-analysis investigating the independent effect of fever on short-term mortality in acute ischaemic stroke was published in 2010 (45). The author searched the MEDLINE database and the Cochrane Library for retrospective and prospective cohort studies investigating the relationship between fever in acute stroke and short-term mortality from January 1990 to November 2008. Studies eligible for inclusion in the review were those that (1) included patients diagnosed with ischaemic stroke with mortality within 30 days or in-hospital mortality as outcome; (2) had performed multivariable analysis; and (3) had adjusted for age and stroke severity (because the researchers' aim was to determine the association between fever and outcome, independent of age and stroke severity). Six cohort studies, totalling 2986 patients, met the inclusion criteria. Nine studies were excluded because they did not provide odds ratios from logistic regression or did not provide mortality data. To estimate the size of the effect of fever on short-term mortality, the authors conducted meta-analysis with random effects model. This meta-analysis yielded a combined odds ratio (OR) of 1.86 (95% CI, 1.10–3.15, P = 0.02). Overall, the results from this meta-analysis suggest that fever occurring within the first 24 hours of onset of ischaemic stroke is significantly associated with almost twice the risk of short-term mortality within one month of the onset of stroke and the association was independent of age, stroke severity or co-morbidity (i.e. hypertension). Overall, this study has highlighted that measures should be taken to prevent and treat fever following acute stroke to promote optimum outcomes.

2.2.1.2 Review of studies investigating the treatment of fever with paracetamol following stroke

In relation to the *treatment* of fever following stroke, the candidate identified one randomised controlled trial called the PAIS trial, which was published in 2009 and conducted in the Netherlands (Table 2.3). The PAIS trial, a multicentre, randomised, double-blind, placebo-controlled trial, commenced in 2003 and aimed to assess if early treatment with high doses of paracetamol improved functional outcome in patients with acute stroke by reducing body temperature and preventing fever (48). Patients were eligible to participate in the trial if they were 18 years or older, had a clinical diagnosis of ischaemic stroke or intracerebral haemorrhage, and were able to receive the study drug within 12 hours of symptom onset. Patients were excluded if they were considered palliative or if they had a body temperature below 36 °C or over 39 °C. Analyses were by intention-to-treat and the primary outcome measure was modified Rankin Scale (mRS) score at three months. A total of 1400 patients from 29 participating centres in the Netherlands participated in the trial. Enrolment in the study was stopped early due to a lack of funding, reducing the power of the study to 60% rather than the anticipated 80% (2500 patients). Of these, 697 patients were randomised to the intervention group and 703 patients were randomised to the placebo group. Patients randomised to the intervention group received 6000 mgs of paracetamol (six doses of 1000 mgs per day) for three consecutive days following stroke diagnosis. Control group patients received a placebo (identical tablets). The results of the PAIS trial did not provide sufficient evidence to support routine use of high-dose paracetamol in patients with acute stroke; however, a post-hoc analysis of patients with baseline body temperature 37 °C to 39 °C, treatment with paracetamol was associated with improved outcomes.

2.2.1.3 Review of studies investigating the effect of hyperglycaemia on outcomes following stroke

One systematic review plus meta-analysis, published in 2001, was identified that investigated the association between admission hyperglycaemia and both short-term mortality and functional recovery after stroke (5) (Table 2.2). Observational studies conducted between 1966 and December 2000 were included in the overview if they (i) assembled and prospectively followed an inception cohort; (ii) identified that blood glucose was drawn within 24 hours of admission; (iii) reported follow-up of ≥ 80% to hospital discharge or to one month; and (iv) reported outcomes according to admission glucose level. Studies specifically investigating subarachnoid haemorrhage, transient ischaemic attack and non-stroke causes of focal neurological deficits were excluded. Studies that did not report the timing of blood glucose measurement were also excluded. The authors identified 31 studies that met the inclusion criteria. The results from the systematic review indicated that the unadjusted relative risk of in-hospital or 30-day mortality was 3.07 (95% CI, 2.50–3.79) in non-diabetic patients and 1.30 (95% CI, 0.49–3.43) in those with diabetes. The relative risk of poor functional outcome in hyperglycaemic non-diabetic patients was 1.41 (95% CI, 1.16–1.73). In summary, the findings from this review demonstrated that hyperglycaemia following acute stroke results in increased morbidity and mortality. The results also suggest that, in patients with no history of diabetes who have an ischaemic stroke, even moderately elevated glucose levels (>6.1 to 7 mmol/L) were associated with both a threefold higher risk of short-term mortality and an increased risk of poor functional recovery compared with lower glucose levels (5).

2.2.1.4 Review of studies investigating the treatment of hyperglycaemia with insulin following stroke

In relation to the *treatment* of hyperglycaemia with insulin following stroke, only one systematic review was identified, published in 2012 (49) (Table 2.3). The aim of this study was to evaluate the available evidence of the effectiveness of tight glucose regulation intervention for clinical outcome of adults admitted to hospital following acute stroke. Electronic searches were conducted using MEDLINE and PubMed databases, and were limited to 1 January 1996 to 20 June 2011. Studies that met the inclusion criteria included any RCT that used intravenous insulin as an intervention for tight glucose regulation among adults aged 18 years and diagnosed with acute stroke. Studies that were excluded from the review were those that included critical care or traumatic brain injured adults in their sample and studies in which the intervention did not include use of insulin regimes. The authors identified eight studies that met the inclusion criteria. However, of these eight studies, the authors concluded that only one large RCT had been conducted investigating if patients with acute stroke would benefit from tight glucose regulation and this study failed to demonstrate improved outcomes. This study was called the Glucose Insulin in Stroke Trial (GIST-UK) and is further explored below. Of the remaining seven studies, six were pilot studies and one was a small trial. The results of this systematic review indicated that intravenous insulin therapy significantly lowers glucose levels when compared with controls but adherence to glucose monitoring and treatment protocols poses considerable challenges for nurses. Overall, the authors concluded that there is no substantive evidence to support aggressive glucose monitoring following acute stroke; however, trials conducted to date have been of poor quality and well-conducted large RCTs are warranted.

As highlighted above, there has only been one large RCT (referred to as the GIST trial), published in 2007, that sought to determine whether treatment with glucose-potassium-insulin (GKI) infusions to maintain glucose levels between 4 and 7 mmol/L following acute stroke reduced death at 90 days (50) (Table 2.3). Patients were eligible to participate in the study if they were admitted to hospital within 24 hours of stroke onset and their blood glucose levels were between 6.0 and 17.0 mmol/L. Patients allocated to the intervention group received variable-dose-insulin GKI infusion for 24 hours, and patients allocated to the control group received intravenous saline infusion for 24 hours. The purpose of GKI infusion was to maintain capillary glucose at 4–7 mmol/L, with no glucose intervention in the control group. The primary outcome was death at 90 days, and the secondary outcome was decreased death and disability at 90 days. The trial was stopped due to slow enrolment after 933 patients were recruited. The results of this study indicated that there was no beneficial effect for GKI treatment on death and disability; however, in the intervention group, overall mean plasma glucose and mean systolic blood pressure were significantly lower than in the control group. The authors acknowledged that the study was underpowered and caution should be undertaken when interpreting the results.

2.2.1.5 Review of studies investigating the effect of swallowing dysfunction on outcomes following stroke

There were no studies that met the inclusion criteria published between 2000 and April 2013 that determined swallowing impairments and their association with *mortality*. The search was extended from 1995 to April 2013, and one cohort study was identified, published in 1999, that investigated swallowing dysfunction and its association with morbidity and *mortality* (51) (Table 2.2). The aim of this study was to investigate the

prognosis of swallowing function over the first six months after acute stroke and to identify the important independent clinical and videofluoroscopic prognostic factors at baseline that are associated with an increased risk of swallowing dysfunction and complications. This prospective inception cohort study was conducted between May 1994 and May 1995 at the Royal Perth Hospital, located in Australia. Patients were eligible to participate in the study if they were (i) diagnosed with acute stroke (first time); (ii) presented within seven days of stroke symptoms; (iii) were conscious and medically stable; and (iv) had no history of previous swallowing impairment or a medical condition that could affect swallowing function. Patients' swallowing function was assessed clinically, at the bedside by two speech pathologists and videofluoroscopically by the study radiologist and one of the study speech pathologists, using a standardised method and diagnostic criteria. All patients were followed up prospectively for six months for the occurrence of death, recurrent stroke, chest infection, recovery of swallowing function and return to normal diet. One hundred twenty-eight patients participated in the study. The results of the study indicated that during six months of follow-up after stroke, five patients (3.9%) died, all of whom had initial videofluoroscopic evidence of swallowing dysfunction. The results of the study also indicated that a swallowing abnormality was detected clinically in 50% of patients (95% CI, 42–60%) and videofluoscopically in 64% of patients (95% CI, 55–72%). Over a six-month period, 20% of patients suffered a chest infection (95% CI, 14–28%) and 87% returned to their pre-stroke diet (95% CI, 79–92%). The single independent predictor of chest infection during the six-month follow-up was a delayed or absent swallowing reflex, detected by videofluoroscopy. The authors recommend that swallowing function should be assessed in all acute stroke patients because swallowing

dysfunction is common following stroke and complications such as death and chest infections do arise.

2.2.1.6 Review of studies investigating swallowing screening following acute stroke

Only one systematic review, published in 2005, was identified that not only investigated the incidence of dysphagia and associated pulmonary complications following stroke (8) but also the effect of swallowing screening on reducing incidences of aspiration pneumonia following stroke (Table 2.3). Databases including MEDLINE, Embase and Pascal were searched for published literature between 1966 and May 2005. Articles eligible for inclusion were those that (i) evaluated the swallowing ability of adults (> 18 years of age) following diagnosis of stroke; (ii) were a retrospective or prospective study; (iii) reported the incidence of dysphagia using clearly described methods; and (iv) if pneumonia was reported, clearly documented the criteria by which it was defined. Twenty-four articles met the inclusion criteria. The results of the study found that there was a high incidence of dysphagia following stroke that was also associated with a higher incidence of pneumonia. Further, the use of a formal dysphagia screen can reduce the risk of pneumonia.

The QASC swallowing protocol (Appendix G) recommended that the initial swallowing screening be conducted by a registered nurse who had undergone training and competency testing by a speech pathologist. Prior to the implementation of the QASC trial only one swallowing screening tool had been tested for reliability with nurses as screeners (52). The most recent study validating a screening tool and comparing swallowing screening conducted by registered nurses to that of a speech pathologist was published in 2008 (53). This study was conducted within a stroke unit located at the

Summa Health Systems Hospital, Ohio. Stroke unit patients who received predetermined scores on specific items of the National Institutes of Health Stroke Scale were eligible for screening. The swallowing screening protocol was developed by a neurologist and consisted of three parts (with swallow, cough, and vocal quality observed during each part): 1 teaspoon lemon ice, 1 teaspoon applesauce, and 1 teaspoon water. Following the nurses screening a speech pathologist was notified to perform an independent screening on the same patient within one hour of the nurses screening. Speech pathologists used the same screening tools as the nurse. For this study each nurse was required to perform five screenings which were then compared to a speech pathologists evaluation of the same patient to determine the validity and reliability of the screening. Eighty-three paired screenings were completed by nurses and speech pathologists. In 78 (94% of cases) there was agreement on the dysphagia screening results between the nurse and the speech pathologist. Two of the mismatched assessments were conducted by the same nurse and consequently this nurse was retrained. Following this study the screening protocol was implemented as standard practice. A before-and-after comparison was also conducted investigating rates of aspiration pneumonia following implementation of the protocols. The results of this study indicated that the rates of aspiration were slightly lower following protocol implementation (3.7% vs 4.3%) (53).

2.2.1.7 Summary of the evidence investigating fever, hyperglycaemia and swallowing dysfunction following acute stroke

The evidence suggested that fever following acute stroke results in increased morbidity and mortality, and furthermore, treatment of fever with paracetamol may be associated

with improved outcomes. The evidence also suggested that hyperglycaemia following acute stroke results in increased morbidity and mortality, and that the treatment of hyperglycaemia with insulin reduces glucose levels. However, there is currently no clinical evidence that targeting the blood glucose to a particular level during acute ischaemic stroke will improve outcomes. Finally, the evidence suggested that dysphagia, aspiration and pneumonia are common following stroke and the use of a formal dysphagia screen can reduce the risk of pneumonia.

Table 2.2: Fever, Hyperglycaemia and Swallowing Dysfunction and Their Association with Stroke Outcomes: Summary of the Evidence

AUTHORS	YEAR	AIM/PURPOSE	DESIGN	SAMPLE	RELEVANT FINDINGS	COMMENTS
Fever						
Prasad & Krishnan(45)	2010	To determine the size of independent effect of fever on the outcome of mortality within one month after acute ischaemic stroke	Meta-analysis	6 cohort studies included, totalling 2986 patients	Fever within the first 24 hours of hospitalisation in patients with ischaemic stroke was associated with doubling of odds of mortality within one month of the onset of stroke	
Hyperglycaemia						
Capes et al.(5)	2001	To summarise the available evidence and to estimate the strength of the association between admission hyperglycaemia and both short-term mortality and functional recovery after stroke	Systematic review and meta-analysis	26 studies	Acute hyperglycaemia predicted increased risk of in-hospital mortality after ischaemic stroke in non-diabetic patients and increased risk of poor functional recovery in non-diabetic stroke survivors	Definition of hyperglycaemia was the one adopted by authors of individual studies and therefore varied from study to study

Table 2.2 (Cont'd): Fever, Hyperglycaemia and Swallowing Dysfunction and Their Association with Stroke Outcomes: Summary of the Evidence

AUTHORS	YEAR	AIM/PURPOSE	DESIGN	SAMPLE	RELEVANT FINDINGS	COMMENTS
Swallowing Dysfunction						
Mann et al.(51)	1999	To prospectively study the prognosis of swallowing function over the first 6 months after acute stroke and to identify the important independent clinical and videofluoroscopic prognostic factors at baseline that are associated with an increased risk of swallowing dysfunction and complications	Cohort study	128 hospital-referred patients with acute first stroke	Swallowing dysfunction following stroke and complications such as death and chest infections occur as a result of an inadequate swallow The single most independent predictor of chest infections following stroke was a delayed or absent swallowing reflex	Authors suggest that the findings should be validated in other studies

Table 2.3: Treatment of Fever, Hyperglycaemia and Swallowing Dysfunction Following Stroke: Summary of the Evidence

AUTHORS	YEAR	AIM/PURPOSE	DESIGN	SAMPLE	RELEVANT FINDINGS	COMMENTS
Fever						
Den Hertog et al.(48)	2009	To assess whether early treatment with paracetamol improved functional outcome in patients with acute stroke by reducing body temperature and preventing fever	RCT	1400 patients	The results of this study do not support routine use of high-dose paracetamol in patients with acute stroke. A post-hoc analysis indicated that Paracetamol may have a beneficial effect on functional outcomes in patients admitted with a body temperature 37 °C to 39 °C, further studies required	
Hyperglycaemia						
Laird & Coates(49)	2012	To evaluate the available evidence on the effectiveness of tight glucose regulation intervention for clinical outcome of adults admitted to hospital with acute stroke	Systematic review	8 trials met the inclusion criteria totalling 1257 adults	There is currently no substantive evidence to support aggressive glucose lowering in the acute phase of stroke	Trials conducted to date have been on poor to sound quality Glucose target range varied across studies

Table 2.3 (Cont'd): Treatment of Fever, Hyperglycaemia and Swallowing Dysfunction Following Stroke: Summary of the Evidence

AUTHORS	YEAR	AIM/PURPOSE	DESIGN	SAMPLE	RELEVANT FINDINGS	COMMENTS
Hyperglycaemia						
Gray et al.(50)	2007	To determine whether treatment with glucose-potassium-insulin (GKI) infusions to maintain euglycaemia immediately after the acute event reduces death at 90 days (target glucose concentration 4–7 mmol/L)	RCT	933 patients recruited	No significant reduction in mortality at 90 days	Trial stopped due to slow recruitment, study underpowered.
Swallowing Dysfunction						
Perry et al.(54)	2001	What are the incidence and outcomes of dysphagia and aspiration in acute stroke? What screening interventions are available to detect dysphagia in patients with acute stroke and what effect have they on patient outcomes?	Systematic review	26 articles met the inclusion criteria	Dysphagia is common and associated with a range of deleterious outcomes. Further studies are required to detect the effects of screening and validate screening methods	

2.2.2. How Should Fever, Hyperglycaemia and Swallowing Dysfunction Following Acute Stroke Be Managed According to National and International Guideline Recommendations?

Clinicians today have greater access to evidence through initiatives such as clinical guidelines. Their purpose is to provide clinicians with a synthesis of the best available external evidence and assist with the implementation of EBP (19). In relation to the first study, the candidate investigated international and national guideline recommendations (published prior to the commencement of the QASC trial) for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke from the United Kingdom (UK) (9), United States of America (USA) (10), Europe (11), Canada (12) and Australia (13).

2.2.2.1 Guideline recommendations for the management of fever following stroke

International guidelines from the UK (9), USA (10), Europe (11), Canada (12) and Australia (13) (Box 2.1) recommend similar monitoring and treatment practices for the management and treatment of fever. However, these recommendations are generally non-specific, that is, only the Canadian guidelines included a recommendation specific to the frequency of temperature monitoring within the first 48 hours following admission for acute stroke (every four hours) (12). Four of these five guidelines recommended that paracetamol be used routinely to treat fever (10-13) but only three (Europe, USA, Canada) provided a threshold for treatment (> 37.5 °C) (11, 12, 55).

2.2.2.2 Guideline recommendations for the management of hyperglycaemia following stroke

No guidelines included recommendations specific to the frequency of glucose monitoring following stroke diagnosis, and insulin was recommended for treatment of hyperglycaemia in three of the five guidelines (10, 12, 13) (USA, Canada, Australia). Only two (UK, USA) provided a threshold for treatment (maintain between 4 and 11 mmol/L; lower glucose levels to _300 mg/dl [16.7 mmol/L]) (9, 10) (Box 2.1).

2.2.2.3 Guideline recommendations for the management of swallowing dysfunction following stroke

For the management of swallowing dysfunction following acute stroke, of the five guidelines reviewed, three (UK, Canada, Australia) recommended a swallow screen (by a non-speech pathologist) be undertaken within the first 24 hours of admission to the hospital and prior to being given food, drink or oral medications (9, 12, 13). Two of the three guidelines (UK, Australia) recommending a swallow screen also recommended a comprehensive swallow assessment (by a speech pathologist) for those with a failed screen (9, 13). One of the guidelines recommended a swallow assessment but no swallow screen (11). One guideline (USA) failed to include any recommendation pertaining to the management of swallowing dysfunction (10) following acute stroke.

2.2.2.4 Summary of national and international guidelines for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke

In summary, a review of national and international guideline recommendations pertaining to the management and treatment of fever, hyperglycaemia and swallowing

dysfunction highlighted that different guidelines provide different recommendations. It was not within the scope of this thesis to further explore the *'why.'* However, this is a complex issue requiring a separate detailed study. It is impossible to say otherwise why some countries have different guidelines for the management of acute stroke. Presumably this is due to a lack of firm evidence for some recommendations and varying interpretations by different people of what evidence is.

As standardised recommendations for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke did not exist, panels of experts (for the QASC trial) developed three clinical treatment protocols (Appendix D, E, F, G) using recommendations from Australia's national clinical guidelines for stroke (13). The protocols included specific monitoring and treatment targets for fever, hyperglycaemia and swallowing dysfunction (Box 2.1). Prior to the QASC trial, it was not known what effect comprehensive and standardised management protocols for these three variables would have on patient management and outcomes.

Box 2.1: International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction^

	UK(9)	*Europe(11)*	*USA(10)*	*Canada(12)*	*Australia(13)*
Fever Management					
Monitoring targets and time frame	Not stated	Not stated	Not stated	'*Every 4 hours for first 48 hours*'	'*Routinely and frequency determined by the patient's status*'
Treatment target	Not stated	> 37.5 °C	Not stated	> 37.5 °C	Not stated
Paracetamol or antipyretic medication recommended	No	Yes	Yes	Yes	Yes
Hyperglycaemia Management					
Venous Blood Glucose					
Monitoring targets	Not stated	'*Initial examination should include ... blood samples for clinical chemistry, glucose*'	'*Several tests should be performed routinely ... These test include blood glucose*'	'*All patients with suspected acute stroke should have their blood glucose concentration checked immediately*'	'*The following investigations should be obtained routinely ... glucose*'

^Where available exact recommendation shown in italics

Box 2.1 (Cont'd): International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction

	UK(9)	*Europe(11)*	*USA(10)*	*Canada(12)*	*Australia(13)*
Hyperglycaemia Management					
Finger-prick blood glucose					
Monitoring targets and time frame	Not stated	'*Check regularly*'	Not stated	'*Check immediately*'	'*Routinely and frequency determined by the patient's status*'
Treatment target	'*Maintain between 4 and 11 mmol/L*'	Not stated	'*Lower markedly elevated glucose levels to _300 mg/dl (16.7 mmol/L)*'	Not stated	Not stated
Insulin for hyperglycaemia recommended	No	No	Yes	Yes	Yes
Swallowing Dysfunction Management					
Swallow screen (non-speech pathologist)	'*On admission*' '*Before being given any oral food, fluid or medication*'	Not stated	Not stated	'*Part of their initial assessment, and before initiating oral intake of medications, fluids or food*' '*If not alert within the first 24 hours*'	'*Within 24 hours of admission and before being given any oral food, fluid or medication*'
Swallow assessment (speech pathologist only)	If failed swallow screen, swallow assessment recommended within 24 hours	'*Recommended*'	Nil	'*Recommended*'	If failed swallow screen, swallow assessment recommended

^Where available exact recommendation shown in italics

2.2.3 Prior Investigations into the Management of Fever, Hyperglycaemia and Swallowing Dysfunction Following Stroke in NSW, Australia, Stroke Units

The NSF of Australia publish a report every two years that provides an overview of the quality of acute stroke care in Australia using data from the Acute Services Clinical Audit (16). The NSF's most recent report, published in 2011 (16), provides a measure of adherence to guideline recommendations published in the *Clinical Guidelines for Stroke Management 2010* (29). Changes in acute clinical care that have occurred since 2007 are also presented. For the NSF 2011 report, a total of 3548 patients' medical records were audited by clinicians from 108 hospitals across Australia. The hospitals that participated in the audit provided care for the majority of stroke cases (88%) admitted to Australian hospitals; hence, the results from this audit are representative of acute stroke care nationally.

The Acute Services Clinical Audit results provide evidence that, in many instances, a large proportion of patients with stroke do not receive evidence-based care (16). For example, many stroke patients do not receive dedicated stroke unit care (16), despite overwhelming evidence of its effectiveness (29). Although the NSF has investigated compliance with many of the stroke guideline recommendations, prior to the commencement of the QASC trial (2007), they had not investigated compliance with guideline recommendations relating to the monitoring and treatment of fever nor to the monitoring and treatment of hyperglycaemia. The NSF had investigated swallowing surveillance, in the form of a swallowing screen by a non-speech pathologist or a swallowing assessment by a speech pathologist; however, these two different assessments had not been investigated independently of one another. The NSF recommendations specifically state that a swallowing screen should be undertaken as

the initial assessment. A swallowing assessment by a speech pathologist is only required if a patient fails a swallowing screen. Prior to the candidate's first study, there was no investigation into swallowing screening by non-speech pathologists in NSW stroke units.

2.2.4 Literature Review Summary Study 1 (Baseline Audit)

This section of the literature review, relevant to Study 1, has highlighted that fever, hyperglycaemia and swallowing dysfunction following acute stroke all result in increased morbidity and mortality; hence, the treatment of all three variables should be a priority. Although this evidence was in existence, the guidelines available to clinicians (prior to the implementation of the QASC intervention) did not include standardised monitoring and treatment recommendations for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke. To the candidate's knowledge no study (nationally or internationally) had explored the monitoring and treatment of fever and hyperglycaemia or swallowing screening by non-speech pathologists. Hence the aim of the candidate's first study was to identify the monitoring and treatment practices for these three variables following acute stroke in NSW, Australian stroke units.

2.2.5 Changing Clinician Behaviour

Prior studies have identified that the distribution alone of guidelines will not change clinician behaviour (19), and it is now widely accepted that the translation of research evidence into practice requires more effort than the simple dissemination of research findings (56).

Implementation science or implementation research is concerned with the application of research findings into clinical practice to improve the quality and effectiveness of health services and patient care (57). Historically, evidence implementation strategies were chosen based on personal beliefs and hunches rather than theoretical or empirical knowledge about what changes provider behaviour (58). Early leaders in the field of implementation science called for change, declaring that evidence-based medicine should be complemented by evidence-based implementation (33).

2.2.5.1 Theoretically informed interventions

There is growing agreement that theory should be used to inform evidence implementation and the design of interventions to promote the uptake of evidence, however, there is currently no consensus among the implementation science community on the optimal theory (59, 60). In fact, there is some question as to whether there can or should be such a thing as a single overarching implementation theory (61). A systematic review of implementation studies found that only 22.5% (53 of 235) were based, implicitly or explicitly, on a theory or theories. The 53 studies that were based on theory cited 25 different theories (62). A recent systematic review identified 61 process theories alone (63). One critique of implementation theories is that they are not evidence

based, and without evidence, there is little information to support the use of one theory over another (64, 65).

2.2.5.2 The development of the QASC behaviour change intervention

The QASC multifaceted behaviour change intervention was not a theoretically informed intervention. Instead, components of the intervention were derived from evidence originating from studies investigating behaviour change interventions (57) (31).

The QASC behaviour change intervention consisted of (1) evidenced-based clinical treatment protocols (also referred to as the FeSS protocols) (Appendix E, F, G); (2) multidisciplinary, team-building workshops to determine local barriers to the implementation of the QASC clinical treatment protocols (31-33); (3) a standardised education programme (34, 66); and (4) engagement of local stroke unit co-ordinators through support and feedback (19, 67). The evidence supporting the development of the QASC behaviour change intervention is further explored below.

The Cochrane Effective Practice and Organisation of Care (EPOC) Group is a review group of the Cochrane Collaboration. The Cochrane Collaboration is an international network of more than 28,000 dedicated people from over 100 countries, working together to help health care providers make well-informed decisions about health care, by preparing, updating and promoting the accessibility of Cochrane Reviews. The research focus of the EPOC Group is on interventions designed to improve the delivery, practice and organisation of health care services. As of November 2010, EPOC has published over 70 reviews on interventions to improve specific types of practice. These reviews are summarised in Table 2.4.

Table 2.4: Behaviour Change Interventions: A Summary of the Evidence (57)

Intervention	Number of studies	Effect Size (%)	Study Findings
Local opinion leaders (67)	18 RCTs	Median absolute improvement of care of 12% (IQR +6.0% to +14.5%)	May successfully promote evidence-based practice, but effectiveness varies both within and between studies
Education meetings (34)	81 RCTs	Median absolute improvement in care of 6.0% (IQR +1.8 to +15.9)	Alone or combined with other interventions can improve professional practice and health care outcomes. Larger effects were associated with higher attendance rates, mixed interactive and didactive meetings and interactive meetings.
Educational outreach (70)	69 RCTs	Median absolute improvements in: -Prescribing behaviours of 4.8% (IQR +3.0% to +6.5%) -Other behaviours of 6.0% (IQR +3.6% to 16.0%)	Has an effect on prescribing that is relatively consistent and small, but potentially important. The effects on other types of professional performance vary from small to modest improvements. The effects of educational outreach for changing more complex behaviours are less certain.

Intervention	Number of studies	Effect Size (%)	Study Findings
Audit & Feedback (68)	118 RCTs	Median absolute improvement of care of 5.0% (IQR +3% to +11%)	Generally leads to small but potentially important improvements in professional practice. In general, larger effects were seen if baseline compliance was low.
Printed educational materials (71)	12 RCTs 11 Non-randomised studies	Median absolute improvement of care on categorical process outcomes (i.e. smoking cessation activities) of 4.3% (IQR -8.0% to +9.6%)	May have a beneficial effect on process outcomes but not on patient outcomes
Computer reminders (69)	28 RCTs	Median absolute improvement of care 4.2% (IQR +0.8 to +18.8)	Generally achieve small to modest improvements in provider behaviour. Most studies have examined the effect of relatively simple reminders.
Tailored interventions (72)	26 RCTs	Meta-regression using 12 RCTs. Pooled OR 1.52 (95% CI, 1.27–1.82, p<0.01)	Interventions tailored to prospectively identified barriers are more likely to improve professional practice than no intervention or dissemination of guidelines

2.2.5.3 The effect of multifaceted interventions on clinician behaviour change

The QASC intervention is classified as a multifaceted intervention because it comprised two or more components (73). Multifaceted interventions should be developed with the intention of targeting different barriers to evidence uptake. Prior studies have found that interventions made up of two or more components are not necessarily more effective than single component interventions (57). However, few of these studies provided any rationale or theoretical base for the choice of the intervention (57). Therefore it is plausible that multifaceted interventions developed from careful assessment of barriers and coherent theoretical base may be more effective than single interventions. Prior studies have also suggested that, when using multifaceted interventions, it is important to carefully consider the components likely to have maximum benefit to avoid a 'kitchen sink' approach (57).

2.2.5.4 The effect of printed educational materials on clinician behaviour change

The evidenced-based clinical treatment protocols (also referred to as the FeSS [**Fe**ver, **S**ugar, **S**wallow] protocols) were developed form the stroke guidelines and were distributed to intervention stroke units.

Printed education materials is the distribution of published or printed recommendations for clinical care, including clinical practice guidelines, audiovisual materials and electronic publications (73). The use of printed education material to promote the uptake of evidence is common because of its low cost and overall feasibility (57). However, its effectiveness compared with other interventions is uncertain, and there is insufficient information in the literature about how it may be optimised (71).

2.2.5.5 The effect of tailored interventions on clinician behaviour change

The QASC triallists implemented two multidisciplinary team-building workshops to determine local barriers to the implementation of the QASC behaviour change intervention at the intervention stroke units. Tailored interventions are strategies to improve professional practice that are planned taking account of prospectively identified barriers to change (73). Although this approach seems logical, it is often not the case in practice. It has been observed that it is common for people to become attached to a familiar strategy, which they apply in all situations (31). Prior studies (72) have found that tailored interventions are more likely to improve professional practice than no intervention or dissemination only. Further research was suggested to determine the effectiveness of tailored interventions in comparison with other strategies.

2.2.5.6 The effect of educational meetings on clinician behaviour change

In those units allocated to the intervention group, the QASC project officer (a registered nurse) also delivered **unit-based education and support** (34). To ensure complete coverage of clinical personnel, each stroke unit was offered two identical education sessions scheduled at different times. The aim of these sessions was to educate clinicians about the clinical treatment protocols. Educational meetings are defined as the participation of health care providers in conferences, lectures, workshops or traineeships (73). Educational meetings are another commonly used strategy because they are relatively inexpensive and generally feasible. Prior studies (34) have found that strategies to increase attendance at educational meetings, using mixed interactive and didactic formats, and focusing on outcomes that are likely to be perceived as serious, may increase the effectiveness of educational meetings. They concluded that

educational meetings alone are not likely to be effective for changing complex behaviours.

2.2.5.7 The effect of local opinion leaders on clinician behaviour change

Another entity of the QASC intervention was the engagement of local stroke unit co-ordinators and clinical champions through support and feedback. Local opinion leaders are defined as providers nominated by their colleagues as educationally influential (73). Opinion leaders target the knowledge, attitudes and social norms of their peer group; thus, the success of this intervention is said to depend on intact functional professional networks (57). Although this is a frequently used strategy, in most studies the role of the opinion leader is not clearly described, which makes it difficult to identify potential ways for optimising the strategy (70).

2.2.6 Summary of Evidence Investigating Behaviour Change Interventions

Behaviour change interventions that have been shown to change professional practice include printed educational materials; educational meetings; educational outreach; local opinion leaders; audit and feedback; and reminders (57). Although prior studies have found that interventions made up of two or more components are not necessarily more effective than single component interventions (57), few of these studies provided any rationale or theoretical base for the choice of the intervention (57). Therefore, it is plausible that multifaceted interventions developed from careful assessment of barriers and coherent theoretical base may be more effective than single interventions. Behaviour change interventions that are developed or 'tailored' to overcome barriers and maximise the effect of facilitators are more likely to foster change (72). However,

the evidence determining the effectiveness of tailored interventions in comparison with other interventions is incomplete (72).

SECTION 2

2.3 LITERATURE REVIEW STUDY 2: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY

The candidate's second study, conducted prior to the implementation of the QASC intervention, was an investigation into individual and organisational traits that may have influenced the successful implementation and sustainability of the QASC intervention. Relevant to Study 1 this second section of the literature review summarises the evidence pertaining to: (a) leadership; (b) organisational learning; (c) attitudes and beliefs towards EBP; and (d) organisational readiness to accept change. The search methods for Study 2 are summarised in Table 2.5.

Table 2.5: Search Methods for Study 2

Focus of Literature Search	Date of Last Search	Keywords	Inclusion Criteria	Databases Searched	Period of Search
Study 2 (NUM Study)					
What individual and organisational traits influence the implementation and sustainability of EBP?	15 April 2013	Evidence-based practice, implementation, leadership, organisational learning; attitudes and beliefs, readiness for change, nursing	Meta-analysis/ systematic reviews of trials and cohort studies; randomised controlled trials; cohort studies (retrospective and prospective)	CINAHL, MEDLINE, EMBASE, The Cochrane Library and PubMed	2000 to May 2013

2.3.1 Nurse Leadership and Its Influence on the Process of Implementing Evidence-Based Practice

The candidate identified one systematic appraisal of the literature, published in 2011, that aimed to uncover current knowledge about leadership and the process of implementing EBP in nursing (20) (Table 2.6). A systematic search was conducted in the Cochrane Library, MedLine and CINAHL databases for all quantitative and qualitative research studies published prior to 2009. For studies to be included, they had to (i) be published in a scientific peer-reviewed journal; (ii) focus on leadership and the process of EBP implementation; and (iii) comprise health care professionals only. Studies investigating general barriers to EBP implementation were excluded, as were implementation studies on the subject of opinion leaders, case managers, change agents or facilitators who did not have an administrative or managerial title. The authors identified seven studies that met the inclusion criteria. Two of these studies were integrative reviews, two had a quantitative design and the remaining three had a qualitative design. Only one study was appraised as being of high scientific quality (74). The authors concluded that, although there appears to be agreement that leaders and the way leadership is performed can play an important role in the process of implementing EBP in nursing, there is a lack of scientific rigour in research underpinning this assumption. Additionally, the findings also indicated that leadership should not be studied in isolation from the work environment because there appears to be an intricate interplay between different factors. The authors concluded that more rigorous research is needed concerning the possible role of the leader and that leadership should not be studied in isolation (74).

2.3.2 Attitudes and Beliefs and Their Influence on the Process of Implementing Evidence-Based Practice

The most recent systematic review investigating individual characteristics that influences nurses' use of research evidence in clinical practice was published in 2011 (25) (Table 2.6). The authors searched 12 online bibliographic databases for RCTs, clinical trials and observational (i.e. quasi-experimental, cohort, case-control, cross-sectional) designs that examined the association between individual characteristics and nurses' use of research in practice from 2001 and 2008. Qualitative studies, case reports and editorials were excluded. Studies were limited further to those published in English, Danish, Swedish and Norwegian languages. Forty-five articles met the inclusion criteria. Individual nurse characteristics were classified according to six categories: beliefs and attitudes, involvement in research activities, information seeking, education and professional characteristics. The authors concluded that attitudes and beliefs was the only individual characteristic assessed in a sufficient number of studies and the only individual characteristic that is consistently (with a positive effect) related to research utilisation. Other individual characteristics with evidence for a positive association with research utilisation include attending conference or in-service training, having a graduate degree, current role, clinical specialty and job satisfaction. Overall, the findings from this review suggest that these individual characteristics may hold promise as targets of future research utilisation.

2.3.3 Organisational Learning and Its Influence on the Process of Implementing Evidence-Based Practice

Organisational learning or the learning organisation (the two terms are often used interchangeably in the literature) may also have an effect on EBP implementation and

change (21, 22). A learning organisation is an organisation skilled at creating, acquiring and transferring knowledge and at modifying its behaviour to reflect new knowledge (75). Goh and Richards (21) propose that there are five major underlying organisation characteristics and management practices that are key conditions essential to allow learning to take place and build learning organisations. These organisation characteristics and management practices include (1) clarity of purpose and mission; (2) leadership commitment and empowerment; (3) experimentation and rewards; (4) transfer of knowledge; and (5) teamwork and group problem solving. Definitions for each of these dimensions are provided in Table 2.6.

Learning organisations have been linked to successful implementation of quality improvement endeavours (76), and prior studies have also found that learning organisations are more conducive to EBP (77). However, the most recent systematic review shows that organisational learning is under-researched in relation to the public health service (78), and further research is needed to understand the processes and contingencies that shape the nature and extent of organisational learning.

Table 2.6: Five Major Underlying Organisation Characteristics and Management Practices That Are Key Conditions Essential to Allow Learning to Take Place and Build Learning Organisations (21)

Learning capability dimensions	Definition
Clarity of mission and vision	The degree to which employees have a clear vision/mission of the organisation and understand how they can contribute to its success and achievement
Leadership commitment and empowerment	The role of leaders in the organisation with respect to helping employees learn and elicit behaviours that are consistent with an experimenting and changing culture
Experimentation and rewards	The degree of freedom employees enjoy in the pursuit of new ways of getting the job done and freedom to take risks
Effective transfer of knowledge	The systems that enable employees to learn from others, from past failures and from other organisations
Teamwork and group problem solving	The degree of teamwork possible in the organisation to solve problems and generate new and innovative ideas

2.3.4 Organisational Readiness for Change

Organisational readiness refers to the level of commitment of *all* members of the organisation to implement organisational change (79, 80). In ordinary language, the term 'readiness' denotes a state of being both psychologically and behaviourly prepared to take action, that is, willing and able. Therefore, organisational readiness can be conceived in psychological terms (81), or others describe organisational readiness for change in more structural terms, emphasising the organisation's financial, material, human and informational resources (82). Although there has been little theoretically grounded discussion on the determinants of organisational readiness (81), Peter and Waterman's Seven-S model (83) suggests several conditions or circumstances that might promote it. The Seven-S model is a management model that describes seven important aspects of organisations that, together, determine the way in which an organisation operates or functions. The seven S's represent strategy, structure, systems, staff, style of management, shared beliefs and values, and skills. Organisational readiness may be linked to one or more of the domains (83). Although there has been some ambiguity regarding determinants of organisational readiness, consensus is that organisational readiness for change is considered a critical precursor to the successful implementation of complex changes in health care settings (23, 24). However, there is limited evidence of reliability or validity for most publicly available measures.

2.3.5 Literature Review Summary Study 2 (NUM Study)

In summary, a review of the literature investigating the influence of leadership, organisational learning, attitudes and beliefs towards EBP and organisational readiness

for change has highlighted that all domains may be critical precursors to the successful uptake and sustainability of EBP, however more rigorous research is required.

Table 2.7: Leadership, Attitudes and Beliefs and Their Influence on Research Utilisation

AUTHORS	YEAR	AIM/PURPOSE	DESIGN	SAMPLE	RELEVANT FINDINGS	COMMENTS
Leadership						
Sandstrom et al.(20)	2011	To systematically review the literature regarding leadership and its possible influence on the process of implementing EBP	Systematic critical appraisal of the literature	7 studies met the inclusion criteria	Leadership is vital for the process of implementing EBP in nursing.	
Attitudes and beliefs						
Squires et al.(25)	2011	To update the evidence published in a previous systematic review on individual characteristics influencing research utilisation by nurses	Systematic review	45 studies met the inclusion criteria	Six categories of potential individual determinants were identified: beliefs and attitudes; involvement in research activities; information seeking; professional characteristics; education and other socioeconomic factors. Of these potential individual determinants there is a support for a link between attitudes and beliefs and research utilisation.	Methodological problems were inherent in many of the studies and robust evidence to support individual characteristics that predict research utilisation is scarce

SECTION 3

2.4 LITERATURE REVIEW STUDY 3: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE

The outcome results of the QASC trial indicated that patients admitted to intervention stroke units were 15.7% more likely to be alive and independent at 90 days after admission. There has been international interest (84, 85) regarding how this occurred, considering that the mean improvement from prior studies adopting multifaceted interventions is 10% (86).

This third section of the literature review corresponds to the candidate's third study (Chapter 5). The aim of Study 3 was to conduct a pre-specified quantitative process evaluation parallel to the QASC trial to aid in the interpretation of the main study (QASC) results. Corresponding to Study 3, this final section of the review aims to: (a) discuss the purpose and design of process evaluations conducted alongside RCTs and; (b) summarise two process evaluations conducted alongside CRCTs that have been judged as 'quality' process evaluations and have significantly added understanding to the main trial findings (28). The search methods for Study 3 are summarised in Table 2.8.

Table 2.8: Search Methods for Study 3

Focus of Literature Search	Date of Last Search	Keywords	Inclusion Criteria	Databases Searched	Period of Search
Study 3 (Process Evaluation)					
What prior process evaluations have been conducted alongside randomised controlled trials? How should a process evaluation be conducted and reported?	16 April 2013	Process evaluation, randomised controlled trial	Process Evaluations; Randomised controlled trials	CINAHL, MEDLINE, EMBASE, The Cochrane Library and PubMed	2000 to May 2013

2.4.1 Purpose of Process Evaluations

Many conventional RCTs evaluating the effect of their intervention on health outcomes are unable to explain why the intervention worked, or why it did not (28). Process evaluations are studies conducted parallel to or following intervention trials to help in the interpretation of the outcome results by exploring the trial processes: implementation and receipt; context and setting; professionals and patients (28). Not only do they assist with the interpretation of the outcome results but they are also used to enhance understanding on whether or how the intervention can move from research to practice (28).

2.4.2 Process Evaluation Design

Much of the current literature on process evaluations on multifaceted interventions focuses on qualitative methods, and less attention is paid to quantitative methods (28). Further, there is no single best way to design and carry out a process evaluation and hence, process evaluations vary considerably. However, there is a general consensus that process evaluations need to be tailored to the trial, the intervention and the outcomes being studied (28).

The process analysis conducted by the candidate was targeted to one component of the intervention: successful (or otherwise) uptake of the evidence-based clinical treatment protocols. Specifically, the candidate's process evaluation investigated clinician behaviour change (i.e. did clinician adherence to the clinical treatment protocols improve in the intervention group) following the implementation of the QASC intervention. Clinician behaviour change was investigated by the candidate to help

explain why patients admitted to intervention stroke units were 15.7% more likely to be alive and independent at 90 days after admission. Compliance to the clinical treatment protocols could be measured through medical record audit; thus, the candidate conducted a quantitative process evaluation.

2.4.3 Reporting Process Evaluations

Prior to the commencement of the study, existing literature did not provide a framework for reporting process evaluations (28). It is only recently (2013) that a reporting framework (Box 2.2) has been published (28), and it was adopted by the candidate for the purpose of reporting the third study.

Box 2.2: Key Information Required when Reporting Process Evaluations (28)

Recommendation 1:
Process evaluations should be clearly labelled as existing process evaluations are poorly labelled and difficult to identify.

Recommendation 2:
Process evaluations should clearly state their purpose and research questions. Furthermore, process evaluations should specify what processes are being examined.

Recommendation 3:
Process evaluations should clearly report if they were pre-specified (planned prior to the commencement of the trial) or post hoc (research questions determined after the trial had ceased), and why the selected timing was chosen. Clarity in what was done and why is key to interpreting the validity and credibility of the findings.

Recommendation 4:
Process evaluations should state and justify their choice of method. The rationale for the methods used should be reported in relation to the process evaluation aims.

Recommendation 5:
Process evaluations should summarise the findings from the main trial. To aid interpretation of evaluation findings, trial and evaluation reports should cross-reference each other and process evaluations should summarise the main trial findings.

2.4.4 Review of Prior Process Evaluations Conducted Alongside CRCTs

The remainder of this literature review reports on two prior process evaluations that were broad and detailed in their reporting, thus being of high quality (28) (Table 2.9). Both also were judged to significantly add understanding to the main trial findings (28). These two process evaluations vary considerably in their purpose, whether they were prospective or retrospective, the processes examined and the methods used.

From April 2002 to December 2003, the Rational Prescribing in Primary Care (RaPP) trial was conducted across 146 general practices in Norway (88). The RaPP trial tested the effectiveness of a multifaceted tailored intervention to support the implementation of guideline recommendations for the use of antihypertensive and cholesterol-lowering drugs for the primary prevention of cardiovascular disease. The intervention was designed to promote: i) assessment of cardiovascular risk before deciding to commence antihypertensive or cholesterol-lowering medication; ii) use of thiazides as the first-line antihypertensive drug; and iii) achievement of treatment goals among patients started on medication. The RaPP trial intervention comprised an outreach visit conducted by a pharmacist whose role was to present recommendations on the prescribing of antihypertensive and cholesterol-lowering therapy to each physician working at general practices allocated to the intervention group. The pharmacist also installed software at intervention general practices which triggered computer reminders when physicians were seeing patients relevant to the recommendations. One hundred and forty-six general practices in Norway participated in this study of which 70 practices (257 physicians) were randomised to the intervention group and 69 practices (244 physicians) were randomised to the control group. The results from the trial demonstrated that the intervention effectively increased the prescribing of thiazides in

the intervention group (17% vs 11%, relative risk 1.94; 95% CI 1.49-2.49), but no effect was demonstrated on the assessment of cardiovascular risk or on the extent to which treatment goals were achieved (88).

A predominantly quantitative process evaluation was conducted alongside the RaPP trial to help explain and interpret the trial findings (87). The main objective of the process evaluation was to identify factors that could explain variation in outcomes across practices randomised to the intervention group. It was hypothesised that the impact of the intervention would be correlated to several variables, including practice specific factors such as the attitude among the physicians toward the recommendations, and process measures, such as the proportion of physicians attending the educational outreach visit. Several data-sources were used including: questionnaires completed by pharmacists immediately after educational outreach visits, semi-structured interviews with physicians subjected to the intervention, and data extracted from their electronic medical records (data on prescribing enabled the researchers to identify patients commenced on medication and then the patients physician was contacted to confirm a cardiovascular risk assessment had been conducted). Multivariate regression analyses were conducted to explore the association between possible explanatory variables and the observed variation across practices for the three main outcomes. Seventy of the 73 intervention practices consented to participating in the process evaluation. The results from the process evaluation indicated that the attendance rate during the educational sessions in each practice was high (average attendance rate 85%, IQR 67-100); few problems were reported, and the physicians were perceived as being largely supportive of the recommendations, except for the recommendation that thiazides should be used as first line antihypertensive medication. When asked why, the most common response

was that they simply preferred to prescribe an antihypertensive from another drug class. Multivariate regression models could explain only a small part of the observed variation across practices and across trial-outcomes. Only one explanatory variable came out statistically significant in the multivariate models. If the doctors had a positive attitude towards reminders about treatment goals, and achievement of treatment goals, this was associated with a 7% absolute increase in achievement of treatment goals compared to doctors who were negative.

Overall, the authors concluded that the process evaluation was unable to provide compelling explanations for the trial results. Possible reasons for this included a lack of statistical power and failure to include potential explanatory variables in the analyses, particularly organisational factors (i.e. lack of time during the appointment to conduct a cardiovascular risk assessment). The authors concluded that the use of qualitative research methods in the course of the trial could have improved their understanding of the trial main findings.

The second process analysis (89) reported by the candidate was conducted following the completion of the Evidence-based OutReach (EBOR) trial (Table 2.8). The EBOR trial was a large CRCT conducted in six health authorities in the North of England and six health authorities in London and was designed to test the effectiveness of educational outreach visits by trained pharmacists (90). Community pharmacists delivered educational outreach visits designed to promote guideline recommendations for the pharmacological treatment of: i) patients with heart failure (specifically the prescribing of angiotensin-converting enzyme (ACE) inhibitors); ii) patients with raised vascular risk (specifically, the prescribing of aspirin as antiplatelet therapy); iii) patients with

osteoarthritis (specifically the prescribing of nonsteroidal anti-inflammatory drugs (NSAIDs)); iv) and patients with depression (specifically, the choice of antidepressants in primary care). Each practice received an outreach visit for two topics and served as a control for the other two topics. From the 12 health authorities that were recruited for the trial, 75 of 102 practices randomly selected from within these health authorities agreed to participate. The results from the trial demonstrated that the intervention (educational outreach delivered by pharmacists) designed to promote guideline adherence lead to 5.2% more patients being managed within guideline recommendations (95% CI: 1.7-8.7) (90).

The aim of the process evaluation conducted after the trial had completed (post hoc) was to explore why this behaviour change occurred (89). Using quantitative and qualitative techniques the process evaluation investigated: i) the number of practices that agreed to take part; ii) the number of general practitioners in each practice attending the outreach visits; iii) the effect of the outreach visit on changing general practitioners' prescribing behaviour; iv) the pharmacists' feedback; and v) the general practitioners feedback. Of the 102 practices randomly selected, 75 (73.5%) agreed to participate. Providing the guideline message to all doctors was more likely to happen in smaller practices. In those practices where the pharmacist was unable to meet with all doctors working at the practice, a smaller effect on the uptake of the guideline was observed. Overall the change in prescribing was 13.5% (95% CI: 6-20.9) in smaller practices compared with 1.4% (95% CI: 2.4-5.3) in larger practices. Although both pharmacists' and general practitioners provided high overall ratings of the outreach presentations the study findings indicated that this did not necessarily lead to prescribing changes. The main barriers to the implementation of guidelines identified by the pharmacists at the

follow-up visits were organisational difficulties, the general practitioners' skepticism of the evidence presented to them and the doctors' lack of interest in changing their prescribing behaviour. The authors concluded that although the study was limited by a post hoc rather than a pre hoc design, it still provided a pragmatic approach to understanding the factors influencing prescriber behavior change following educational outreach visits implemented by pharmacists.

2.4.5 Literature Review Summary Study 3 (Process Evaluation)

The final section of the literature review: (a) investigated the purpose and design of process evaluations and; (b) summarised two process evaluations conducted alongside CRCTs that had been judged as 'quality' process evaluations and had significantly added understanding to the main trial findings. It was concluded that although process evaluations are essential to help in the interpretation of main study results, very few quantitative process evaluations have ever been conducted leaving many RCTs unable to fully explain the main study findings. Furthermore, process evaluations may not be able to explain fully, but may only shed some light on the main trial findings.

Table 2.9: Mapping of the Reporting Framework (adopted by the candidate) to Two Selected Process Evaluations

Process Evaluation	Main trial being evaluated	Main trial intervention	Title included words 'process evaluation'	Purpose of process evaluation and research question clearly stated	Processes being examined clearly stated	Timing specified	Method clearly stated	Method justified	Main trial findings reported
Fretheim et al. (87)	RaPP CRCT designed to test the effectiveness of a tailored multifaceted intervention developed for improving adherence to clinical practice guidelines for the pharmacological treatment of hypertension and hypercholesterolaemia (88)	Multifaceted intervention (educational outreach, audit and feedback, computerised reminders, patient information)	Yes	*'The main objective of this analysis was to identify factors that could explain variation in outcomes across intervention practices'*	Delivery to clusters Adoption Quantitative associations with effectiveness	Prospective/ pre-specified	Quantification of general practitioner perceptions of the intervention and the trial. Pharmacist assessment of the quality of educational outreach Regression analysis of associations with change in prescribing	Partly	Main trial findings summarised and referenced

Table 2.9 (Cont'd): Mapping of the Reporting Framework (adopted by the candidate) to Two Selected Process Evaluations

Process Evaluation	Main trial being evaluated	Main trial intervention	Title included words 'process evaluation'	Purpose of process evaluation and research question clearly stated	Processes being examined clearly stated	Timing specified	Method clearly stated	Method justified	Main trial findings reported
Nazareth et al. (89)	EBOR CRCT designed to improve General Practitioners prescribing quality (90)	Pharmacist-led educational outreach intervention	Yes	*To describe the steps leading to the final primary outcome and explore the effect of the intervention on each step of the hypothesised pathway of change in professionals prescribing behaviour*	Cluster recruitment Delivery to clusters Adoption Delivery to target population Quantitative associations with effectiveness (reported in main trial paper)	Retrospective/ post hoc	Reporting of proportion of practices recruited Association between proportion of general practitioners in each practice attending education outreach, the intervention and change in prescribing. Mixed methods assessment of barriers and facilitators to change	Partly	Trial design, intervention, targeted outcomes all reported Main trial results summarised Main trial paper referenced

CHAPTER 3: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA

3.1 PROLOGUE

In Chapter 2, the candidate summarised the evidence pertaining to Study 1 on the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. The evidence suggested that all three variables result in increased morbidity and mortality; hence, early detection and treatment of these three items should be a priority. The candidate's review of international guideline recommendations pertaining to the management of fever, hyperglycaemia and swallowing dysfunction highlighted that standardised recommendations for the monitoring and treatment of fever, monitoring and treatment of hyperglycaemia, and swallowing screening following acute stroke do not exist. For this reason, the QASC triallists developed three standardised evidence-based treatment protocols that included more specific treatment and monitoring targets for these three variables (Appendix D, E, F, G). Although the NSF of Australia investigates adherence with acute stroke guidelines every two years, prior to the commencement of the QASC trial, they had not investigated clinician compliance with recommendations pertaining to the monitoring and treatment of fever and hyperglycaemia, or of swallowing screening by non-speech pathologists. Further, it was unknown what effect comprehensive and standardised management protocols (in conjunction with evidence-based implementation strategies) for these three variables would have on patient management and outcomes. The candidate's first study served two purposes: (1) to identify in-patient monitoring and treatment practices (for the baseline cohort of the QASC trial) for fever, hyperglycaemia and swallowing dysfunction following stroke prior to the implementation of the QASC clinical

treatment protocols and (2) to provide pre-intervention processes of care measures (for the candidate's third study) to determine the success or otherwise of the QASC behaviour change intervention.

STUDY 1

Drury, P., Levi, C., D'Este, C., McElduff, P., McInnes, E., Hardy, J., Dale, S., Cheung, N W., Grimshaw, J., Quinn C., Ward, J., Evans, M., Cadilhac, D., Griffiths, R., Middleton, S. Management of fever, hyperglycaemia and swallowing dysfunction following hospital admission for acute stroke in New South Wales, Australia. *International Journal of Stroke.* Published January 2014 (Vol 9, pg 23-31)

3.2 ABSTRACT

Background: Fever, hyperglycaemia and swallow dysfunction post-stroke are associated with significantly worse outcomes. This study reports treatment and monitoring practices for these three items from a cohort of acute stroke patients prior to randomisation in the Quality in Acute Stroke Care (QASC) trial.

Method: Retrospective medical record audits were undertaken for prospective patients from 19 stroke units. For the first three days following stroke, all temperature readings and administration of paracetamol for fever (≥ 37.5 °C), and all glucose readings and administration of insulin for hyperglycaemia (> 11 mmol/L) were recorded. Also recorded were swallowing screenings and swallow assessments during the first 24 hours of admission.

Results: Data for 718 (98%) patients were available; 138 (19%) had four-hourly or more temperature readings and 204 patients (29%) had a fever, with 44 (22%) receiving paracetamol. A quarter of patients (n = 102/412, 25%) had six-hourly or more glucose readings and 23% (95/412) had hyperglycaemia, with 31% (29/95) of these treated with insulin. The majority of patients received a swallow assessment (n = 562, 78%) by a

speech pathologist in the first instance rather than a swallow screen by a non-speech pathologist (n = 156, 22%). Of those who passed a screen (n = 108 of 156, 69%), 68% (n = 73) were reassessed by a speech pathologist and 97% (n = 71) were reconfirmed to be able to swallow safely.

Conclusions: The results of this study showed that acute stroke patients were undermonitored and undertreated for fever and hyperglycaemia, underscreened for swallowing dysfunction and unnecessarily reassessed by a speech pathologist, indicating the need for urgent behaviour change.

3.3 INTRODUCTION

Fever, hyperglycaemia and swallowing dysfunction in the early post-stroke period are associated with significantly worse outcomes (4-6) (7, 8), and early detection and treatment of these three items should be a priority (13).

International guidelines from the United Kingdom (UK) (9), United States of America (USA) (10), Europe (11), Canada (12) and Australia (13) (Box 3.1) recommend similar monitoring and treatment practices for the management of fever, hyperglycaemia and swallowing. However, these recommendations are generally non-specific: only the Canadian guidelines included a recommendation specific to the frequency of temperature monitoring within the first 48 hours following admission for acute stroke (every four hours) (12). Four of these five guidelines recommended that paracetamol be used routinely to treat fever (10-13) but only two provided a threshold for treatment (> 37.5 °C) (11, 12). No guidelines included recommendations specific to the frequency of glucose monitoring following stroke diagnosis, and insulin was recommended for treatment of hyperglycaemia in three of the five guidelines (10, 12, 13) with only two

providing a threshold for treatment (maintain between 4 and 11 mmol/L; lower glucose levels to _300 mg/dl [16.7 mmol/L]) (Box 3.1) (9, 10). For the management of swallowing dysfunction following acute stroke, of the five guidelines reviewed, three recommended that a swallow screen (by a non-speech pathologist) be undertaken within the first 24 hours of admission to the hospital and prior to being given food, drink or oral medications (9, 12, 13). Two of the three guidelines recommending a swallow screen also recommended a comprehensive swallow assessment (by a speech pathologist) for those with a failed screen (9, 13). One of the guidelines recommended a swallow assessment but no swallow screen (11). One guideline failed to include any recommendation pertaining to the management of swallowing dysfunction (10).

Box 3.1: International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction

	UK(9)	*Europe(11)*	*USA(10)*	*Canada(12)*	*Australia(13)*
Fever Management					
Monitoring targets and time frame	Not stated	Not stated	Not stated	'*Every 4 hours for first 48 hours*'	'*Routinely and frequency determined by the patient's status*'
Treatment target	Not stated	> 37.5 °C	Not stated	> 37.5 °C	Not stated
Paracetamol or antipyretic medication recommended	No	Yes	Yes	Yes	Yes
Hyperglycaemia Management					
Venous Blood Glucose					
Monitoring targets	Not stated	'*Initial examination should include ... blood samples for clinical chemistry, glucose*'	'*Several tests should be performed routinely ... These test include blood glucose*'	'*All patients with suspected acute stroke should have their blood glucose concentration checked immediately*'	'*The following investigations should be obtained routinely ... glucose*'

Box 3.1 (Cont'd): International Guideline Recommendations for Fever, Hyperglycaemia and Swallowing Dysfunction

	UK(9)	*Europe(11)*	*USA(10)*	*Canada(12)*	*Australia(13)*
Hyperglycaemia Management					
Finger-prick blood glucose					
Monitoring targets and time frame	Not stated	'*Check regularly*'	Not stated	'*Check immediately*'	'*Routinely and frequency determined by the patient's status*'
Treatment target	'*Maintain between 4 and 11 mmol/L'*	Not stated	'*Lower markedly elevated glucose levels to _300 mg/dl (16.7 mmol/L)'*	Not stated	Not stated
Insulin for hyperglycaemia recommended	No	No	Yes	Yes	Yes
Swallowing Dysfunction Management					
Swallow screen (non-speech pathologist)	'*On admission'* *'Before being given any oral food, fluid or medication*'	Not stated	Not stated	'*Part of their initial assessment, and before initiating oral intake of medications, fluids or food'* *'If not alert within the first 24 hours*'	'*Within 24 hours of admission and before being given any oral food, fluid or medication*'
Swallow assessment (speech pathologist only)	If failed swallow screen, swallow assessment recommended within 24 hours	'*Recommended*'	Nil	'*Recommended*'	If failed swallow screen, swallow assessment recommended

The Quality in Acute Stroke Care Trial (QASC) (1, 30), a cluster randomised controlled trial (CRCT) was designed to test the effect of a multidisciplinary team-building intervention to implement evidence-based treatment protocols for the management of fever, hyperglycaemia and swallowing dysfunction on 90-day post-stroke outcomes and clinician behaviour change. Panels of experts developed three clinical treatment protocols using recommendations from Australia's national clinical guidelines for stroke (13). The protocols included specific monitoring and treatment targets for fever, hyperglycaemia and swallowing dysfunction (Box 3.2). To date, it is unknown what effect comprehensive and standardised management protocols (in conjunction with evidence-based implementation strategies) for these three variables have on patient management and outcomes. This study reports treatment and monitoring for fever (temperature $\geq$ 37.5 °C), hyperglycaemia (glucose level > 11 mmol/L) and swallowing dysfunction for a cohort of acute stroke patients in New South Wales (NSW), Australia, prior to the implementation of the protocols and randomisation as part of the QASC trial.

Box 3.2: QASC Trial Clinical Treatment Protocols

(Also Referred to as FeSS [Fever, Sugar, Swallow] Protocols)^

Fever

1. Temperature monitored & charted four hourly for 72 hours following stroke unit admission.
2. Temperature ≥ 37.5 °C treated with paracetamol (IV, PR or oral).

Sugar (Hyperglycaemia)

1. Venous blood glucose measured (venous blood not finger prick) on admission to hospital.
2. At least six-hourly finger-prick blood glucose readings for 72 hours following stroke unit admission.
3. On admission to stroke unit, if blood glucose level:
   > 11 mmol/L and known diabetic, commence insulin (IV or SC).
   > 16 mmol/L and patient without known diabetes, commence insulin (IV or SC).
4. If blood glucose level > 11 mmol/L at any time in first 72 hours following stroke unit admission, commence insulin.

Swallowing Dysfunction

1. Swallow screen within 24 h of stroke unit admission if not attended in the emergency department.
2. Patients who fail the swallow screen refer to a speech pathologist for a swallowing assessment.

Key:
IV: Intravenous
SC: Subcutaneous
PR: Per rectum

^ Further information about the QASC trial including the treatment protocols and QASC medical record audit tool is available at www.acu.edu.au/qasc.

3.4 METHOD

Retrospective medical record audits were undertaken from January to November 2009 of patients prospectively recruited between July 2005 and October 2007 (for the pre-intervention cohort of the QASC trial).

3.4.1 Participants

Nineteen hospitals in NSW, Australia, that had Category A and B acute stroke units (those that had immediate access to brain imaging and high dependency units) (91) were

eligible to participate. Eligible patients were those who were admitted to these stroke units within 48 hours of developing stroke symptoms, were diagnosed with an ischaemic stroke or intracerebral haemorrhage, were greater than 18 years of age, spoke English and had access to a telephone. Patients who died while in hospital were still included in the audit if they met the eligibility criteria and were managed in a participating stroke unit. Patients who were diagnosed with severe stroke and referred for palliation were excluded from the study.

3.4.2 Outcome Measures

All outcomes were derived from the protocols (Box 3.2) and were measured at the individual or event level (Tables 3.1, 3.2, 3.3 and 3.4).

3.4.3 Data Collection

Four auditors, not otherwise involved in the QASC trial and blind to the study design, collected the audit data as follows: all temperature readings and administration of paracetamol for fever (≥ 37.5 °C) over the first 72 hours of admission to the stroke unit; all finger-prick glucose readings and administration of insulin for hyperglycaemia (> 11 mmol/L) over the first 72 hours of admission to the stroke unit; venous blood glucose levels in the emergency department or within two hours of stroke unit admission; and swallowing surveillance including swallowing screens by non-speech pathologists and comprehensive swallowing assessments by speech pathologists within the first 24 hours of hospital admission. To meet the criteria for a successful swallowing screening, all three of the following individual elements had to be documented: level of consciousness, cranial nerve assessment (specifically, cranial nerves 9, 10 and 11) and a water swallow test; or a hospital-approved swallowing screen tool (with these three

components) had to be completed. In our participating hospitals, as was the common practice within NSW at this time, speech pathologists performed a full swallow assessment when called to see patients; swallow screens were performed only by non-speech pathologists.

Auditors also collected information on age, sex, stroke subtype (Oxfordshire Community Stroke Project [OCSP] classification) (92), stroke severity (Scandinavian Stroke Scale [SSS]) (93), level of disability on admission (modified Rankin Scale [mRS]) (94), date and time of symptom onset, date and time of admission to the emergency department (where relevant), date and time of admission to the stroke unit, hospital discharge date, death during hospitalisation and diabetic status. The QASC audit tool and data dictionary is accessible via www.acu.edu.au/qasc.

Auditors attended a two-day training programme. Audits were conducted by two pairs of auditors, who undertook dual independent data abstraction, enabling clarification of uncertainties. For quality assurance purposes, 10% of patient records were re-audited.

This study was approved by the Human Research Ethics Committee of the Australian Catholic University and the relevant human research ethics committees of all participating hospitals.

3.4.4 Data Analysis

Analyses were undertaken using STATA 11.0 software. Frequency distributions of sociodemographic and clinical characteristics of the sample are presented. Since patients who experienced fever and hyperglycaemia had an increased number of

readings recorded, we computed a mean temperature and blood glucose reading for each patient for the first 72 hours following stroke unit admission and, using these, then determined the sample mean temperature and glucose level (i.e. mean of the patient mean values). Because paracetamol can only be administered 4–6 hourly within 24 hours (95), the analysis was restricted to treatment of the first febrile event only. The number and proportion of patients with each outcome (for binary measures), means and standard deviations for normally distributed continuous variables or medians and quartiles for non-normally distributed continuous variables are presented with 95% confidence intervals (CIs), with exact CIs obtained for medians using the binomial method (96). Comparisons for hyperglycaemic management between patients with diabetes and patients without a history of diabetes were carried out using the Wald chi-square test adjusted for clustering by hospital.

3.5 RESULTS

Of the 735 eligible QASC consenting patients, 17 medical records were unable to be located and 718 (98%) patients had their data audited (missing data 2.3%).

Almost half of the patients (n = 307 of 630; 49%) were aged 75 or above, and over half (n = 403, 57%) were male. Thirty-nine per cent of patients (n = 218 of 558) had a partial anterior circulation infarct (PACI) (97). The majority of patients had an SSS of > 30 (n = 427 [84%] of 506), indicating a mild to moderate stroke (93), and just under half the patients had an admission mRS ≥ 2 (n = 330 [49%] of 674), which indicated some degree of dependency or death. Eight patients (1%) died while in hospital. Most patients (n = 640, 89%) were admitted to the stroke unit via the emergency department, and the median time spent in the emergency department prior to transfer to the stroke unit was

7.4 hours (n = 640) (Q1 5.7, Q3 10.1). The median hospital length of stay was eight days (Q1 6, Q3 12) (Table 3.1).

Table 3.1: Demographic and Clinical Characteristics of Patients Admitted to NSW Stroke Units[^#]

	n	%
Age (n = 630)		
< 65	168	27
65–74	155	25
75–84	228	36
> 85	79	13
Gender (n = 712)		
Male	403	57
Female	309	43
Mortality Status (n = 718)		
Survived	710	99
Died while in hospital	8	1
Admission to Stroke Unit via (n = 718)		
Emergency Department	640	89
Other	78	11
Oxfordshire Community Stroke Project (n = 558)		
Partial Anterior Circulation Infarct	218	39
Lacunar Infarct	141	25
Posterior Circulation Infarct	81	15
Total Anterior Circulation Infarct	49	9
Intracerebral Haemorrhage	39	7
Trans Ischaemic Attack	30	5
Scandinavian Stroke Score (n = 506)		
0–14 (Very Severe)	34	7
15–29 (Severe)	45	9
30–44 (Moderate)	126	25
45–58 (Mild)	301	59
Modified Rankin Score documented in the emergency department or within 72 hours of stroke unit admission (n = 674)		
0 – No symptoms at all	108	16
1 – No significant disability despite symptoms	236	35
2 – Slight disability	103	15
3 – Moderate disability	106	16
4 – Moderately severe disability	30	4
5 – Severe disability	48	7
6 – Dead	43	6

^ Percentages may not total to 100%, due to rounding.
# Denominators vary due to missing data.

3.5.1 Management of Fever

Temperature was recorded at least once within 72 hours of stroke unit admission for 714 patients (99%), of whom 138 (19%, 95% CI, 16–22%) had one or more temperature readings every four hours. The mean temperature reading within the first 72 hours of admission to the stroke unit was 36.6 °C (SD 0.30). During this period, 204 patients (29%, 95% CI, 25–32%) had a temperature reading ≥ 37.5 °C of whom 44 (22%, 95% CI, 16–27%) received paracetamol within two hours of the first febrile event. The median time to administration of paracetamol (for those whose time of temperature reading and/or paracetamol administration time was documented (n = 41) for the first instance of fever (≥ 37.5 °C) was 30 minutes (Q1 10, Q3 120 minutes) (Table 3.2).

Table 3.2: Fever Processes of Care Measures

Outcome	Eligible sample	n (%)	95% CI
Monitoring			
Patients with at least one temperature reading recorded every four hours or more within the first 72 hours of stroke unit admission	714	138 (19%)	16% to 22%
Mean temperature reading within first 72 hours of stroke unit admission (°C) (for those who had at least one temperature reading)	714	36.63 (0.30)*	36.61 to 36.65
Patients with a febrile event (temperature ≥ 37.5 °C) within the first 72 hours of stroke unit admission (for those who had at least one temperature reading)	714	204 (29%)	25% to 32%
Treatment			
Patients administered paracetamol within two hours when temperature ≥ 37.5 °C (at first febrile event)	204	44 (22%)	16% to 27%
Time (minutes) to administration of paracetamol when temperature ≥ 37.5 °C at first febrile event (for those who received paracetamol)	41 of 44#	30 (10, 120)^	57 to 314

* mean of means (SD)
^ median (Q1, Q3)
# data are missing

3.5.2 Management of Hyperglycaemia

Just over one-quarter of the patients (n = 186, 26%, 95% CI, 23–29%) had a formal venous blood glucose (non-finger-prick) measured in the emergency department or within two hours of stroke unit admission. The mean formal venous blood glucose measurement taken in the emergency department or within two hours of stroke unit admission was 6.4 (SD 2.6). A finger-prick glucose reading was recorded at least once within the first 72 hours of stroke unit admission for 412 (57%) patients, of whom 158 (38%, 95% CI, 34–43%) had a finger-prick glucose reading recorded within two hours of stroke unit admission and 102 patients (25%, 95% CI, 21–29%) had at least one or more finger-prick glucose readings every six hours. The mean finger-prick glucose reading for those who had had at least one finger-prick glucose reading (n = 412) was 7.1 mmol/L (SD 2.0). Ninety-five of the 412 patients (23%, 95% CI, 19–27%) had a finger-prick glucose reading > 11 mmols/L. Twenty-nine (31%, 95% CI, 21–40%) of these hyperglycaemic patients were treated with insulin, with the median time to treatment of first hyperglycaemic episode being 11 minutes (Q1 0, Q3 26 minutes) (Table 3.3).

Table 3.3: Hyperglycaemia Processes of Care Measures

Outcome	Eligible sample	n (%)	95% CI
Monitoring			
Patients with a formal venous glucose measurement in the emergency department or within two hours of stroke unit admission	718	186 (26%)	23% to 29%
Mean formal venous glucose measurement taken in the emergency department or within two hours of stroke unit admission	186	6.4 (SD 2.6)	6.1 to 6.6
Patients with at least one finger-prick glucose reading taken within the first 72 hours of stroke unit admission	718	412 (57%)	54% to 61%
Patients with finger-prick glucose reading recorded within two hours of stroke unit admission (for those who had at least one finger-prick glucose reading)	412	158 (38%)	34% to 43%
Patients with at least one finger-prick blood glucose reading recorded every six hours within 72 hours of stroke unit admission (for those who had at least one finger-prick glucose reading)	412	102 (25%)	21% to 29%
Mean finger-prick glucose reading recorded within 72 hours of stroke unit admission (mmol/L) (for those who had at least one finger-prick glucose reading)	412	7.1 (2.0)*	6.9 to 7.3
Patients with a hyperglycaemic event (finger-prick blood glucose > 11 mmol/L) within 72 hours of stroke unit admission (for those who had at least one finger-prick glucose reading)	412	95 (23%)	19% to 27%
Treatment			
Patients treated with insulin when finger-prick blood glucose > 11 mmol/L	95	29 (31%)	21% to 40%
Time (min) to administration of insulin when first finger-prick blood glucose > 11 mmol/L (for those administered insulin)	9 of 29#	11 (0, 26)^	–20 to 109

* mean of means (SD)
^ median (Q1, Q3)
# data are missing

A history of diabetes was documented for 115 patients (16%). Patients with known diabetes (n = 115) were significantly more likely when compared with patients without known diabetes to receive a venous blood glucose in the emergency department or within two hours of stroke unit admission (39% v. 23%, p = 0.002); a finger-prick glucose reading at any time within the first 72 hours of stroke unit admission (94% v. 50%, p = < 0.001); at least one finger-prick glucose reading within two hours of stroke unit admission (50% v. 34%, p = 0.002); at least one or more finger-prick glucose readings sixth hourly within the first 72 hours of stroke unit admission (70% v. 9%, p = < 0.001); and be treated with insulin when finger-prick glucose reading > 11 mmols/L (36% v. 16%, p = 0.01) (Table 3.4).

Among patients with known diabetes, 26 (23%) had a finger-prick reading > 11 mmols/L within the first two hours of stroke unit admission (first finger-prick) and, of these, 11 patients (42%) were administered insulin. Among patients without known diabetes, only one had a finger-prick reading > 16 mmols/L on admission to the stroke unit. This patient was not treated with insulin (Table 3.4).

Table 3.4: Hyperglycaemia Processes of Care Measures among Patients with Known Diabetes and Patients without Known Diabetes

Outcome	Patients with known diabetes n = 115	Patients without known diabetes n = 603	p*	Difference between groups (95% CI)^
Monitoring	n %	n %		
Patients with a formal venous glucose measurement in the emergency department or within two hours of stroke unit admission	45 (39%)	141 (23%)	0.002	15% (6% to 24%)
Patients with at least one finger-prick glucose reading taken within the first 72 hours of stroke unit admission	108 (94%)	304 (50%)	< 0.001	40% (33% to 48%)
Patients with finger-prick glucose reading recorded within two hours of stroke unit admission (for those who had at least one finger-prick glucose reading)	54 of 108 (50%)	104 of 304 (34%)	0.002	17% (6% to 28%)
Patients with at least one finger-prick blood glucose reading recorded every six hours within 72 hours of stroke unit admission (for those who had at least one finger-prick glucose reading)	76 of 108 (70%)	26 of 304 (9.0%)	< 0.001	62% (53% to 71%)
Patients with at least one finger-prick blood glucose reading > 11 mmol/L (for those who had at least one finger-prick glucose reading)	70 of 108 (65%)	25 of 304 (8%)	< 0.001	50% (47% to 66%)
Treatment				
Patients treated with insulin when finger-prick blood glucose > 11 mmol/L (for those who had at least one finger-prick glucose reading)	25 of 70 (36%)	4 of 25 (16%)	0.01	23% (5% to 40%)

*P-values are from Wald chi-square test

^ adjusted for clustering of patients within stroke units; thus is not necessarily equal to the absolute difference in percentages between groups

3.5.3 Management of Swallowing Dysfunction

The majority of patients (n = 662, 92%, 95% CI, 90–94%) underwent swallowing surveillance either in the form of a swallow screen by a non-speech pathologist (n = 156, 22%) or swallow assessment by a speech pathologist (n = 506, 78%) within 24 hours of hospital admission. The majority of screens (n = 149, 96%, 95% CI, 92–99%) were conducted in the emergency department and only seven (7) screens (4%, CI, 1–9%) were conducted in the stroke unit (Table 3.5).

Of those patients who underwent a screening by a non-speech pathologist within 24 hours of admission (n = 156, 22%), 48 patients (31%, 95% CI, 23–38%) were deemed to have an unsafe swallow, of whom 47 (98%) were then reviewed by a speech pathologist and underwent a swallow assessment. Of those who were seen by the speech pathologist and had an assessment, nine (19%, 95% CI, 7–31%) were deemed to have dysphagia. The median time between failing a swallow screen (by a non-speech pathologist) and a swallow assessment by a speech pathologist was 23.3 hours (Q1 5.7 hours Q3 47.6 hours) (Table 3.5).

An analysis to determine if patients who had passed a screen and were then further unnecessarily assessed by a speech pathologist showed that, of the 108 patients (69%) who passed the swallowing screen, 73 (68%) had a full assessment subsequently performed by a speech pathologist. Of those who were reassessed, 97% (n = 71, 95% CI, 93–99%) were deemed by the speech pathologist to have a safe swallow.

Table 3.5: Swallowing Dysfunction Processes of Care Measures

Outcome	Eligible Sample	n (%)	95% CI
Monitoring			
Patients who underwent swallow surveillance in the form of a swallow screen and/or swallow assessment within 24 hours of hospital admission	718	662 (92%)	90% to 94%
Patients who underwent a swallow screen (by non-speech pathologist) in the emergency department or within 24 hours of stroke unit admission	718	156 (22%)	19% to 25%
Patients who underwent a swallow screen (by non-speech pathologist) in the emergency department (for those who had a swallow screen)	156	149 (96%)	92% to 99%
Patients who underwent a swallow screen (by non-speech pathologist) in the stroke unit and within 24 hours of stroke unit admission (for those who had a swallow screen)	156	7 (4%)	1% to 9%
Suspected dysphagia (for those who had a swallow screen by non-speech pathologist	156	48 (31%)	23% to 38%
Treatment			
Proportion who underwent a speech pathologist assessment following suspected dysphagia (for those who had failed the swallow screen undertaken by non-speech pathologist)	48	47 (98%)	94% to 100%
Deemed to have an unsafe swallow by speech pathologist and placed nil by mouth (NBM)	47	9 (19%)	7% to 31%
*Time (hours) to speech pathologist assessment following a failed swallowing screening	7 of 48[#]	23.27 (5.68, 47.55)^	4.08 to 45.57

* mean (SD)
^ median (Q1, Q3)
# data are missing

3.6 DISCUSSION

The results of this study indicated that the management of fever, hyperglycaemia and swallowing dysfunction in NSW stroke units was suboptimal and required urgent behaviour change.

3.6.1 Management of Fever

Fever occurred in approximately one-third of patients, which is consistent with prior studies that have defined fever as ≥ 37.5 °C (41, 98). Comparisons with other studies are difficult because of differences in fever definition. The results of this study indicate that, only 19% of patients had at least one temperature reading recorded fourth hourly within the first 72 hours following stroke unit admission. Further, poor fever management practices were noted: only 22% of patients with fever were treated with paracetamol at their first febrile event. A failure to monitor patients and treat temperature is of concern, considering that fever has been associated with poor outcomes following stroke (4, 46, 98-100) and that paracetamol has been found to be an effective therapy in reducing fever among patients with stroke (101).

Little is known about which individual aspects of fever, that is, level of fever or duration, are associated with poor outcomes (102, 103). Although the administration of paracetamol was timely (median 30 minutes), further studies exploring temperature duration and associated outcomes are required. This is one of the first studies to report how quickly fever is treated in acute stroke patients.

3.6.2 Management of Hyperglycaemia

Only 23% of stroke patients who had a finger-prick glucose measurement within the first 72 hour of stroke unit admission experienced a hyperglycaemic event (finger-prick glucose > 11 mmol/L), which is lower than the 43–68% previously reported (5). This may be attributed to this study's definition of hyperglycaemia (finger-prick glucose > 11 mmol/L), which is higher than that reported in prior studies (6.1–10 mmol/L) (5).

Despite guidelines recommending glucose testing following stroke, 74% of acute stroke patients from this study did not have a venous blood glucose measured in the emergency department or within two hours of stroke unit admission. During the first 72 hours of stroke unit admission, 43% of acute stroke patients had no finger-prick glucose monitoring. Of those who had their finger-prick glucose monitored (n = 412, 57%) only 25% had at least one finger-prick glucose level recorded every six hours. A failure to monitor the patient's glucose levels frequently, or at all, may result in hyperglycaemia being undetected, despite the association of hyperglycaemia in the early post-stroke period with worse outcomes (5, 6). Patients without known diabetes were less likely to have a venous blood glucose measurement or finger-prick glucose monitoring at any time in the first 72 hours of stroke unit admission compared with patients with known diabetes, but even among those with known diabetes, the level of testing was extremely poor. Further, patients without known diabetes were also less likely to have hyperglycaemic events treated with insulin. This is of concern, considering that stroke patients without known diabetes who have even moderately elevated glucose levels (> 6.7–8 mmol/L) on admission have a threefold risk of death relative to known diabetic patients with this same level of elevated glucose (5).

The findings from this study also indicated suboptimal treatment of hyperglycaemia following acute stroke, which has also been reported in prior studies (104). In this study, only 31% of patients received corrective treatment for a hyperglycaemic event (finger-prick glucose > 11 mmol/L) with insulin, and it is clear that more effort to optimise glucose control is needed. Clinicians failed to recognise that hyperglycaemia is a significant event in stroke regardless of diabetes status.

3.6.3 Management of Swallowing Dysfunction

The majority of patients (92%) in this study's cohort underwent swallowing surveillance within 24 hours of hospital admission. Although international guidelines recommend patients only receive a swallow assessment following a failed screen (9, 13), the results of this study indicate that the majority of patients received a comprehensive speech pathologist assessment (78%) and no swallow screen.

That 68% of patients who had passed a swallow screen subsequently also received a full speech assessment by a speech pathologist is of note. It is possible that this additional surveillance may have been unnecessary because 97% of patients who were initially screened by a non-speech pathologist and passed were also deemed to have a safe swallow following an assessment by the speech pathologist. However, there is the small, but unlikely, possibility that all of these patients deteriorated and required a subsequent speech pathologist consultation.

The majority of screens were conducted in the emergency department (96%) rather than in the stroke unit (4%). This study did not investigate whether a patient received food, fluids or medications prior to a screen; if a patient had received food, fluids or

medications in the emergency department, this may have been a deterrent for any further screening in the stroke unit because stroke unit nurses may have assumed the patient had previously been deemed to have a safe swallow. Further exploration of administration of food, fluids or medications before swallowing screen or assessment is warranted.

The results of this study also indicated that a patient who failed a screen by a non-speech pathologist was required to wait nearly 24 hours nil by mouth before undergoing a speech pathologist assessment. Further studies exploring contributions to lengthy waiting times for a speech pathologist assessment is required.

This study was limited to the investigation of the monitoring and treatment for fever, hyperglycaemia and swallowing dysfunction in the first 72 hours of stroke unit admission. Other studies have examined these parameters up to seven days (47, 99); however, the majority of febrile episodes (58%) have been found to occur in the first 72 hours of admission (103). Data were not collected on the route of the temperature measurement because this was rarely documented. Auditors were unable to identify from the medical records whether non-speech pathologist personnel who undertook the swallow screenings were specifically trained in swallowing screening or whether any screening tools used had been validated. However, the following strengths of this study are acknowledged. This study included a large cohort of patients from 19 stroke units, thus enhancing generalisability. For this study, *all* temperature and hyperglycaemic measurements were recorded; thus, for the first time a complete data set on the aetiology of fever and hyperglycaemic events within the first 72 hours following acute stroke is available.

3.7 CONCLUSIONS

In conclusion, the management of fever, hyperglycaemia and swallowing dysfunction in the acute phase following stroke was suboptimal, indicating the need for urgent behaviour change. The review of international guideline recommendations pertaining to the management of fever, hyperglycaemia and swallowing dysfunction highlighted that standardised recommendations for the monitoring and treatment of fever, hyperglycaemia and swallowing dysfunction following acute stroke do not exist. The QASC trial (1) has developed evidence-based protocols with specific monitoring and treatment targets for these three physiological variables. Prior studies have identified that the distribution alone of guidelines and protocols will not change clinician behaviour (19); thus, further research is required to identify effective behaviour change interventions to promote the uptake of guideline and protocol recommendations. The data from this study also provided pre-intervention processes of care measures to determine the success or otherwise of the QASC behaviour change intervention, aimed to improve monitoring and treatment for fever, hyperglycaemia and swallowing dysfunction within the first 72 hours following stroke.

CHAPTER 4: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY

4.1 PROLOGUE

The first study presented by the candidate in Chapter 3 identified that in-patient management of fever, hyperglycaemia and swallowing dysfunction in the first three days following stroke in NSW stroke units was suboptimal and urgent behaviour change was required to promote optimum outcomes for stroke patients. Efforts to change clinical practice have a lower likelihood of success unless barriers that obstruct change are identified and taken into account. In Chapter 2, the literature review, the candidate identified that leadership, organisational learning, attitudes and beliefs, and organisational readiness to accept change were individual or organisational traits that may influence the implementation and the sustainability of evidence-based practice. For this reason, the aim of the candidate's second study, conducted prior to the implementation of the QASC trial, was to investigate the perceptions of NUMs of NSW stroke units participating in the QASC trial of self-leadership ability, organisational learning, attitudes and beliefs towards EBP, and stroke unit readiness for change.

STUDY 2

Drury, P., McInnes, L., Hardy, J., Dale, S., Middleton, S. Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey. Submitted to: International Journal of Nursing Practice, October 2013.

4.2 ABSTRACT

Background: The Quality in Acute Stroke Care (QASC) trial was conducted in 19 Australian stroke units located in New South Wales (NSW) to promote evidence-based management for fever, hyperglycaemia and swallowing dysfunction following stroke. Prior to the implementation of the QASC trial, this study set out to determine knowledge of individual and organisational traits within participating stroke units that may have impeded or facilitated the successful uptake of the QASC intervention and evidence-based practice (EBP).

Method: Nurse unit managers (NUMs) of stroke units participating in the QASC trial (n = 19) were surveyed, to determine their perceptions of self-leadership ability (as measured by the Leadership Practices Inventory [LPI]), organisational learning (as measured by the Organisational Learning Survey [OLS]), attitudes and beliefs towards EBP, and the stroke units' readiness for change prior to the implementation of the QASC intervention.

Results: All 19 (100%) NUMs returned the survey. The mean values of the LPI of all subscales were in the upper third of the possible range between 6 and 60, indicating a high level of reported leadership skills consistent with transformational leadership. The mean score across all five learning capabilities of the OLS were above the midpoint of 4

on the seven-point scale, indicating that NUMs reported a culture of learning. NUMs' attitudes towards EBP were positive (median 80, interquartile range [IQR] 80–95 [0 = extremely unwelcoming to 100 = extremely welcoming]), although colleagues were perceived as less welcoming (median 70, IQR 60–80 [0 = extremely unwelcoming to 100 = extremely welcoming]). NUMs agreed (median 3, IQR 2–3.5 [1 = strongly disagree to 5 = strongly agree]) that using evidence in practice places unreasonable demands on their colleagues, and 47% (n = 9) of NUMs indicated that resources were not available for evidence implementation.

Conclusions and Implications: High-level leadership skills and a positive culture of learning are likely to support evidence uptake; however, NUMs may be unable to address all organisational barriers, such as insufficient resources and time constraints, which could impede EBP. The view that EBP places additional demands on already overloaded nurses is highly concerning; it may also impede evidence uptake. Barriers to change identified in this study may not be unique to stroke units.

4.3 BACKGROUND

When implemented, findings from rigorous research studies can improve health outcomes for patients (105), yet one of the most consistent findings from clinical and health services research is the failure to translate research into practice (57). There is a need to change the behaviour of individuals and groups, including nurses, to promote the uptake of evidence and the sustainability of evidence-based practice (EBP). Behaviour change interventions that have been shown to change professional practice include printed educational materials, educational meetings, educational outreach, local opinion leaders, audit and feedback, and reminders (57). Multifaceted interventions (interventions comprising two or more components) developed from careful assessment

of barriers may also be more effective than single interventions (57). Behaviour change interventions that are developed or 'tailored' to overcome barriers and maximise the effect of facilitators are more likely to foster change (72); however, the evidence determining the effectiveness of tailored interventions in comparison with other interventions is incomplete (72).

The uptake of a behaviour change intervention also may be impeded by individual (25) and organisational traits within the local setting (26). Individual traits including attitudes and beliefs (25) towards EBP have been associated with an increase in EBP, as have organisational traits such as leadership (20), organisational learning (21) (22) and readiness for change (23, 24).

4.3.1 Individual Traits Associated with Research Utilisation

A recent systematic review investigating the association between individual traits and nurses' use of research in practice concluded that attitudes and beliefs was the only individual trait assessed in a sufficient number of studies and the only individual trait that is consistently positively related to research utilisation. Other individual traits with evidence for a positive association with research utilisation include attending conferences or in-service training, having a graduate degree, current role, clinical specialty, and job satisfaction. Overall, the findings from this review suggest that these individual traits, particularly attitudes and beliefs, may hold promise as targets of future research utilisation; however, robust evidence to support individual traits that predict research utilisation is scarce (25).

4.3.2 Organisational Traits Associated with Research Utilisation

The strength of the relationship between organisational traits and research utilisation by nurses is still largely unknown (26). A systematic appraisal of the literature aimed to uncover current knowledge about leadership and the process of implementing EBP in nursing concluded that there appears to be agreement that leaders and the way leadership is performed can play an important role in the process of implementing EBP in nursing (20). The findings from this review also indicated that leadership should not be studied in isolation from the work environment in which the leader operates because there appears to be an intricate interplay between different factors and research utilisation.

Prior studies investigating the characteristics of nurse leaders and their influence on EBP have failed to define the concept of leadership, making it difficult to identify what might characterise a leadership role that facilitates successful EBP implementation (106-108). However, transformational leadership has been postulated to facilitate major organisational change (109) and has been linked to improved patient outcomes (110). More rigorous research is needed concerning the possible role of the leader and research utilisation (20).

In addition to the potential importance of leadership for EBP implementation, organisational learning or the learning organisation (the two terms are often used interchangeably in the literature) may also have an effect on evidence utilisation and change (21, 22). A learning organisation is an organisation skilled at creating, obtaining and conveying knowledge and at modifying its behaviour to reflect new knowledge (75). Although prior studies have found that learning organisations are more conducive

to EBP (77), a recent systematic review of organisational learning and knowledge with relevance to public service organisations shows that organisational learning is under-researched in relation to the public health service (78) and further research is needed to understand the processes and contingencies that shape the nature and extent of organisational learning.

Another organisation trait that may influence EBP is organisational readiness, which refers to the level of commitment of *all* members of the organisation to implement organisational change (79, 80). Organisational readiness for change is considered a critical precursor to the successful implementation of complex changes in health care settings (23, 24). However, there has been little theoretically grounded discussion on the determinants of organisational readiness (81). Peter and Waterman's Seven-S management model (83) suggests several conditions or circumstances that might promote it. The Seven-S model describes seven important aspects of organisations that, together, determine the way in which an organisation operates or functions. The seven S's represent strategy, structure, systems, staff, style of management, shared beliefs and values, and skills. Organisational readiness may be linked to one or more of these domains (83).

From July 2005 to October 2010, the Quality in Acute Stroke Care Trial (QASC) was conducted across 19 acute stroke units in NSW, Australia (1). The aim of the QASC trial was to promote evidence-based management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. The QASC behaviour change intervention comprised the introduction of multidisciplinary supported, nurse-initiated evidence-based protocols using team-building workshops, barrier assessment, and

educational outreach and reminders. Prior to the implementation of the QASC trial, this study set out to determine knowledge of individual and organisational traits that may have impeded or facilitated the successful uptake of the QASC intervention and EBP. Accordingly, the aim of this study was to identify NUMs peceptions of self-leadership ability, organisational learning, attitudes and beliefs towards EBP, and readiness for change within NSW stroke units prior to the implementation of the QASC trial.

4.4 METHODS

NUMs working in the 19 NSW stroke units that had consented to participate in the QASC trial were surveyed. This survey was conducted three months prior to randomisation of acute stroke units.

4.4.1 Participants

NUMs were chosen as the population of interest because the intervention comprised multidisciplinary supported nurse-initiated clinical treatment protocols to manage fever, hyperglycaemia and swallowing. NUMs are the most senior nurses working within the stroke unit team, and their role is pivotal to the co-ordination of patient care and stroke unit management. Further, at the stroke unit level, they are influential in ensuring the delivery of high-quality patient care and efficient use of resources.

4.4.2 Survey Administration

Each NUM was mailed an advanced notification prior to the survey with a preaddressed envelope for survey return. Non-responders were telephoned 14, 21 and 28 days following initial survey distribution.

4.4.3 Survey Instrument

The survey (Appendix I) comprised five sections, which are explained in full below. The survey was pilot tested for content validity with six nurse leaders not otherwise involved in the study.

The first section of the survey required NUMs to complete the Leadership Practices Inventory (LPI) (27), a 30-item measure that is separated into five subscales and assesses the presence of features consistent with transformational leadership style. Each of the five leadership practices (five subscales) is measured by six items rated on a 10-point Likert scale (1 = almost never, 10 = almost always). Over a period of 15 years, studies by the authors of the LPI as well as by other researchers have tested its reliability and validity (111, 112). Internal reliabilities for the five LPI subscales were a Cronbach's α co-efficient above 0.75 for the self version, and test–retest reliability was 0.94. (111, 112). Studies conducted with nurse managers also reported internal consistencies as ranging between 0.58 and 0.85 for the five subscales (113, 114).

The second section of the survey required NUMs to complete the Organisational Learning Survey (OLS). The OLS features 21 questions separated into five subscales, all of which encourage organisational learning (21). Each of the five subscales is measured by items rated on a 1–7 rating scale (1 = strongly disagree, 7 = strongly agree) (21). This measure has been used in a study of the relationships between individual, team and organisational learning in nursing (115). The internal consistency for the OLS five subscales were a Cronbach's α co-efficient of 0.90, and test–retest reliability after 10 weeks was 0.77 (116).

Section three of the survey, comprising seven questions, was designed to explore NUMs' attitudes and beliefs about EBP and was patterned after a survey used to study the attitudes of general practitioners toward evidence-based medicine (117). To determine the attitudes and beliefs of NUMs employed on the stroke unit towards EBP, NUMs were required to estimate their own attitude and perceived attitudes of colleagues towards EBP (0 = extremely cynical to 100 = extremely positive), usefulness of EBP in day-to-day management of patients (0 = completely useless to 100 = extremely useful) and percentage of clinical practice that was evidence based (0–100%). NUMs were also required to indicate their level of agreement to the following statements: EBP improves patient care (0 = strongly disagree to 100 = strongly agree); EBP is of limited value in nursing because much of the primary care lacks scientific base (1 = strongly agree to 5 = strongly disagree); the adoption of EBP, however worthwhile as an ideal, places another demand on already overloaded nurses (1 = strongly agree to 5 = strongly disagree).

The fourth section of the survey was designed to measure the stroke units' 'readiness to accept change' and originated from the Seven-S model (83). Thirteen questions were developed targeting the seven important aspects of an organisation (Table 4.5). NUMs were required to respond to questions using visual analogue scales or yes/no responses (Table 4.5). The Seven-S model has been used as a diagnostic tool in prior nursing studies investigating barriers and facilitators to a practice change (118, 119).

The final section of the survey collected demographic data (six questions).

4.4.4 Data Analysis

All data were analysed using STATA version 11.0. Individual NUMs' responses to the 30 questions included in the LPI were grouped under the five leadership dimensions (27). All NUMs' scores for each of the five practices were summed and then means and standard deviations were calculated for each leadership dimension. The potential subscale score ranges from 6 to 60, with higher scores indicating better leadership skills and more frequent engagement by NUMs in the leadership dimension consistent with transformational leadership.

Responses to the 21 questions included in the OLS were grouped under five learning capabilities (21). A total mean score for each subscale was calculated. The potential score range for each subscale (learning capability) was 1–7. Higher mean scores indicated NUMs perceived stroke units to have a higher learning capability. Specifically, values above 4 indicated the presence of a culture of learning and values below 4 did not.

Data from section three of the survey (measuring attitudes and beliefs) were summarised using frequencies and calculations of measures of central tendencies. For questions in which scores ranged from 1 to 5 (two questions), median values above 2.5 indicated agreement and median values below 2.5 indicated disagreement.

Data from section four, measuring readiness to accept change, were summarised using frequencies. For those items with a five-point Likert scale, the 'strongly agree' and 'agree' categories were combined, as were the 'neither agree nor disagree', 'strongly disagree' and 'disagree' categories, so that responses fell into one of two categories:

‘agree’ or ‘disagree’. For the items with a ‘yes/no/unsure’ choice set, the ‘unsure’ category was combined with the ‘no’ category.

This study was approved by the Human Research Ethics Committee of the Australian Catholic University and from area health service human research ethics committees pertaining to each hospital.

4.5 RESULTS

Completed questionnaires were received from 19 NUMs (100% response rate). The majority of the NUMs were female (n = 16, 84%). The largest represented age group was 40–49 years old (n = 8, 42%). Just over one-half of NUMs (n = 10, 53%) were educated to a bachelor’s level and, among the participants, the highest qualification was a master’s degree (n = 3, 16%). The median length of time employed as an NUM on the stroke unit was 10 months (IQR 5–36) (Table 4.1).

Table 4.1: Characteristics of Nurse Unit Managers (n = 19)^

NUM age group (years)	
30–39	3 (16%)
40–49	8 (42%)
50–59	5 (26%)
60–69	3 (16%)
NUM sex	
Male	3 (16%)
Female	16 (84%)
Median time employed as nurse unit manager (months)	10.0 (IQR 5–36)
Level of education^	
Hospital certificate	1 (5.3%)
Diploma	3 (16%)
Bachelor's degree	10 (53%)
Graduate certificate	1 (5.3%)
Graduate diploma	1 (5.3%)
Master's degree	3 (16%)

^ Percentages may not total 100%, due to rounding.

4.5.1 Self-Reported Leadership Ability

The mean values of the LPI of all subscales were predominantly in the upper third of the possible range between 6 and 60, indicating that NUMs of NSW stroke units provided a high level of leadership on all five subscales on the LPI. The highest value was in the practice 'enabling others to act' according to self-assessment (self mean 49.26, SD 3.22), and the lowest was in 'inspiring a shared vision' (self mean 40.46, SD 4.87) (Table 4.2).

Table 4.2: Mean Self-Reported Leadership Practices Inventory Subscales Scores (n = 19)

Leadership practices self-reported scores	Mean (SD)
Models the way (personal credibility)	46.47 (3.83)
Inspires a shared vision (clear picture of the future and encourages the team to work together towards a common goal)	40.46 (4.87)
Challenges the process (seeks opportunities and innovative ways to change, and improve)	42.38 (4.36)
Enables others to act (fosters collaboration)	49.26 (3.22)
Encourages the heart (recognises individual contributions and builds team spirit)	45.16 (4.21)

* Mean scores could have ranged from 6 to 60; higher scores indicate better leadership skills and more frequent engagement by NUMs in the leadership dimension.

4.5.2 Organisational Learning

The mean scores across all five learning capabilities were clarity of mission and values (mean 4.2, SD 1.56), leadership commitment and empowerment (mean 4.92, SD 1.44), experimentation and rewards (mean 4.94, SD 1.54), effective transfer of knowledge (4.86, SD 1.15), and teamwork and group problem solving (mean 4.81, SD 1.35). The scores were above the midpoint of 4 on the seven-point scale, indicating the presence of a culture of learning (Table 4.3).

Table 4.3: Organisational Learning Subscales Scores (n = 19)*

Learning capability dimensions	Mean (SD)
Clarity of mission and vision (the degree to which employees have a clear vision/mission of the organisation and understand how they can contribute to its success and achievement)	4.72 (1.56)
Leadership commitment and empowerment (the role of leaders in the organisation with respect to helping employees learn and elicit behaviours that are consistent with an experimenting and changing culture)	4.92 (1.44)
Experimentation and rewards (the degree of freedom employees enjoy in the pursuit of new ways of getting the job done and freedom to take risks)	4.94 (1.54)
Effective transfer of knowledge (the systems that enable employees to learn from others, from past failures and from other organisations)	4.86 (1.15)
Teamwork and group problem solving (the degree of teamwork possible in the organisation to solve problems and generate new and innovative ideas)	4.81 (1.35)
Overall organisational learning capability	**4.85 (1.41)**

*Mean values above 4 indicate agreement; mean values below 4 indicate disagreement (seven-point Likert scale).

4.5.3 Attitudes and Beliefs towards EBP

NUMs' attitudes and beliefs towards EBP were positive (median 80, IQR 80–95), although colleagues were perceived to be less welcoming (median 70, IQR 60–80). Most NUMs perceived research findings to be extremely useful in their day-to-day management of patients (median 80, IQR 75–95) and overwhelmingly believed that EBP improves patient care (median 95, IQR 90–100). The median value for the estimated percentage of the respondents' clinical practice that was evidence based was

80% (IQR 70–85). Respondents disagreed (median 2, IQR 1–3) that there was a lack of strong evidence to support aspects of their practice; however, NUMs agreed (median 3, IQR 2–3.5) that using evidence in practice places unreasonable demands on their colleagues (Table 4.4).

Table 4.4 Self-Reported Attitudes and Beliefs towards EBP (n = 19)

Item	
How would you describe your attitude towards the current promotion of evidence-based practice? (0 = extremely unwelcoming to 100 = extremely welcoming)	
Median	80
Minimum	70
Maximum	100
Interquartile range	80–95
How would you describe the attitude of most of your nurse colleagues towards evidence-based practice? (0 = extremely unwelcoming to 100 = extremely welcoming)	
Median	70
Minimum	40
Maximum	100
Interquartile range	60–80
How useful are research findings in your day-to-day management of patients? (0 = totally useless to 100 = extremely useful)	
Median	80
Minimum	50
Maximum	100
Interquartile range	75–95
Overall, what percentage of your clinical practice do you consider is currently evidence based? (0%–100%)	
Median	80
Minimum	50
Maximum	95
Interquartile range	70–85

Table 4.4 (Cont'd) Self-Reported Attitudes and Beliefs towards EBP

(n = 19)

Item	
Practicing evidence-based practice improves patient care (0 = strongly disagree to 100 = strongly agree)	
Median	95
Minimum	50
Maximum	100
Interquartile range	90–100
Evidence-based practice is of limited value in nursing because much of the primary care lacks a scientific base*^ (1 = strongly disagree to 5 = strongly agree)	
Median	2
Minimum	1
Maximum	5
Interquartile range	1–3
The adoption of evidence-based practice, however worthwhile as an idea, places another demand on already overloaded nurses*^ (1 = strongly disagree to 5 = strongly agree)	
Median	3
Minimum	1
Maximum	5
Interquartile range	2–3.5

*Median values above 2.5 indicate agreement; values below 2.5 indicate disagreement.

4.5.4 Readiness to Accept Change

All NUMs (n = 19, 100%) agreed that staff were receptive to using evidence-based guidelines, and 100% (n = 19) agreed that there was a positive culture towards guideline implementation within their hospital. The majority of NUMs (n = 18, 95%) indicated that guideline dissemination and implementation had been built into the organisational structure, and 68% (n = 13) indicated that their organisation provided multiprofessional forums or networks to facilitate dissemination and implementation of guidelines into practice. The majority of NUMs (n = 17, 89%) agreed that their organisation employed a strategy to communicate new guideline information, and 53% (n = 10), agreed that their organisation specifically allocated resources for dedicated staff time to plan guideline dissemination and implementation. The majority of NUMs (n = 14, 74%,) indicated that there was an organised programme of training to develop staff skills to implement guidelines, and 95% (n = 18) indicated that staff requests for acquiring new skills and knowledge about implementation of evidence-based guidelines was supported. The majority of NUMs indicated that their organisation had allocated a staff member specific to the implementation of guidelines (n = 16, 84%), and 94% (n = 15 of 16) indicated that this designated staff member had the expertise to lead the co-ordination of guideline dissemination and implementation. However, for those stroke units who had an allocated staff member (n = 16), 56% (n = 9 of 16) of NUMs indicated that this designated person was not allocated sufficient time to co-ordinate and implement guidelines into practice. The majority of all respondents 95% (n = 18) of NUMs indicated that staff are given the opportunity to give feedback on the relevance of the guideline recommendations to their practice.

Table 4.5: Organisations' Readiness to Accept Change[#]

Shared values	**A lot**	**A little**	**Not at all**	**Unsure**	
Overall, in your opinion, are the healthcare professionals in the hospital receptive to using evidence-based guidelines? (n=19)	14 (74%)	5 (26%)	0	0	
In your view, is there a positive culture towards guideline implementation within the hospital? (n=19)	16 (84%)	3 (16%)	0	0	
Structure	**A lot**	**A little**	**Not at all**	**Unsure**	
To what extent has the process of guideline dissemination and implementation been built into the organisational structure/knowledge management systems of the hospital (i.e., responsibility for guideline dissemination and implementation is designated to individuals and/or departments at different tiers of the hospital hierarchy)?^[#] (n=19)	14 (74%)	4 (21%)	1 (5.3%)	0	
Strategy	**Strongly agree**	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly Disagree**
My organisation provides multiprofessional forums or networks to facilitate dissemination and implementation of guidelines into practice. (n=19)	6 (32%)	7 (37%)	4 (21%)	2 (11%)	0

* 'Always' or 'sometimes' indicates agreement; 'never' or 'unsure' indicates disagreement.

^ 'A lot' or 'a little' indicates agreement; 'not at all' or 'unsure' indicates disagreement.

Percentages may not total 100 due to rounding or missing data.

Table 4.5 (Cont'd): Organisations' Readiness to Accept Change[#]

Systems	**Yes**	**No**	**Unsure**	
Does the hospital have a strategy to communicate new guideline information? (n=19)	17 (89%)	2 (11%)	0	
	Always	**Sometimes**	**Never**	**Unsure**
In your experience, is the hospital able to allocate resources (e.g. dedicated staff time for policy development and action planning) for guideline dissemination and implementation?* (n=19)	4 (21%)	6 (31%)	2 (11%)	7 (37%)
Staff	**Yes**	**No**	**Unsure**	
Does the hospital have staff whose role is specifically designated to the implementation of guidelines?* (n=19)	16 (84%)	2 (11%)	1 (5.3%)	
If your hospital does have a staff member whose role is specifically designated to the implementation of guidelines, does this staff member have the expertise to lead on the co-ordination of guideline dissemination and implementation? (n=16)	15 (94%)	0	1 (6.3%)	
If your hospital does have a staff member whose role is specifically designated to the implementation of guidelines, does this designated staff member have the designated time to lead in the co-ordination of guideline dissemination and implementation? (n=16)	5 (31%)	9 (56%)	2 (13%)	

* 'Always' or 'sometimes' indicates agreement; 'never' or 'unsure' indicates disagreement.

^ 'A lot' or 'a little' indicates agreement; 'not at all' or 'unsure' indicates disagreement.

Percentages may not total 100 due to rounding or missing data.

Table 4.5 (Cont'd): Organisations' Readiness to Accept Change[#]

Style	**Always**	**Sometimes**	**Never**	**Unsure**
Are staff given an opportunity to feed back on the relevance of the guideline recommendations to their practice?*[#]	10 (52%)	8 (42%)	1 (5.3%)	0
Skills	**Yes**	**No**	**Unsure**	
Is there an organised programme of training to develop staff skills to implement guidelines?	14 (74%)	5 (26%)	0	
	Always	**Sometimes**	**Never**	**Unsure**
Do managers support staff requests for acquiring new skills and knowledge with regards to the implementation of evidenced-based guidelines?*	17 (90%)	1 (5.3%)	0	1 (5.3%)

* 'Always' or 'sometimes' indicates agreement; 'never' or 'unsure' indicates disagreement.

^ 'A lot' or 'a little' indicates agreement; 'not at all' or 'unsure' indicates disagreement.

Percentages may not total 100 due to rounding or missing data.

4.6 DISCUSSION

This study was conducted to identify NUMs' perceptions of self-leadership ability, organisational learning, attitudes and beliefs towards EBP; and readiness for change within NSW, Australia, stroke units prior to conducting the QASC trial. While this information was not explicitly used to inform the QASC intervention, the intention was to obtain pre-trial data to help explain the main trial results. The results of this study suggest that NSW stroke units prior to the implementation of the QASC trial were guided by NUMs who reported exemplary leadership skills consistent with transformational leadership, embraced a culture of learning, were supportive and accepting of EBP, and were committed to and ready for a practice change - all of which are essential for the successful uptake of EBP.

Although NUMs indicated that NSW stroke units were ready for a practice change, they also indicated that barriers to change existed. Consistent with prior studies (107) (74), a lack of time and a lack of resources were identified as major organisational barriers to EBP in our study. These data indicate that over three-quarters of NSW stroke units had a hospital staff member whose role was specifically designated to guideline dissemination and implementation; however, over half of NUMs indicated that these staff members were not allocated sufficient time for this role. This is of concern, considering that organisations in which guidelines had been successfully implemented and sustained had someone specifically designated for guideline implementation (74). Change is subject to wider organisational and political pressures, and leaders such as NUMs encounter challenges such as cost cutting and staff shortages. Other studies suggest that managers may be unable to address organisational barriers and provide all

the components, such as resources (including staff), necessary to implement change and EBP because this is outside their control (20).

Also consistent with other studies investigating nursing and research utilisation, NUMs perceived their nursing colleagues to be less welcoming towards EBP (120). Prior studies have found that nurses practicing in leadership roles were significantly more likely to utilise research than staff nurses (25). It is of concern that very few NUMs participating in this study had obtained a graduate degree (i.e. master's degree) because current evidence indicates that there is a positive association between research utilisation and holding a graduate degree (25).

Although NUMs estimated that 80% of clinical practice was evidence based, the National Stroke Foundation's 2011 audit report confirms that not all Australians diagnosed with stroke receive evidence-based care (42). The National Stroke Foundation of Australia publishes a report every two years that provides an overview of the quality of acute stroke care in Australia. For the NSF 2011 report (42), a total of 3548 patient medical records were audited by clinicians from 108 hospitals across Australia. The hospitals that participated in the audit provided care for the majority of stroke cases (88%) admitted to Australian hospitals; hence, the results from this audit are representative of acute stroke care nationally. The findings from our study suggest that NUMs have likely overestimated the frequency with which evidence-based practice occurs in NSW stroke units, and further studies are required that measure EBP use versus actual practice.

A limitation of this study was the use of self-report data and the likelihood of desirability bias (i.e. participants provide responses they think the researcher wants or expects). This study has attempted to minimise this potential bias by assuring respondent anonymity. This study was also limited by its small sample size of 19 NUMs. However, since this study achieved a 100% participation rate, the results clearly represent the views of all NUMs from those stroke units that participated in the QASC trial. A lack of study resources precluded a more in-depth analysis of views of organisational traits that impede evidence uptake at the level of the individual nurse and other members of the health care team working on the stroke unit, but such a study would be of value in future trials wishing to implement a practice change. That this study was conducted prior to implementation of our intervention and as part of a more in-depth process evaluation is a strength, and that it has quantified these domains provides important baseline levels not previously reported in Australian stroke units.

4.7 CONCLUSIONS

NUMs from the stroke units participating in the QASC trial perceived NSW stroke units to be ready for a practice change and supported the introduction of evidence-based nurse-initiated protocols. NUMs are the most senior members of the nursing team at the stroke unit level and are well placed to influence and drive practice change. The barriers to change, including insufficient resources and time constraints, identified by NUMs in this study are not likely to be unique to stroke units. However, NUMs may be unable to address these organisational barriers and thus provide all the components necessary to implement change and EBP.

CHAPTER 5: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE

5.1 PROLOGUE

In Chapter 3 (Study 1), the candidate identified that the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke was suboptimal and urgent behaviour change was required. In Chapter 4 (Study 2), the candidate identified that, prior to the implementation of the QASC trial, NSW stroke units were guided by NUMs who had exemplary leadership skills, embraced a culture of learning, were supportive and accepting of EBP, and were committed to and ready for a practice change. The aim of the candidate's third and final study (Chapter 5), a process evaluation, was to examine clinician behaviour change and nurse adherence to the FeSS protocols following the implementation of the QASC intervention to help explain the main trial patient outcome results.

STUDY 3

Drury, P., Levi, C., D'Este, C., McElduff, P., McInnes, E., Hardy, J., Dale, S., Cheung, N W., Grimshaw, J., Quinn C., Ward, J., Evans, M., Cadilhac, D., Griffiths, R., Middleton, S. Quality in Acute Stroke Care (QASC): Process evaluation of an intervention to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. *International Journal of Stroke*. In press, accepted August 2013.

5.2 ABSTRACT

Background: The QASC randomised controlled trial of a multifaceted evidence-based intervention for improving the in-patient management of fever, hyperglycaemia and swallowing dysfunction in the first three days following stroke resulted in patients from the intervention group being 15.7% more likely to be alive and independent at 90 days after admission. The candidate carried out a pre-specified quantitative process evaluation to help explain and interpret the QASC trial findings.

Methods: Retrospective medical record audits were undertaken for prospectively recruited patients from 19 stroke units following the implementation of three clinical treatment protocols (predominantly targeting nurse behaviour) for the management of fever, hyperglycaemia and swallowing dysfunction in intervention stroke units. Auditors were blind to trial group.

Results: Data from 1804 patients (718 pre-intervention; 1086 post-intervention) showed that significantly more patients in the intervention group received care according to the fever (n = 186 of 603, 31% v. n = 74 of 483, p = < 0.001), sugar (n = 398 of 603, 66% v. n = 217 of 483, 45%, p = < 0.001) and swallow protocols (n = 288 of 603, 48% v. n =

126 of 483, 26%, p = 0.04). Significantly more patients from intervention stroke units received four-hourly temperature monitoring (n = 222 of 603, 37% v. n = 90 of 483, 19%, p = < 0.001) and six-hourly glucose monitoring (194 of 603, 32% v. 46 of 483, 9.5%, p = < 0.001) within 72 hours of admission to a stroke unit, and a swallowing screen (308 of 603, 51% v. 148 of 483, 31%, p = 0.04) within the first 24 hours of admission to hospital. There was no difference between the groups in the treatment of fever with paracetamol (22 of 105, 21% v. 38 of 131, 29%, p = 0.78) or of hyperglycaemia with insulin (40 of 100, 40% v. 17 of 57, 30%, p = 0.49).

Interpretation: The QASC intervention resulted in better protocol adherence in intervention stroke units, which goes some way to explaining the main trial findings of improved patient 90-day outcomes. Although monitoring practices significantly improved, there was no difference between the groups in the treatment of fever and hyperglycaemia following acute stroke. A stronger link between improved treatment practices and improved outcomes would have explained the success of the QASC intervention, but the candidate's study is still unable to definitively explain the large improvements in death and dependency found in the main trial results. One potential theory proposed is that improved monitoring may have led to better overall surveillance of deteriorating patients and faster initiation of other treatment not measured as part of the main trial.

5.3 BACKGROUND

Conventional randomised controlled trials (RCTs) evaluate the effects of interventions on pre-specified health outcomes, yet many are unable to explain why the intervention worked, or why it did not (28, 36). Process evaluations are studies conducted parallel to or following intervention trials to help in the interpretation of the outcome results by exploring: the trial processes, that is, implementation and receipt, context and setting, professionals and patients (28). The candidate reports results from the third and final study, a process evaluation conducted parallel to the Quality in Acute Stroke Care (QASC) trial.

From July 2005 to October 2010, the QASC cluster randomised controlled trial (CRCT) was conducted across 19 acute stroke units in New South Wales (NSW), Australia (1). The QASC trial tested the effectiveness of a multifaceted intervention developed for improving the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke (1). The intervention comprised evidence-based treatment protocols developed from Australia's national clinical guidelines for stroke, supported by team-building workshops and site-based education and support. The protocols were intended to trigger prompt nursing assessment and treatment of fever, hyperglycaemia and swallowing dysfunction in the first three days following admission to hospital for stroke. Prior to the implementation of the protocols, two site-based team-building workshops were conducted focusing on identifying enablers and barriers to protocol uptake (31), development of teamwork (32), identifying champions (35) and local adaptation (33). Two interactive and didactic outreach educational sessions (34, 70, 121) were also held focusing on protocol orientation and staff education. Stroke unit staff was contacted six weekly by the QASC project manager, via a site visit, telephone

call or email, which all acted as reminders (19). The protocols along with ongoing support and reminders continued over three years from 2007 to 2010. Control groups only received an abridged version of existing guidelines.

Results from the trial showed that irrespective of stroke severity, patients admitted to intervention stroke units that received the nurse-initiated protocols were 15.7% more likely to be alive and independent at 90 days after admission (1). Prior to the commencement of the trial, we designed a process evaluation to be conducted parallel to the QASC trial. The aim of the candidate's process evaluation was to examine nurse protocol adherence by measuring the proportion of patients managed according to the fever (Fe), sugar (S) and swallow (S) (FeSS) protocols (Boxes 5.1, 5.2 and 5.3) to explain the main trial outcomes.

Box 5.1: Outcome Measures for Fever Protocol

Primary outcome measure

- Proportion of patients who met all fever clinical care elements (n = 2 elements)

Secondary outcome measures

- Proportion of patients who met element one of the fever protocols: Temperature monitored and charted every four hours after stroke unit admission for first 72 hours. This element was defined as having been met if a patient had at least six readings within each of the first three 24-hour periods (72 hours in total) following stroke unit admission.
- Proportion of patients who met element two of the fever protocol: Temperature ≥ 37.5 °C treated with paracetamol. This element was defined as having been met if the patient was treated with paracetamol (at the first febrile event) within two hours of having temperature ≥ 37.5 °C; or if no temperature reading ≥ 37.5 °C was recorded for the first 72 hours following stroke unit admission.

Box 5.2: Outcome Measures for Sugar Protocol

Primary outcome measure

- Proportion of patients who met all sugar clinical care elements (n = 5 elements)

Secondary outcome measures

- Proportion of patients who met element one of the sugar protocols: Formal glucose measured (venous blood not finger-prick) on admission to hospital or on admission to the stroke unit. This is defined as having been met if the patient had glucose measured from venous blood either in the emergency department or within two hours of stroke unit admission.
- Proportion of patients who met element two of the sugar protocol: Finger-prick blood glucose on admission to stroke unit. This is defined as having been met if the patient has a finger-prick blood glucose within two hours of admission to the stroke unit (this is independent of the venous blood glucose measure).
- Proportion of patients who met element three of the sugar protocol: Finger-prick glucose every 1–6 h for first 72 h following stroke unit admission depending on previous blood glucose value: this element of care is defined as having been met if the patient had at least four finger-prick glucose measures within each of the first three 24-hour periods following stroke unit admission.
- Proportion of patients who met element four of the sugar protocol: On admission, if blood glucose between 8 mmol/L and 11 mmol/L and patient is diabetic, or between 8 mmol/L and 16 mmol/L and patient is not diabetic, start saline infusion. This element of care is defined as being met if, for the first finger-prick blood glucose, the patient has the specified combination of blood glucose level and diabetes status, and saline is administered within two hours of the relevant blood glucose reading, or if the patient did not have an elevated blood glucose.
- Proportion of patients who met element five of the sugar protocol: If, at any time in first 72 hours after admission, blood glucose $\geq$ 11 mmol/L and patient is diabetic, or blood glucose $\geq$ 16 mmol/L and patient is not diabetic, start insulin infusion: This element of care is defined as being met if the patient has the specified combination of blood glucose level and diabetes status, within the first 72 hours from admission to the ASU, and insulin is administered within two hours of the relevant blood glucose reading, or if the patient did not have elevated blood glucose.

Box 5.3: Outcome Measures for Swallow Protocol

Primary outcome measure

- Proportion of patients who met all swallow clinical care elements (n = 2 elements)

Secondary outcome measures

- Proportion of patients who met swallow clinical care element one: Patients underwent a swallowing screening within 24 hours of stroke unit admission. To meet the criteria for a successful swallowing screening, the three individual elements all had to be documented in the patient's medical records: level of consciousness, cranial nerve assessment and a water swallow test; or a hospital approved swallowing screening tool had to be completed. This element of care is defined as having been met if the patient did not have a swallow screen in the emergency department but did have a swallow screen within 24 hours of stroke unit admission.
- Proportion of patients who met element two of the swallow protocol: Patients who failed the swallowing screening were referred to a speech pathologist for a comprehensive swallowing assessment. This element is defined as being met if the patient was referred to a speech pathologist following a failed screen or if the patient did not fail the swallowing screening.

5.4 METHOD

5.4.1 Trial Design and Participants

The main trial methods have previously been reported in full (1) and are available in further depth at http://www.acu.edu.au/qasc. To ascertain protocol adherence, retrospective medical record audits were undertaken, using prospectively documented data, of the QASC trial pre- and post-intervention patient cohort.

5.4.2 Outcome Measures

All outcomes were measured at the individual or event level and were derived from the FeSS protocols as outlined in Boxes 5.1, 5.2 and 5.3. For each of fever, hyperglycaemia and swallowing dysfunction, the primary outcome was the proportion of patients for

whom all relevant management and treatment protocols were delivered. Secondary outcomes were the proportions of patients who received each of the relevant individual elements of clinical care.

5.4.3 Data Collection

Four auditors not otherwise involved in the QASC trial and blind to study design conducted the medical record audits. Auditors completed a training programme over two days. Audits were conducted by two pairs of auditors. Each pair of auditors independently audited one medical record at any time in the same medical record department so that they were available to each other to clarify uncertainties. For quality assurance purposes, 10% of patient records were re-audited. The medical record audit tool and data dictionary are available at www.acu.edu.au/qasc.

5.4.4 Statistical Analysis

Analyses were undertaken using STATA 11.0 software. Frequency distributions of sociodemographic and clinical characteristics of the sample are presented. All outcomes were adjusted for pre-intervention levels and for clustering within stroke units, using a logistic regression model fitted within a generalised estimating equation framework for binary outcomes and a random intercept linear regression model fitted for continuous outcomes. The linear and logistic models included the predictor variables of period (before and after), intervention and the interaction between period and intervention. The P-value from the Wald test for the interaction term was used to determine if the pre-post change in the intervention group was statistically different from the change in the control group. For binary outcomes, the models were refit using the identify link so that

the intervention effect could be presented as differences in proportions with 95% confidence intervals.

For outcomes involving treatment of patients meeting specific criteria (i.e. administration of paracetamol for individuals with temperature ≥ 37.5 °C), patients were defined as having met this care element if no treatment was required. Because there are restrictions on paracetamol use (95) (it can only be administered 4–6 hourly per 24 hours), the analysis was restricted to treatment of the first febrile event only. Similarly, because one patient may experience multiple hyperglycaemic events, the analysis was restricted to treatment of the first hyperglycaemic event.

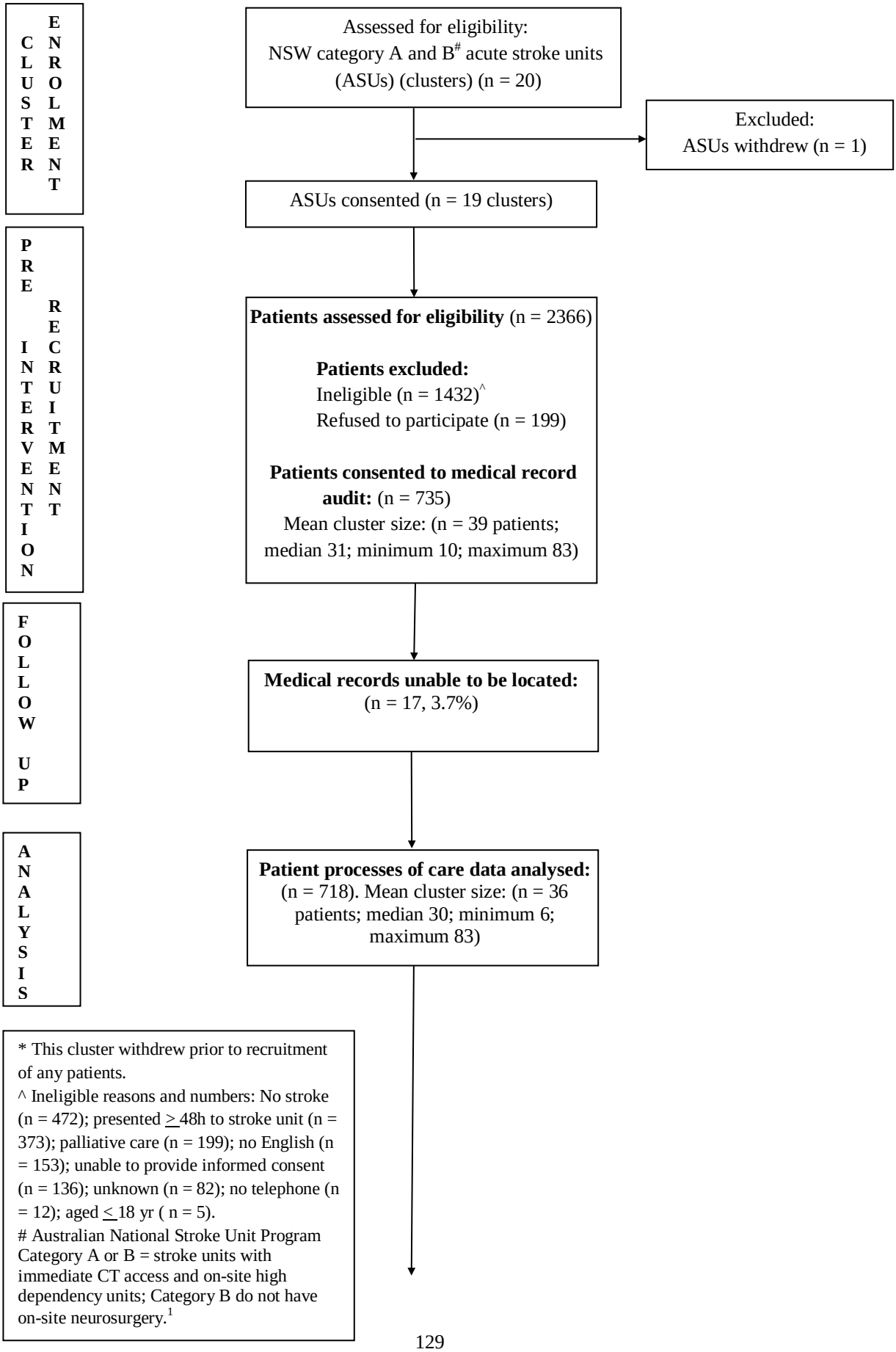
This trial was approved by the Human Research Ethics Committee of the Australian Catholic University and the relevant ethics committees of all 19 participating hospitals.

5.5 RESULTS

The majority of eligible NSW stroke units agreed to participate (n = 19, 95%). Of the 1861 eligible QASC consenting patients, medical records were unavailable for 57 patients (3·6%) (17 [2.4%] from the pre-intervention cohort and 40 [3.7%] from the post-intervention cohort) resulting in collection of data for 1804 patients. Of the 1804 patients, 718 were audited prior to commencement of the intervention (pre-intervention cohort) and 1086 were audited post implementation of the intervention (post-intervention cohort) (intervention: n = 603; control: n = 483) (Figure 5.1). As previously published (1), age, sex, premorbid level of dependency (Modified Rankin Score [mRS]), stroke location, stroke severity, and time between onset of stroke symptoms

and arrival at stroke unit were similar for post-intervention patients in the intervention and control groups (Table 5.1).

Figure 5.1: CONSORT Flow Diagram



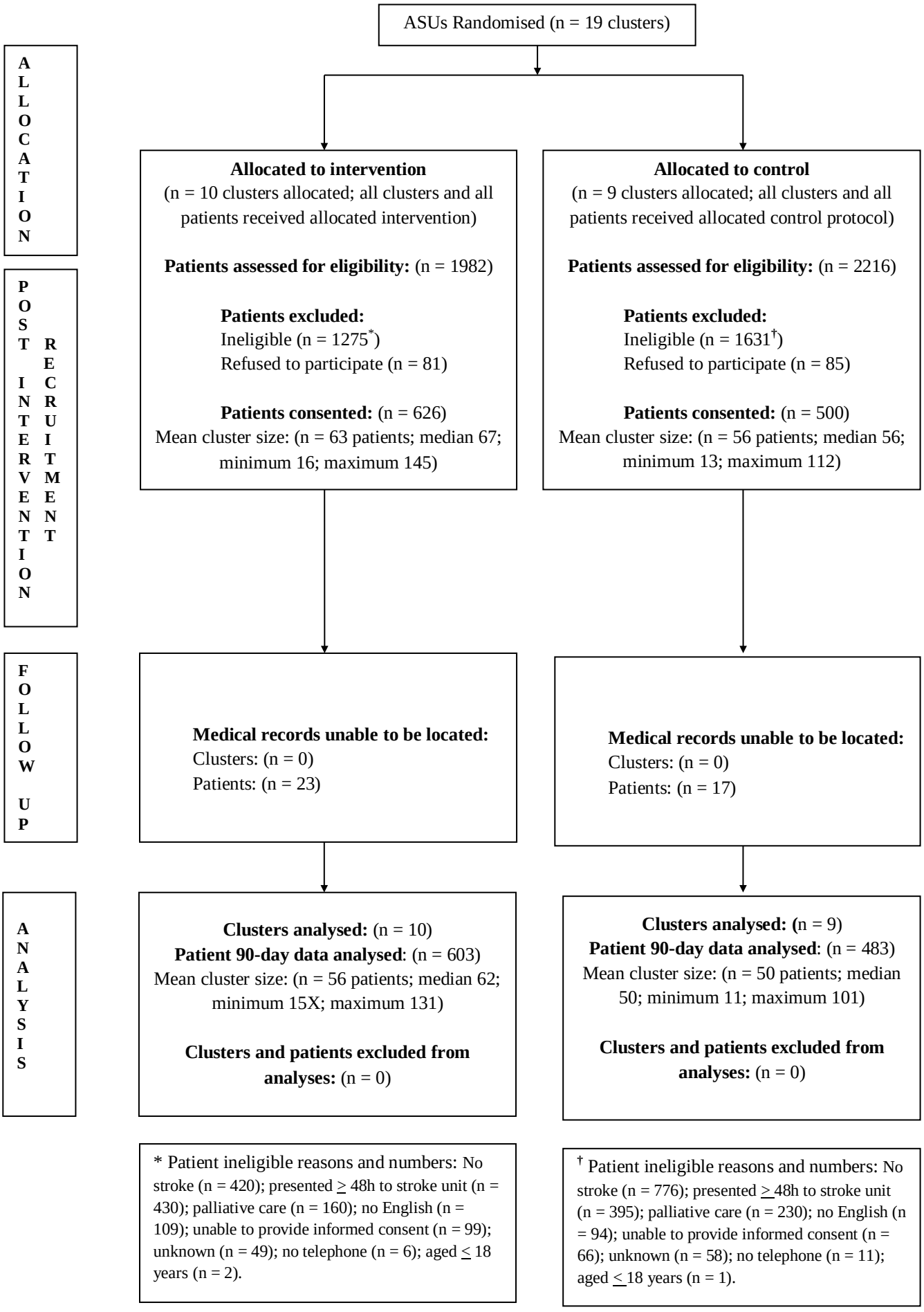

ASUs Randomised (n = 19 clusters)
ALLOCATION
POST INTERVENTION RECRUITMENT
FOLLOW UP
ANALYSIS
Allocated to intervention
(n = 10 clusters allocated; all clusters and all patients received allocated intervention)
Patients assessed for eligibility: (n = 1982)
Patients excluded:
Ineligible (n = 1275*)
Refused to participate (n = 81)
Patients consented: (n = 626)
Mean cluster size: (n = 63 patients; median 67; minimum 16; maximum 145)
Allocated to control
(n = 9 clusters allocated; all clusters and all patients received allocated control protocol)
Patients assessed for eligibility: (n = 2216)
Patients excluded:
Ineligible (n = 1631†)
Refused to participate (n = 85)
Patients consented: (n = 500)
Mean cluster size: (n = 56 patients; median 56; minimum 13; maximum 112)
Medical records unable to be located:
Clusters: (n = 0)
Patients: (n = 23)
Medical records unable to be located:
Clusters: (n = 0)
Patients: (n = 17)
Clusters analysed: (n = 10)
Patient 90-day data analysed: (n = 603)
Mean cluster size: (n = 56 patients; median 62; minimum 15X; maximum 131)
Clusters and patients excluded from analyses: (n = 0)
Clusters analysed: (n = 9)
Patient 90-day data analysed: (n = 483)
Mean cluster size: (n = 50 patients; median 50; minimum 11; maximum 101)
Clusters and patients excluded from analyses: (n = 0)
* Patient ineligible reasons and numbers: No stroke (n = 420); presented ≥ 48h to stroke unit (n = 430); palliative care (n = 160); no English (n = 109); unable to provide informed consent (n = 99); unknown (n = 49); no telephone (n = 6); aged ≤ 18 years (n = 2).
† Patient ineligible reasons and numbers: No stroke (n = 776); presented ≥ 48h to stroke unit (n = 395); palliative care (n = 230); no English (n = 94); unable to provide informed consent (n = 66); unknown (n = 58); no telephone (n = 11); aged ≤ 18 years (n = 1).

Table 5.1: Demographic and Clinical Characteristics of the Post-Intervention Cohort Behaviour Change (n=1086)

Variable	Statistic/Category	Group	
		Control (n = 483)	Intervention (n = 603)
Age group	< 65	137/480 (29%)	190/596 (32%)
	65–74	123/480 (26%)	141/596 (24%)
	75–84	151/480 (32%)	171/596 (29%)
	≥ 85	69/480 (14%)	94/596 (16%)
Gender	Male	284/483 (59%)	356/483 (60%)
	Female	198/483 (41%)	241/483 (40%)
Oxfordshire Stroke Classification Project (OCSP)	Total Anterior Circulation Infarct	25/288 (9%)	37/561 (7%)
	Partial Anterior Circulation Infarct	119/288 (41%)	286/561 (51%)
	Lacunar Infarct	80/288 (28%)	88/561 (16%)
	Posterior Circulation Infarct	52/288 (18%)	112/561 (20%)
	Intracerebral Haemorrhage	12/483 (4%)	38/561 (7%)
Premorbid modified Rankin Scale (mRS)	No symptoms at all	368/415 (89%)	461/515 (90%)
	No significant disability despite symptoms	18/415 (4.3%)	16/515 (3.1%)
	Slight disability	16/415 (3.9%)	20/515 (3.9%)
	Moderate disability	11/415 (2.7%)	16/515 (3.1%)
	Moderately severe disability	2/415 (0.5%)	2/515 (0.4%)
Stroke severity (Los Angeles Motor Scale)	0 (mild stroke)	275/476 (58%)	253/594 (43%)
	≥ 1 (more severe stroke)	275/476 (58%)	341/594 (57%)

Variable	Statistic/Category	Group	
		Control (n = 483)	Intervention (n = 603)
Time from onset of symptoms to stroke unit (hours)		n = 478	n = 596
Mean (SD)		14.10 (11.76)	15.86 (10.70)

5.5.1 Fever Protocol Adherence

The fever protocol comprised two clinical care elements (Box 5.1). Significantly more patients from intervention stroke units had the primary outcome, that is, met all fever clinical care elements (n = 186 of 603, 31% v. n = 74 of 483, 15%), p = < 0.001). Significantly more patients from intervention stroke units had their temperature monitored at least once every four hours within the first 72 hours of stroke unit admission when compared with control stroke unit patients (n = 222 of 603, 37% v. n = 90 of 483, 19%, p = < 0.001). Significantly more patients admitted to intervention stroke units also had their fever treated with paracetamol (n = 528 of 603, 88% v. n = 397 of 483, 82%, p = 0.001), noting, however, that significantly fewer patients from intervention stroke units developed a febrile event (n = 105 of 589, 18% v. n = 131 of 475, 28%, p = < 0.001). Of those who developed a febrile event, there was no difference between groups in proportion of patients administered paracetamol within two hours of the first febrile event if temperature reached or exceeded 37.5 ℃ (n = 22 of 105, 21% v. n = 38 of 131, 29%, p = 0.78) (Table 5.2).

Table 5.2: Fever Protocol Adherence

	Group			
Outcome (ICC^)	**Control (n = 483)**	**Intervention (n = 603)**	**P†**	**Difference in absolute change (95% CI)**
Primary outcome measure				
Proportion of patients who met all fever clinical care elements (n = 2)	74 (15%)	186 (31%)	< 0.001	14.8% (7.9% to 22%)
Secondary outcome measures				
Proportion of patients who met fever clinical care element 1: Temperature monitored four hourly for 72 hours following stroke unit admission	90 (19%)	222 (37%)	< 0.001	15.0% (7.9% to 22%)
Proportion of patients who met fever clinical care element 2: Temperature ≥ 37.5 °C treated with paracetamol (2a); or no febrile event recorded for 72 hours following stroke unit admission	397 (82%)	528 (88%)	0.001	12.2% (5.0% to 20%)
Subgroup analysis				
Proportion of patients with a febrile event (temperature ≥ 37.5 °C) for the first 72 hours after stroke unit admission (for those who had at least o temperature reading)	131 of 475 (28%)	105 of 589 (18%)	< 0.001	16.7% (8.5% to 25%)
Proportion of patients administered paracetamol within 2 hours when temperature ≥ 37.5 °C (at first febrile event)	38 of 131 (29%)	22 of 105 (21%)	0.78	–3.0% (–18% to 13%)

† P-values are for the interaction term between intervention group and time period (pre- or post-intervention) and are adjusted for clustering within stroke units. ^ Intra-cluster correlation co-efficient (ICC).

5.5.2 Sugar Protocol Adherence

The sugar protocol comprised five clinical care elements (Box 5.2). Significantly more patients from intervention stroke units had the primary outcome, that is, met all sugar clinical care elements (n = 22 of 603, 3.7% v. n = 3 of 483, 0.6% p = 0.01). Significantly more patients from intervention stroke units had a venous blood glucose measurement in the emergency department or within two hours of stroke unit admission (n = 190 of 603, 32% v. n = 68 of 483, 14%, p = < 0.001). There was no difference between the groups in the proportion of patients who had a finger-prick glucose reading on admission to the stroke unit (n = 192 of 603, 32% v. n = 90 of 483, 19%, p = 0.0.07). Significantly more patients from intervention stroke units had at least one finger-prick glucose reading every six hours within the first 72 hours of stroke unit admission (n = 194 of 603, 32% v. n = 46 of 483, 9.5%, p = < 0.001). There was no difference between the groups in the proportion of patients who had intravenous normal saline commenced if finger-prick glucose level > 8 mmol/L (n = 551 of 603, 91% v. n = 450 of 483, 93%, p = 0.85). There was no difference between the groups in the proportion of patients who were treated with insulin when first finger-prick blood glucose > 11 mmol/L (patient with known diabetes) or first finger-prick blood glucose level > 16 mmol/L (patient without known diabetes) (n = 586 of 603, 97% v. n = 471 of 483, 98%, p = 0.35) (Table 5.3).

A subgroup analysis showed that of those who received a finger-prick blood glucose level, there was no difference between groups in the proportion of patients who developed a hyperglycaemic event (finger-prick blood glucose level > 11 mmol/L) (n = 100 of 507, 20% v. n = 61 of 294, 21%, p = 0.60), nor was there a difference between

the groups in proportion of patients commenced on insulin (SCI or IVI) when finger-prick glucose exceeded 11 mmol/L (n = 40 of 100, 40% v. n = 17 of 57, 30%, p = 0.47) (Table 5.3).

Table 5.3: Sugar Protocol Adherence

	Group			
Outcome (ICC^)	**Control (n = 483)**	**Intervention (n = 603)**	**P†**	**Difference in absolute change (95% CI)**
Primary outcome measure				
Proportion of patients who met all sugar clinical care elements (n = 5)	3 (0.6%)	22 (3.7%)	0.01	3.6% (0.8% to 6.3%)
Secondary outcome measures				
Proportion of patients who met sugar clinical care element 1: Formal venous blood glucose on admission to the hospital or stroke unit	68 (14%)	190 (32%)	< 0.001	23.8% (16% to 31%)
Proportion of patients who met sugar clinical care element 2: Finger-prick blood glucose on admission to the stroke unit (within 2 hours of stroke unit admission)	90 (19%)	192 (32%)	0.07	8.8% (0.7% to 17%)
Proportion of patients who met sugar clinical care element 3: Finger-prick blood glucose every 1–6 hours within the first 72 hours of stroke unit admission	46 (9.5%)	194 (32%)	< 0.001	24.0% (17% to 31%)
Proportion of patients who met sugar clinical care element 4: intravenous normal saline commenced if finger-prick glucose > 8 mmol/L; or if no finger-prick glucose > 8 mmol/L	450 (93%)	551 (91%)	0.85	0.2% (–4.7% to 5.1%)

Outcome (ICC^)	Group: Control (n = 483)	Group: Intervention (n = 603)	P†	Difference in absolute change (95% CI)
Proportion of patients who met sugar clinical care element 5: insulin administered for diabetic patients if finger-prick glucose > 11 mmol/L (or no finger-prick > 11 mmol/L and diabetic); insulin administered for patients with no history of diabetes if finger-prick glucose > 16 mmol/L (or no finger-prick > 16 mmol/L and no history of diabetes)	471 (98%)	586 (97%)	0.35	–1.4% (–4.3% to 1.6%)
Subgroup analysis				
Proportion of patients with a hyperglycaemic event (finger-prick blood glucose > 11 mmol/L) within the first 72 hours after stroke unit admission (for those who had at least one finger-prick glucose reading)	61 (21%)	100 (20%)	0.57	–2.8% (–13% to 7.3%)
Proportion of patients treated with insulin when finger-prick blood glucose > 11 mmol/L (of those who had a hyperglycaemic event)	17 of 57 (30%)	40 of 100 (40%)	0.49	9.1% (–15% to 34%)

† P-values are for the interaction term between intervention group and time period (pre- or post-intervention) and are adjusted for clustering within stroke units.
^ Intra-cluster correlation co-efficient (ICC).

5.5.2.1 Protocol adherence among patients without known diabetes

A subgroup analysis showed that patients without known diabetes admitted to intervention stroke units were significantly more likely to have their finger-prick glucose level monitored at least once every six hours within the first 72 hours of stroke unit admission (primary outcome) (119 of 403, 30% v. 15 of 218, 7%, p = 0.003). Only three patients without known diabetes among the cohort developed a glucose level > 16 mmols/L, our protocol insulin treatment level; therefore, we conducted an exploratory analysis investigating treatment with insulin at 11 mmols/L. There was no difference between groups in the proportion of patients without known diabetes who had a hyperglycaemic event > 11 mmols/L (37 of 403, 9% v. 18 of 218, 8%, p = 0.29) within the first 72 hours of stroke unit admission. There was a significant decrease in the proportion of patients without known diabetes who had a hyperglycaemic event treated with insulin (3 of 37, 8% v. 3 of 16, 19%, p = 0.03) (Table 5.4).

Table 5.4: Sugar Protocol Adherence among Non-Known Diabetic Patients

	Group			
Outcome (ICC^)	**Control (n = 394)**	**Intervention (n = 495)**	**P†**	**Difference in absolute change (95% CI)**
Glucose monitoring				
Non-known diabetics with at least one finger-prick glucose reading within 72 hours of stroke unit admission	218 (55%)	403 (81%)	< 0.001	40% (31% to 49%)
Non-known diabetics with at least one finger-prick glucose reading recorded within 2 hours of stroke unit admission (of those who had at least one finger-prick glucose measurement)	61 of 218 (28%)	148 of 403 (37%)	0.06	–12% (–25% to 1.0%)
Non-known diabetics with at least 1 finger-prick blood glucose reading recorded every 6 hours within the first 72 hours of stroke unit admission (of those who had at least one finger-prick glucose measurement)	15 of 218 (6.9%)	119 of 403 (30%)	0.003	16% (5.0% to 26%)
Non-known diabetics with a hyperglycaemic event (finger-prick blood glucose > 11 mmol/L) within the first 72 hours after stroke unit admission (for those who had at least one finger-prick glucose reading)	18 of 218 (8.3%)	37 of 403 (9.2%)	0.29	–4.0% (–12% to 4.0%)

	Group			
Outcome (ICC^)	**Control (n = 394)**	**Intervention (n = 495)**	**P†**	**Difference in absolute change (95% CI)**
Glucose Treatment				
Non-known diabetics treated with insulin when finger-prick blood glucose > 11 mmol/L (of those who had a hyperglycaemic event)	3 of 16 (19%)	3 of 37 (8.1%)	0.03	–37% (–69% to –4.0%)

† P-values are for the interaction term between intervention group and time period (pre- or post-intervention) and are adjusted for clustering within stroke units

^ Intra-cluster correlation co-efficient (ICC)

5.5.2.2 Protocol adherence among patients with known diabetes

Patients with known diabetes from the intervention stroke units were significantly more likely to have their finger-prick glucose level monitored at least once every six hours (n = 75 of 104, 72% v. 31 of 76, 41%, p = 0.03). There was no difference between the groups in the proportion of patients with known diabetes who had a hyperglycaemic event (finger-prick glucose > 11 mmols/L) within the first 72 hours of stroke unit admission (63 of 104, 61%, v. 43 of 76, 57%, p = 0.76), nor was there any difference between the groups in the proportion of patients with known diabetes treated with insulin when glucose levels exceeded 11 mmols/L (37 of 63, 59% v. 14 of 41, 34%) (Table 5.5).

Table 5.5: Sugar Protocol Adherence among Known Diabetic Patients

	Group			
Outcome (ICC^)	**Control (n = 89)**	**Intervention (n = 108)**	**P†**	**Difference in absolute change (95% CI)**
Glucose Monitoring				
Known diabetics with at least one finger-prick glucose reading within 72 hours of stroke unit admission	76 of 89 (85%)	104 of 108 (96%)	0.22	8.0% (–5.0% to 20%)
Known diabetics with at least one finger-prick glucose reading recorded within 2 hours of stroke unit admission (of those who had at least one finger-prick glucose measurement)	29 of 76 (38%)	44 of 104 (42%)	0.57	–7.0% (–31% to 17%)
Known diabetics with at least 1 finger-prick blood glucose reading recorded every 6 hours within the first 72 hours of stroke unit admission (of those who had at least one finger-prick glucose measurement)	31 of 76 (41%)	75 of 104 (72%)	0.03	25% (3.0% to 48%)
Known diabetics with a hyperglycaemic event (finger-prick blood glucose > 11 mmol/L) within the first 72 hours after stroke unit admission (for those who had at least one finger-prick glucose reading)	43 of 76 (57%)	63 of 104 (61%)	0.76	4.0% (–20% to 27%)
Glucose Treatment				
Known diabetics treated with insulin when finger-prick blood glucose > 11 mmol/L (of those who had a hyperglycaemic event)	14 of 41 (34%)	37 of 63 (59%)	0.06	28% (–1.0% to 57%)

† P-values are for the interaction term between intervention group and time period (pre- or post-intervention) and are adjusted for clustering within stroke units.

^ Intra-cluster correlation co-efficient (ICC).

5.5.3 Swallow Protocol Adherence

The swallow protocol comprised two clinical care elements (Box 5.3). Significantly more patients from intervention stroke units met the primary outcome criteria and received all relevant swallow clinical care elements (n = 2) (n = 241 of 603, 40% v. n = 19 of 483, 4.0%, p = < 0.001). Significantly more patients from intervention stroke units underwent a swallowing screening within 24 hours of stroke unit admission (n = 242 of 522, 46% v. n = 24 of 350, 6.8%, p = < 0.0001). Significantly more patients from intervention stroke units were referred to a speech pathologist for a comprehensive swallow assessment following a failed screen (n = 289 of 603, 48% v. n = 126 of 483, 26%, p = 0.04). A subgroup analysis of those patients admitted to the emergency department prior to transfer to the stroke unit indicated that patients from intervention stroke units were significantly less likely to receive a swallow screen in the emergency department (n = 105 of 308, 34% v. n = 139 of 148, 94%, p = < 0.001) prior to transfer to the stroke unit and more likely to receive a screen in the stroke unit (n = 15 of 148, 10% v. n = 227 of 308, 74%, p = < 0.001). Patients from intervention stroke units were significantly more likely to fail the swallow screen (n = 89 of 308, 29% v. n = 36 of 148, 24%, p = 0.02) initiated by a non-speech pathologist. A lower proportion of patients from intervention stroke units underwent a comprehensive assessment by a speech pathologist following a failed screen (n = 84 of 89, 94% v. n = 36 of 36, 100%, p = 0.03). Of those who failed the swallowing screening, there was no significant difference between the groups in the number of patients confirmed to have dysphagia by a speech pathologist (n = 70 of 89, 79% v. n = 14 of 36, 39%, p = 0.15). There was no significant difference in the number of patients who had food or fluids prior to a screen (55 of 308, 18% v. 10 of 148, 7%, p = 0.007); however, significantly more patients admitted to intervention stroke units were administered medications prior to being

screened when compared with control group stroke units (115 of 308, 37%, v. 14 of 148, 9.5%, p = < 0.001) (Table 5.6).

Table 5.6: Swallow Protocol Adherence

	Group			
Outcome (ICC^)	**Control (n = 483)**	**Intervention (n = 603)**	**P†**	**Difference in absolute change (95% CI)**
Primary outcome measure				
Proportion of patients who met all swallow clinical care elements (n = 2)	19 (4.0%)	241 (40%)	< 0.001	13% (5.5% to 21%)
Secondary outcome measures				
Proportion of patients who met swallow clinical care element 1: swallowing screening by non-speech pathologist within 24 hours of stroke unit admission (of those who did not receive a screen in the emergency department)	24 of 350 (6.8%)	242 of 522 (46%)	< 0.0001	29% (22% to 36%)
Proportion of patients who met swallow clinical care element 2: referred to a speech pathologist following a failed screen; or had a screen and passed	126 (26%)	289 (48%)	0.04	14% (5.6% to 21%)
Subgroup analysis				
Proportion of patients with a screen in the emergency department and prior to transfer to stroke unit	139 of 148 (94%)	105 of 308 (35%)	< 0.001	65% (52% to 78%)

	Group			
Outcome (ICC^)	**Control (n = 483)**	**Intervention (n = 603)**	**P†**	**Difference in absolute change (95% CI)**
Proportion of patients with a failed swallowing screening (of those who had a screen in the emergency department or stroke unit)	36 of 148 (24%)	89 of 308 (29%)	0.03	19% (2.7% to 36%)
Referred to speech pathologist following a failed screen	14 of 36 (39%)	70 of 89 (79%)	0.35	22% (–9.7% to 53%)
Proportion of patients who underwent a speech pathologist assessment following a failed screen by a non-speech pathologist	36 of 36 (100%)	84 of 89 (94%)	0.03	6.7% (1.2% to 27%)
Proportion of patients confirmed to have dysphagia by speech pathologist (of those who underwent a speech pathologist assessment and results were available)	8 of 34 (24%)	11 of 82 (13%)	0.07	21% (–2.8% to 45%)
Proportion of patients who had food or fluids prior to a screen or assessment (of those who had a screen or assessment in the ED or within 24 hours of stroke unit admission)	10 of 148 (6.8%)	55 of 308 (18%)	0.07	11% (–0.7% to 22%)
Proportion of patients who had medications prior to a screen or assessment (of those who had a screen or assessment in the ED or within 24 hours of stroke unit admission)	14 of 148 (9.5%)	115 of 308 (37%)	< 0.001	28% (14% to 42%)

† P-values are for the interaction term between intervention group and time period (pre- or post-intervention) and are adjusted for clustering within stroke units. ^ Intra-cluster correlation co-efficient (ICC).

5.6 DISCUSSION

As previously stated, the main QASC trial outcome results showed that, irrespective of stroke severity, patients admitted to intervention stroke units that received our intervention were 15.7% more likely to be alive and independent at 90 days after admission (1). There has been international interest about how these improvements occurred (84) (85), and the candidate's process evaluation goes someway to 'unpick' these highly significant results. Significantly more patients were managed according to the fever, sugar and swallow protocols, demonstrating a clear positive effect of our intervention on nurse practice change on each of these three care elements. Prior studies adopting multifaceted interventions also report modest improvements in clinical performance (86, 87, 89, 122).

The results from this study indicate that patients admitted to intervention stroke units were significantly more likely to be monitored more frequently for fever and hyperglycaemia and significantly more likely to be screened for swallowing dysfunction. Significantly more patients from the intervention group also were likely to receive paracetamol for a fever, although we acknowledge this may be due to fewer patients developing a fever in the intervention group rather than more patients in the intervention group receiving paracetamol. However, this in itself is a positive outcome if not a surprising one. Perhaps fewer patients in the intervention group developed a fever because nurses were observing them more closely and providing other measures to control their temperature. Further, although protocol adherence significantly improved, management of fever, hyperglycaemia and swallowing dysfunction following acute stroke was suboptimal with low absolute rates in both groups. We note also that there was no difference between the groups in the treatment of hyperglycaemia. In addition,

following the QASC intervention, non-known diabetics from intervention stroke units were significantly less likely to receive treatment for hyperglycaemia despite the evidence that stroke patients without known diabetes who have even moderately elevated glucose levels (> 6.7–8 mmol/L) on admission have a threefold risk of death relative to known diabetic patients with this same level of elevated glucose (5).

While noting the resulting improved FeSS protocol adherence in the intervention group, the finding of non-significant treatment practice differences between groups is of interest. As with other process evaluations (87), this study is still unable to definitively explain the large improvements in death and dependency found in the main trial results (1). One potential theory proposed is that improved monitoring may have led to better overall surveillance of deteriorating patients and faster initiation of other treatment not measured as part of the main trial (85).

Although the QASC intervention was targeted at the stroke unit, for interest's sake, the candidate recorded the location of the swallow screens attended, that is, in the emergency department or in the stroke unit. The candidate found that patients from intervention stroke units were significantly less likely to receive a swallow screen in the emergency department. This could have occurred because emergency department clinicians may have known patients were now being screened in the stroke unit as part of participation in the QASC trial and decided to leave the screening for stroke unit staff. Since screening decreased in the emergency department, it is possible that this decreased emphasis resulted in patients receiving medications such as aspirin in the emergency department, prior to swallow screening. The QASC intervention significantly increased screening in the stroke unit, and implementation of the QASC

intervention in emergency departments is warranted to reduce the risk of aspiration pneumonia and worse outcomes for stroke patients (8).

Significantly more patients admitted to intervention stroke units failed a swallow screen conducted by a non-speech pathologist. Two systematic reviews have been reported in the literature regarding the evidence supporting swallowing screening procedures and their link with improved outcomes (123, 124). Although significantly more patients from intervention stroke units were referred to a speech pathologist following a failed screen, significantly fewer patients in intervention stroke units were reviewed by the speech pathologist following a failed screen. It is possible that an increase in referrals has placed additional demands on speech pathologists; thus, they were unable to assess all patients identified at risk of swallow dysfunction from intervention stroke units. A 'lack of time' has been consistently reported in prior studies as a barrier to clinician behaviour change (125). Despite this finding, rates of aspiration pneumonia did not differ between groups, as previously reported (1).

This process evaluation only shed limited explanatory light on the trial results. Further work should focus on linking monitoring and treatment of stroke patients within the first 72 hours of admission to longer term outcomes such as death and dependency at three months. The candidate acknowledges that organisational factors, that is, 'attitudes and beliefs', may have affected the successful uptake of the QASC intervention (126). Although the QASC triallists attempted to address organisational barriers at team-building meetings and didactic education sessions, the candidate did not attempt to systematically measure the level of support for the recommendations the QASC triallists proposed.

The majority of interventions are undertheorised (72, 126-131) and more use of theory-based approaches has been recommended when designing interventions to improve professional practice (5)(62). The candidate acknowledges that the QASC triallists did not adopt a theory-based approach when developing the QASC behaviour change intervention; however, it was informed by a small survey of the nurse unit managers' attitudes from participating stroke units to evidence-based practices. The intervention was also developed from evidence available at the time (132) that indicated that combined interventions were more effective than single interventions. Following the development of the intervention, new evidence emerged suggesting that multifaceted interventions were no more effective than single interventions (86). Although this process evaluation was unable to fully explain the main trial patient results, the study findings indicate that the QASC multifaceted intervention had a positive effect on clinician behaviour and the management of fever, hyperglycaemia and swallowing dysfunction after stroke; hence, assessment of this intervention in other health care settings is warranted, such as the emergency department, where screening practices have declined. Further research to examine the sustainability of our intervention would be of value (85).

The candidate acknowledges the following strengths of this study. This process evaluation was pre-specified, not post-hoc and, unlike the majority of published process evaluations, which are poorly reported (28), adopted a process evaluation reporting framework (28). Much of the current literature on process evaluations of complex interventions focuses on qualitative methods, and very few quantitative process evaluations, such as this one, have ever been published (133) (28). Also, unlike in prior

process evaluations (87), the candidate collected baseline data; hence, the post-intervention rate is a valid measure.

5.7 CONCLUSION

The QASC intervention resulted in better protocol adherence in intervention stroke units, which goes some way to explaining the main trial findings of improved patient 90-day outcomes and warrants further uptake. Since the treatment of fever and hyperglycaemia remained suboptimal following the implementation of the intervention, further investigations to identify barriers to treatment of these care elements in acute stroke patients is recommended. Further, the implementation of the QASC intervention in emergency departments is recommended, considering that screening for swallow dysfunction has declined since the QASC trial commenced. The main message that should be taken from this process analysis is the value of regular monitoring of patients following acute stroke for fever, hyperglycaemia and swallowing dysfunction, and correction of physiological abnormalities promptly (85). The next step must be to assess the QASC intervention in other health care settings and to undertake long-term studies to show a sustainable effect (85).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

In this thesis, the candidate has presented three studies conducted as part of the QASC CRCT implemented from July 2005 to October 2010 across 19 NSW, Australia, stroke units. The aim of the QASC trial was to develop, implement and evaluate a behaviour change intervention to promote guideline recommendations for the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. The QASC intervention comprised evidence-based clinical treatment protocols (initiated by nurses), multidisciplinary team-building on-site workshops, and unit-based education and support. **Prior to the implementation of the QASC intervention**, the candidate's role was to (1) establish monitoring and treatment practices within NSW stroke units for fever hyperglycaemia and swallowing dysfunction and (2) investigate NSW stroke unit NUMs' perceptions of self-leadership ability, organisational learning, attitudes and beliefs towards EBP, and organisational readiness for change; and (3) **at the conclusion of the trial**, the candidate's role was to conduct a process evaluation to assist in the interpretation of the QASC patient outcome results.

In Chapter 1, the candidate provided an overview of the QASC trial by way of background, and the relationship of the candidate's three studies to this large trial was established.

In Chapter 2, the candidate provided a detailed examination of the literature specific to each of the three studies presented in this thesis. In relation to Study 1, firstly the evidence for ***why*** it is important to manage fever, hyperglycaemia and swallowing dysfunction following stroke and, secondly, the evidence for ***how*** each of these variables should be managed according to evidence-based national and international

guidelines was examined and discussed. The review demonstrated that fever, hyperglycaemia and swallowing dysfunction in the acute stage following stroke all result in increased morbidity and mortality (4-8). Although clinical practice guidelines were available both nationally (13, 14) and internationally (9-13) to convey this evidence to clinicians and consumers, prior to the commencement of the QASC trial there had been no investigations into clinician compliance with guideline recommendations specific to in-patient monitoring and treatment of fever, monitoring and treatment of hyperglycaemia, and specifically swallowing screening by non-speech pathologists following acute stroke. Further investigations into clinician compliance with recommendations specific to these three variables were warranted to establish if current management was in accordance with the latest evidence and care was being implemented to promote optimum outcomes for acute stroke patients.

In relation to Study 2, the evidence pertaining to leadership, organisational learning, attitudes and beliefs towards EBP and organisational readiness to accept change were summarised, all of which had been cited in the literature as factors that may influence the implementation and sustainability of EBP.

Corresponding to the candidate's third study, the literature review concluded with an outline of the purpose and design of process evaluations conducted alongside RCTs of multifaceted interventions. Many conventional RCTs evaluating the effect of their intervention on pre-specified health outcomes are unable to explain why the intervention worked, or why it did not. Very few quantitative process evaluations such as the candidate's third study have been published.

The candidate's three studies comprising this thesis were presented in Chapters 3, 4 and 5. Each study is summarised below and implications for practice discussed.

6.1 CONCLUSIONS AND RECOMMENDATIONS STUDY 1: MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING HOSPITAL ADMISSION FOR ACUTE STROKE IN NEW SOUTH WALES, AUSTRALIA

Chapter 3 reported the findings of the candidate's first study, a unique review reporting in-patient monitoring and treatment of fever, monitoring and treatment of hyperglycaemia, and swallowing screening by non-speech pathologists following acute stroke prior to the QASC trial. Processes of care data were available from 718 (98%) patients from 19 NSW stroke units. The results from this study indicated that over three-quarters of patients failed (n=580, 81%) to undergo at least four-hourly temperature readings and over three-quarters (n=160/204, 78%) of stroke patients failed to receive paracetamol for fever within the first three days following stroke. Further, three-quarters of stroke patients (n=310/412, 75%) failed to undergo at least six-hourly glucose readings and just under three-quarters of hyperglycaemic stroke patients (n=66/95, 69%) failed to receive treatment with insulin for a hyperglycaemic event within the first three days following stroke. In relation to swallowing surveillance within the first 24 hours of admission following stroke, the results of the candidate's first study indicated that the majority of patients received a swallow assessment (n=562, 78%) by a speech pathologist in the first instance rather than a swallow screen by a non-speech pathologist (n=156, 22%) as recommended by stroke guidelines. Of those who passed a screen (n=108/156, 69%), 68% (n=73) were reassessed by a speech pathologist and 97% (n=71) were reconfirmed to be able to swallow safely. The results from the candidate's

first study highlighted that clinician compliance with guideline recommendations was poor because acute stroke patients were undermonitored and undertreated for fever and hyperglycaemia, underscreened for swallowing dysfunction by non-speech pathologists and unnecessarily reassessed by a speech pathologist.

6.1.1 Study 1: Implications for Practice

Although the NSF acute stroke guidelines were first published in 2007, consistently with prior studies, the candidate's first study confirmed that the distribution alone of guideline recommendations does not change clinician behaviour. To the candidate's knowledge, this is the first study to investigate evidence-based management of fever, hyperglycaemia and swallowing dysfunction within the first three days following stroke. To the candidate's knowledge, it was also the first to confirm that the management of these three variables was suboptimal, indicating the need for urgent behaviour change to promote optimal outcomes for stroke patients.

6.2 CONCLUSIONS AND RECOMMENDATIONS STUDY 2: NURSE MANAGER'S PERCEPTIONS OF INDIVIDUAL AND ORGANISATIONAL TRAITS INFLUENCING EVIDENCE-BASED PRACTICE FOLLOWING ACUTE STROKE: A SURVEY

Interventions, such as the QASC intervention, have a lower likelihood of success if barriers to change, which may vary across different health care settings, are not taken into account. Factors such as leadership, organisational learning, attitudes and beliefs towards EBP and readiness for change may influence change and the uptake of evidence. Chapter 4 reported the findings from the candidate's second study, which was undertaken to explore these domains prior to the implementation of the QASC

intervention. A survey was administered to NUMs of stroke units participating in the trial (n = 19) to determine their perceptions of self-leadership ability (as measured by the Leadership Practices Inventory [LPI]), organisational learning (as measured by the Organisational Learning Survey [OLS]), attitudes and beliefs towards EBP, and the stroke unit's readiness for change. All 19 NUMs (100%) returned the survey. The mean values of the LPI of all subscales were in the upper third of the possible range between 6 and 60, indicating a high level of reported leadership skills consistent with transformational leadership. The mean score across all five learning capabilities of the OLS were above the midpoint of 4 on the seven-point scale, indicating that NUMs reported a culture of learning. NUMs' attitudes towards EBP were positive (median 80, IQR 80–95 [0 = extremely unwelcoming to 100 = extremely welcoming]), although colleagues were perceived as less welcoming (median 70, IQR 60–80 [0 = extremely unwelcoming to 100 = extremely welcoming]). NUMs agreed (medium 3, 2–3.5 [1 = strongly disagree to 5 = strongly agree]) that using evidence in practice places another demand on already overloaded nurses; 49% (n = 9) of NUMs indicated that resources were not available for evidence implementation. Although findings from this study suggested barriers to change existed, NUMs perceived NSW stroke units to be ready for a practice change and to support the introduction of the clinical treatment nurse-initiated protocols.

6.2.1 Study 2: Implications for Practice

The barriers to change, including insufficient resources and time constraints, identified by NUMs in this study are unlikely to be unique to stroke units and NUMs may be unable to address these organisational barriers and thus provide all the components

necessary to implement change and EBP. The findings from this study provides important baseline levels not previously reported in Australian stroke units.

6.3 CONCLUSIONS AND RECOMMENDATIONS STUDY 3: QUALITY IN ACUTE STROKE CARE (QASC): PROCESS EVALUATION OF AN INTERVENTION TO IMPROVE THE MANAGEMENT OF FEVER, HYPERGLYCAEMIA AND SWALLOWING DYSFUNCTION FOLLOWING ACUTE STROKE

The QASC CRCT of a multifaceted evidence-based intervention for improving the in-patient management of fever, hyperglycaemia and swallowing dysfunction in the first three days following stroke improved outcomes at 90 days by 15.7%. Previous evaluations of multifaceted interventions to improve clinical outcomes have reported only modest improvements in clinical performance (mean 10%); hence, there has been international interest about how change occurs (84, 85). Chapter 5 reported the findings from the candidate's third and final study, a pre-specified quantitative process evaluation designed to assist with the interpretation of the QASC patient outcome results. Retrospective medical record audits were undertaken for prospectively recruited patients admitted to the 19 stroke units participating in the trial. Processes of care data from 1804 patients (718 pre-intervention; 1086 post-intervention) showed that significantly more patients in the intervention group received care according to the fever (n = 186 of 603, 31% v. n = 74 of 483, p = < 0.001), sugar (n = 398 of 603, 66% v. n = 217 of 483, 45%, p = < 0.001), and swallow protocols (n = 288 of 603, 48% v. n = 126 of 483, 26%, p = 0.04). Specifically, significantly more patients from intervention stroke units received four-hourly temperature monitoring (n = 222 of 603, 37% v. n = 90 of 483, 19%, p = < 0.001) and six-hourly glucose monitoring (194 of 603, 32% v. 46

of 483, 9.5%, p = < 0.001) within 72 hours of admission to a stroke unit, and a swallowing screen by a non-speech pathologist (308 of 603, 51% v. 148 of 483, 31%, p = 0.04) within the first 24 hours of admission to hospital. There was no difference between the groups in the treatment of fever with paracetamol (22 of 105, 21% v. 38 of 131, 29%, p = 0.78) or hyperglycaemia with insulin (40 of 100, 40% v. 17 of 57, 30%, p = 0.49). The QASC intervention had a positive effect on behaviour change and specifically better protocol adherence in intervention stroke units when compared with control stroke units; however, monitoring and treatment was less than optimal. Although monitoring practices significantly improved, there was no difference between the groups in the treatment of fever and hyperglycaemia following acute stroke. A higher proportion of protocol adherence would have more definitively explained the success of the QASC intervention. It is possible that improved monitoring may have led to better overall surveillance of deteriorating patients and faster initiation of other treatment not measured as part of the main trial.

6.3.1 Study 3: Implications for Practice

Since the treatment of fever, hyperglycaemia and swallowing dysfunction remained suboptimal following the implementation of the QASC intervention, further investigations to identify barriers to treatment of these care elements in acute stroke patients are required. The QASC intervention had a positive effect on clinician behaviour change and resulted in better protocol adherence in intervention ASUs, which goes some way towards explaining the main QASC trial findings of improved patient 90-day outcomes and, as such, rollout of the intervention in stroke services is warranted. In light of this, working in conjunction with the Agency for Clinical Innovation, the QASC researchers have commenced rollout and evaluation of the QASC intervention

on a larger scale in the 36 stroke services in NSW. Further attention to management of fever, hyperglycaemia and swallowing dysfunction by staff in emergency departments is also warranted to improve outcomes for stroke patients further. As a direct result of the QASC trial and the candidate's doctoral studies, the NSF have incorporated routine fever, hyperglycaemia and swallowing dysfunction indicators into their clinical audit program. The candidate had an integral role in the development process for these indicators. Over time, some measures of sustainability of the success of improved fever, hyperglycaemia and swallow dysfunction management will be possible through the NSF clinical audit process.

6.4 SUMMARY

The three studies presented in this thesis were conducted as part of the QASC trial designed to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. An audit of in-patient management practices for fever, hyperglycaemia and swallowing dysfunction following stroke in NSW stroke units demonstrated a need for urgent behaviour change to promote optimum outcomes for stroke patients. An investigation into factors that may have impeded the successful uptake of the QASC intervention and EBP within NSW stroke units highlighted that, although organisational barriers to change existed, NSW stroke units were ready for a practice change. Findings from the process evaluation found that the QASC multifaceted intervention did significantly change clinician behaviour, but the management of fever, hyperglycaemia and swallowing dysfunction still remained suboptimal. Future studies examining the sustainability of behaviour change interventions are warranted.

REFERENCES

1. Middleton S, McElduff P, Ward J, Grimshaw JM, Dale S, D'Este C, et al. Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. Lancet 2011.

2. Australian Bureau of Statistics. Causes of death 2206. Canberra: ABS; 2008.

3. Senes S. How we manage stroke in Australia. Canberra: Australian Institute of Heath and Welfare; 2006.

4. Hajat C, Hajat S, Sharma P. Effects of poststroke pyrexia on stroke outcome: a meta-analysis of studies in patients. Stroke 2000;31(2):410-414.

5. Capes SE, Hunt D, Malmberg K, Pathak P, Gerstein HC. Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: a systematic overview. Stroke 2001;32(10):2426-2432.

6. Scott JF, Robinson GM, French JM, O'Connell JE, Alberti KGMM, Gray CS. Prevalence of admission hyperglycaemia across clinical subtypes of acute stroke. Lancet 1999;353:376-377.

7. Carnaby G, Hankey GJ, Pizzi J. Behavioural intervention for dysphagia in acute stroke: a randomised controlled trial. Lancet Neurology 2006;5(1):31-37.

8. Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R. Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. Stroke 2005;36(12):2756-2763.

9. National Institute for Health and Clinical Excellence. Diagnosis and initial management of acute stroke and transient ischemic attack (TIA). London: NICE; 2008.

10. Adams H, Adams R, Del Zoppo G, Goldstein LB, Stroke Council of the American Heart Association, American Stroke Association. Guidelines for the early

management of patients with ischemic stroke: 2005 guidelines update a scientific statement from the Stroke Council of the American Heart Association/American Stroke Association. Stroke 2005;36(4):916-923.

11. European Stroke Organisation (ESO) Executive Committee, ESO Writing Committee. Guidelines for management of ischaemic stroke and transient ischaemic attack 2008. Cerebrovascular Diseases 2008;25(5):457-507.

12. Lindsay P, Bayley M, Hellings C, Hill M, Woodbury E, Phillips S. Canadian best practice recommendations for stroke care. CMAJ 2008;179(12):S1-25.

13. National Stroke Foundation. Clinical guidelines for acute stroke management. Melbourne: NSF; 2007.

14. National Stroke Foundation. Clinical guidelines for stroke management 2010. Melbourne: NSF; 2010.

15. Rudd AG, Hoffman A, Irwin P, Lowe D, Pearson MG. Stroke unit care and outcome: results from the 2001 National Sentinel Audit of Stroke (England, Wales, and Northern Ireland). Stroke 2005;36(1):103-106.

16. National Stroke Foundation. National stroke audit acute services clinical audit report 2011. Melbourne: NSF; 2011.

17. Hoffmann T, Lindley R. Stroke care in Australia: why is it still the poor cousin of health care? MJA 2013;198(5):246-247.

18. Runciman W, Hunt T, Hannaford N, Hibbert P, Westbrook J, Coiera E, et al. Care track: assessing the appropriateness of health care delivery in Australia. MJA 2012;197(2):100-105.

19. Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. Health Technology Assessment 2004;8(6):1-72.

20. Sandstrom B, Borglin G, Nilsson R, Willman A. Promoting the implementation of evidence-based practice: a literature review focusing on the role of nursing leadership. World Views on Evidence-Based Nursing 2011;8(4):212-223.

21. Goh S, Richards G. Benchmarking the learning capability of organizations. European Management Journal 1997;15(5):575-583.

22. Rycroft-Malone J, Kitson A, Harvey G, McCormack B, Seers K, Titchen A, et al. Ingredients for change: revisiting a conceptual framework. Quality & Safety in Health Care 2002;11(2):174-180.

23. Armenakis A, Harris S, Mossholder K. Creating readiness for organisational change. Human Relations 1993;46:681-703.

24. Armenakis AA, Bedeian AG. Organizational change: a review of theory and research in the 1990s. Journal of Management 1999;25(3):293-315.

25. Squires J, Estabrooks C, Gustavsson P, Wallin L. Individual determinants of research utilization by nurses: a systematic review update. Implementation Science 2011;6(1):1.

26. Meijers JM, Janssen MA, Cummings GG, Wallin L, Estabrooks CA, YG Halfens R. Assessing the relationships between contextual factors and research utilization in nursing: systematic literature review. Journal of Advanced Nursing 2006;55(5):622-635.

27. Kouzes P, Posner B. The five practices of exemplary leadership. San Francisco, CA: Pfeiffer; 2003.

28. Grant A, Treweek S, Dreischulte T, Foy R, Guthrie B. Process evaluations for cluster-randomised trials of complex interventions: a proposed framework for design and reporting. Trials 2013;14(15):21.

29. National Stroke Foundation. Clinical guidelines for stroke management 2010. Melbourne: NSF; 2010.

30. Middleton S, Levi C, Griffiths R, Grimshaw J, Ward J. Quality in Acute Stroke Care Project: protocol for a clustered randomised control trial to evaluate the management of Fever, Sugar and Swallowing Dysfunction (FeSS) following acute stroke. Internal Medicine Journal 2006;36(2):A1.

31. Grol R, Wensing M, Eccles M. Implementation of changes in practice. In: Improving patient care: the implementation of change in clinical practice. Edinburgh: Elsevier Butterworth-Heinemann; 2005. p. 6-15.

32. Hamilton S, McLaren S, Mulhall A. Assessing organisational readiness for change: use of diagnostic analysis prior to the implementation of a multidisciplinary assessment for acute stroke care. Implementation Science 2007;2(1):21.

33. Grol R, Grimshaw J. Evidence-based implementation of evidence-based medicine. Joint Commission Journal on Quality Improvement 1999;25(10):503-513.

34. Forsetlund L, Bjorndal A, Rashidian A, Jamtvedt G, O'Brien MA, Wolf F, et al. Continuing education meetings and workshops: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews 2009(2):CD003030.

35. Flodgren G, Parmelli E, Doumit G, Gattellari M, O'Brien MA, Grimshaw J, et al. Local opinion leaders: effects on professional practice and health care outcomes. In: Cochrane Database of Systematic Reviews. Chichester, UK: John Wiley & Sons, Ltd; 2007.

36. Oakley A, Strange V, Bonell C, Allen E, Stephenson J, RIPPLE Study Team. Process evaluation in randomised controlled trials of complex interventions. BMJ 2006;332(7538):413-416.

37. Caplan L. Stroke. New York: American Academy of Neurology; 2008.

38. Kaufmann A, Firlik D, Fukui M, Wechsler L, Jungries C, Yonas H. Ischemic core penumbra in human stroke. Stroke 1999;30:93-99.

39. Castillo J, Davalos A, Marrugat J, Noya M. Timing for fever-related brain damage in acute ischemic stroke. Stroke 1998;29(12):2455-2460.

40. Wang Y, Lim LL, Levi C, Heller RF, Fisher J. Influence of admission body temperature on stroke mortality. Stroke; A Journal Of Cerebral Circulation 2000;31(2):404-409.

41. Reith J, Jorgensen HS, Pedersen PM, Nakayama H, Raaschou HO, Jeppesen LL, et al. Body temperature in acute stroke: relation to stroke severity, infarct size, mortality, and outcome. Lancet 1996;347(8999):422-425.

42. National Stroke Foundation. National stroke audit—acute services clinical audit report 2011. Melbourne: NSF; 2011.

43. Gentile NT, Seftchick MW, Huynh T, Kruus LK, Gaughan J. Decreased mortality by normalizing blood glucose after acute ischemic stroke. Academic Emergency Medicine 2006;13(2):174-180.

44. Williams LS, Rotich J, Fineberg N, Espay A, Bruno A, Fineberg S, et al. Effects of admission hyperglycemia on mortality and costs in acute ischemic stroke. Neurology 2002;59(1):67-71.

45. Prasad K, Krishnan P. Fever is associated with doubling of odds of short term mortality in ischemic stroke: an updated meta analysis. Acta Neurologica Scandinavica 2010;122(6):404-408.

46. Greer DM, Funk SE, Reaven NL, Ouzounelli M, Uman GC. Impact of fever on outcome in patients with stroke and neurologic injury: a comprehensive meta-analysis. Stroke 2008;39(11):3029-3035.

47. Saini M, Saqqur M, Kamruzzaman A, Lees K, Shuaib A. Effect of hyperthermia on prognosis after acute ischemic stroke. Stroke 2009;40(9):3051-3059.

48. Den Hertog HM, van der Worp HB, van Gemert HMA, Algra A, Kappelle LJ, van Gijn J, et al. The Paracetamol (Acetaminophen) In Stroke (PAIS) trial: a multicentre, randomised, placebo-controlled, phase III trial. The Lancet Neurology 2009;8(5):434-440.

49. Laird E, Coates V. Systematic review of randomized controlled trials to regulate glycaemia after stroke. Journal of Advanced Nursing 2012;69(2):263-277.

50. Gray CS, Hildreth AJ, Sandercock PA, O'Connell JE, Johnston DE, Cartlidge NE, et al. Glucose-potassium-insulin infusions in the management of post-stroke hyperglycaemia: the UK Glucose Insulin in Stroke Trial (GIST-UK). Lancet Neurology 2007;6(5):397-406.

51. Mann G, Hankey GJ, Cameron D. Swallowing function after stroke: prognosis and prognostic factors at 6 months. Stroke 1999;30(4):744-748.

52. Perry L. Screening swallowing function of patients with acute stroke. Part two: detailed evaluation of the tool used by nurses. Journal of Clinical Nursing 2001;10(4):474-481.

53. Weinhardt J, Hazelett S, Barrett D, Lada R, Enos T, Keleman R. Accuracy of a bedside dysphagia screening: a comparison of registered nurses and speech therapists. Rehabilitation Nursing 2008;33:247-252.

54. Perry L. Screening swallowing function of patients with acute stroke. Part one: identification, implementation and initial evaluation of a screening tool for use by nurses. Journal of Clinical Nursing 2001;10(4):463-473.

55. Jauch EC, Saver JL, Adams JHP, Bruno A, Connors J, Demaerschalk B, et al. Guidelines for the early management of patients with acute ischemic stroke: a guideline

for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2013;44(3):870-947.

56. Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: understanding time lags in translational research. Journal of the Royal Society of Medicine 2011;104(12):510-520.

57. Grimshaw J, Eccles M, Lavis J, Hill S, Squires J. Knowledge translation of research findings. Implementation Science 2012;7(1):50.

58. Grol R, Baker R, Moss F. Quality improvement research: the science of change in health care. London: BMJ Books; 2004.

59. Grol RP, Bosch MC, Hulscher ME, Eccles MP, Wensing M. Planning and studying improvement in patient care: the use of theoretical perspectives. Milbank Quarterly 2007;85(1):93-138.

60. Michie S, Johnston M, Francis J, Hardeman W, Eccles M. From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. Applied Psychology 2008;57(4):660-680.

61. Estabrooks CA, Thompson DS, Lovely JJE, Hofmeyer A. A guide to knowledge translation theory. Journal of Continuing Education in the Health Professions 2006;26(1):25-36.

62. Davies P, Walker A, Grimshaw J. A systematic review of the use of theory in the design of guideline dissemination and implementation strategies. Implementation Science 2010;5:14-19.

63. Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. American Journal of Preventative Medicine 2012;43(3):337-350.

64. Ward V, House A, Hamer S. Developing a framework for transferring knowledge into action: a thematic analysis of the literature. Journal of Health Services Research & Policy 2009;14(3):156-164.

65. Mitton C, Adair CE, McKenzie E, Patten SB, Perry BW. Knowledge transfer and exchange: review and synthesis of the literature. Milbank Quarterly 2007;85(4):729-768.

66. O'Brien MA, Rogers S, Jamtvedt G, Oxman AD, Odgaard-Jensen J, Kristoffersne DT, et al. Educational outreach visits: effects on professional practice and health care outcomes. Cochrane Database Systematic Review 2007(4):CD000409.

67. Flodgren G, Parmelli E, Doumit G, Gattellari M, O'Brien MA, Grimshaw J, et al. Local opinion leaders: effects on professional practice and health care outcomes. Cochrane Database Systematic Review 2011(8):CD000125.

68. Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD. Audit and feedback: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews 2010:CD000259.

69. Shojania K, Jennings A, Mayhew A, Ramsay C, Eccles M, Grimshaw J. The effects of on-screen, point of care computer reminders on processes and outcomes of care. Cochrane Database of Systematic Reviews 2009(3):CD001096.

70. O'Brien Mary A, Rogers S, Jamtvedt G, Oxman Andrew D, Odgaard-Jensen J, Kristoffersen Doris T, et al. Educational outreach visits: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews. Chichester, UK: John Wiley & Sons, Ltd; 2007.

71. Farmer AP, x00E, gar, Turcot L, Grimshaw J, Harvey E, et al. Printed educational materials: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews 2008(3):CD004398.

72. Baker R, Camosso-Stefinovic J, Gillies C. Tailored interventions to overcome identified barriers to change: effects on professional practice and health outcomes. Cochrane Database of Systematic Reviews (Online) 2010(3):CD005470.

73. Group E. Cochrane effective practice and organisation of care group. In; 2012.

74. Gifford W, Davies B, Edwards N, Griffin P, Lybanon V. Managerial leadership for nurses' use of research evidence: an integrative review of the literature. Worldviews on Evidence-Based Nursing 2007;3:126-145.

75. Garvin D. Building a learning organization. Harvard Business Review 1993;July-August:78-91.

76. Nutley S, Davies H. Developing organizational learning in the NHS. Medical Education 2001;35(35-42).

77. Rycroft-Malone J, Harvey G, Seers K, Kitson A, McCormack B. An exploration of the factors that influence the implementation of evidence into practice. Journal of Clinical Nursing 2004;13:913-924.

78. Rashman L, Withers E, Hartley J. Organizational learning and knowledge in public service organizations: a systematic review of the literature. International Journal of Management Review 2009;11(4):463-494.

79. Weiner B, Amick H, Lee S. Conceptualization and measurement of organizational readiness for change: a review of the literature in health services research and other fields. Medical Care Research and Review 2008;65(4):379-436.

80. Weiner B, Lewis M, Linnan L. Using organization theory to understand the determinants of effective implementation of worksite health promotion programs. Health Education Research 2009;24(2):292-305.

81. Weiner B. A theory of organizational readiness for change. Implementation Science. 2009;4(67):doi:10.1186/1748-5908-4-67.

82. Demiris G, Courtney K, Meyer W. Current status and perceived needs of information technology in critical access hospitals: a survey study. Informatics in Primary Care 2007;15(1):45-51.

83. Waterman R, Peters T, Philips J. Structure is not organisation. Business Horizons; 1980;23(3):14-26.

84. Alberts M. ACP Journal Club. Targeting management of fever, hyperglycaemia, and swallowing improved outcomes in acute stroke. Annals of Internal Medicine 2012;156(6):JC3-9.

85. Wolfe C, Rudd A. Improvement of care in acute stroke units. Lancet 2011; 378(9804):1679-1680.

86. Grimshaw J, Eccles M, Tetroe J. Implementing clinical guidelines: current evidence and future implications. Journal of Continuing Education in the Health Professions 2004;24(Suppl 1):S31-S37.

87. Fretheim A, Havelsrud K, Oxman A. Rational Prescribing in Primary Care (RaPP): process evaluation of an intervention to improve prescribing of antihypertensive and cholesterol-lowering drugs. Implementation Science 2006;1(19):doi:10.1186/1748-5908-1-19.

88. Fretheim A, Oxman A, Havelsrud K, Treweek S, Kristoffersen D, Bjorndal A. Rational Prescribing in Primary Care (RaPP): a cluster randomized trial of a tailored intervention. PLoS Medicine 2006;3(6):e134.

89. Nazareth I, Freemantle N, Duggan C, Mason J, Haines A. Evaluation of a complex intervention for changing professional behaviour: the Evidence Based Out Reach (EBOR) Trial. Journal of Health Services Research and Policy. 2002;7(4):230-238.

90. Freemantle N, Eccles M, Wood J, Mason J, Nazareth I, Duggan C, et al. A randomised trial of Evidence Based Outreach (EBOR): rationale and design. Controlled Clinical Trials 1999;20(5):479-492.

91. Cadilhac DA, Lalor EE, Pearce DC, Levi CR, Donnan GA. Access to stroke care units in Australian public hospitals: facts and temporal progress. Internal Medicine Journal 2006;36(11):700-704.

92. Aerden L, Luijckx GJ, Ricci S, Hilton A, Kessels F, Lodder J. Validation of the Oxfordshire Community Stroke Project syndrome diagnosis derived from a standard symptom list in acute stroke. Journal of the Neurological Sciences 2004;220(1-2):55-58.

93. Lindenstrom E, Boysen G, Christiansen L, Hansen B, Nielsen P. Reliability of Scandinavian Neurological Stroke Scale. Cardiovascular Diseases 1991;1(2):103-107.

94. De Haan R, Limburg M, Bossuyt P, Van der Meulen J, Aaronson N. The clinical meaning of Rankin 'handicap' grades after stroke. Stroke 1995;26(11):2027-2030.

95. NSW Health. Policy Directive: Paracetamol use. North Sydney: Department of Health; 2009.

96. Conover WJ. Practical non-parametric statistics. New York: Wiley; 1999.

97. Bamford J, Sandercock P. Classification and natural history of clinically identifiable subtypes of cerebral infarction. Lancet 1991;337(8756):1521-1526.

98. Wang CX, Stroink A, Casto JM, Kattner K. Hyperthermia exacerbates ischaemic brain injury. International Journal of Stroke 2009;4(4):274-284.

99. Azzimondi G, Bassein L, Nonino F, Fiorani L, Vignatelli L, Re G, et al. Fever in acute stroke worsens prognosis. A prospective study. Stroke 1995;26(11):2040-2043.

100. Kammersgaard LP, Jorgensen HS, Rungby JA, Reith J, Nakayama H, Weber UJ, et al. Admission body temperature predicts long-term mortality after acute stroke: the Copenhagen Stroke Study. Stroke 2002;33(7):1759-1762.

101. Dippel DW, van Breda EJ, van der Worp HB, van Gemert HM, Meijer RJ, Kappelle LJ, et al. Effect of paracetamol (acetaminophen) and ibuprofen on body temperature in acute ischemic stroke PISA, a phase II double-blind, randomized, placebo-controlled trial. BMC Cardiovascular Disorders 2003;3(2).

102. Naidech A, Bendok B, Bernstein R, Alberts M, Batjer H, Watts C. Fever burden and functional recovery after subarachnoid hemorrhage. Neurosurgery 2008;63(2):212-218.

103. Phipps MA, Desai R, Wira C, Bravata DM. Epidemiology and outcomes of fever burden among patients with acute ischemic stroke. Stroke 2011;42(12):1-6.

104. Fuentes B, Ortega-Casarrubios MA, SanJose B, Castillo J, Leira R, Serena J, et al. Persistent hyperglycemia >155 mg/dL in acute ischemic stroke patients: how well are we correcting it?: implications for outcome. Stroke 2010;41(10):2362-2365.

105. Heater B, Becker A, Olson R. Nursing interventions and patient outcomes: a meta-analysis of studies. Nursing Research 1988;37(5):303-307.

106. Parahoo K, McCaughan E. Research utilization among medical and surgical nurses: a comparison of their self-reports and perceptions of barriers and facilitators. Journal of Nursing Management 2001;9(1):21-30.

107. Hutchinson A, Johnston L. Beyond the barriers scale: commonly reported barriers to research use. The Journal of Nursing Administration 2006;36(4):189-199.

108. Udod S, Care D. Setting the climate for evidence-based nursing practice: what is the leader's role? Nursing Leadership 2004;17(4):64-75.

109. Burns J. Leadership. New York: Harper & Row; 1978.

110. Wong C, Cummings G. The relationship between nursing leadership and patient outcomes: a systematic review. Journal of Nursing Management 2007;15:508-521.

111. Posner B, Kouzes P. Development and validation of the leadership practices inventory. Educational & Psychologial Measurement 1988;48(2):483-496.

112. Tourangeau A, McGilton K. Measuring leadership practices of nurses using the leadership practices inventory. Nursing Research 2004;53(3):182-189.

113. Tourangeau A, Lemonde M, Dakers D, Alksnis C, Luba M. Evaluation of a leadership development intervention. Canadian Journal of Nursing Leadership 2003;16(3):94-104.

114. Bowles A, Bowles N. A comparative study of transformational leadership in nursing development units and conventional clinical settings. Journal of Nursing Management 2000;8(2):69-76.

115. Chan CCA. Examining the relationships between individual, team and organizational learning in an Australian hospital. Learning in Health and Social Care 2003;2(4):223-235.

116. Goh S. The learning organization: an empirical test of a normative perspective. International Journal of Organization Theory and Behaviour 2001;4(3-4):329-355.

117. McColl A, Smith H, White P, Field J. General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. BMJ 1998;316(7128):361-367.

118. Dover N. Caring for patients in the right place at the right time. Emergency Nurse 2012;20(3):30-36.

119. Rycroft-Malone J, Seers K, Crichton N, Chandler J, Hawkes C, Allen C, et al. A pragmatic cluster randomised trial evaluating three implementation interventions. Implementation Science 2012;7(80).

120. McCloskey D. Nurses' perceptions of research utilization in a corporate health care system. Journal of Nursing Scholarship 2008;40(1):39-45.

121. Thomson O'Brien MA, Jamtvedt G, Kristoffersen DT, Oxman AD. Educational outreach visits: effects on professional practice and health care outcomes. Cochrane Database of Systematic Reviews 2006.

122. Flottorp S, Havelsrud K, Oxman A. Evaluation of a pragmatic trial of interventions to implement guidelines in primary care: why is it so hard to change practice? Family Practice 2003;20:333-339.

123. Martino R, Pron G, Diamant N. Screening for oropharyngeal dysphagia in stroke: insufficient evidence for guidelines. Dysphagia 2000;15(1):19-30.

124. Perry L, Love C. Screening for dysphagia and aspiration in acute stroke: a systematic review. Dysphagia 2001;16(1):7-18.

125. Marchionni C, Ritchie J. Organizational factors that support the implementation of nursing best practice guidelines. Journal of Nursing Management 2008;16:266-274.

126. Kitson A, Rycroft-Malone J, Harvey G, McCormack B, Seers K, Titchen A. Evaluating the successful implementation of evidence into practice using the PARiHS framework: theoretical and practical challenges. Implementation Science 2008;3(1):1.

127. Eccles M, Grimshaw J, Walker A, Johnston M, Pitts N. Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings. Journal of Clinical Epidemiology 2005;58(2):107-112.

128. Rycroft-Malone J. Evidence-informed practice: from individual to context. Journal of Nursing Management 2008;16(4):404-408.

129. Greenhalgh T, Wieringa S. Is it time to drop the 'knowledge transfer' metaphor? Journal of the Royal Socety of Medicine 2011;104(12):501-509.

130. Contandriopoulos D, Lemire M, Denis JL, Tremblay E. Knowledge exchange processes in organisations and policy arenas: a narrative systematic review of the literature. Milbank Quarterly 2010;88(4):444-483.

131. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. Milbank Quarterly 2004;82(4):581-629.

132. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. Lancet 2003;362(9391):1225-1230.

133. Ellard D, Taylor S, Parsons S, Thorogood M. The OPERA trial: a protocol for the process evaluation of a randomised trial of an exercise intervention for older people in residential and nursing accommodation. Trials 2011;12(28).

APPENDICES

APPENDIX A: ETHICS APPROVAL

Australian Catholic University
Brisbane Sydney Canberra Ballarat Melbourne

ACU National

Human Research Ethics Committee

Committee Approval Form

Principal Investigator/Supervisor: Professor Sandy Middleton Nth Sydney Campus
Co-Investigators: Dr Chris Levi, Prof Rhonda Griffiths, Prof Jeremy Grimshaw, Prof Jeanette Ward
Nth Sydney Campus
Student Researcher: Brisbane Campus

Ethics approval has been granted for the following project:
Clustered Randomised Controlled Trial (CRCT) of a multidisciplinary, team building intervention to manage Fever, Sugar and Swallowing (FeSS) in acute stroke

for the period: 27 July 2005 to 31 December 2007

Human Research Ethics Committee (HREC) Register Number: N200405 31

The following standard conditions as stipulated in the *National Statement on Ethical Conduct in Research Involving Humans* (1999) apply:

(i) that Principal Investigators / Supervisors provide, on the form supplied by the Human Research Ethics Committee, annual reports on matters such as:
- security of records
- compliance with approved consent procedures and documentation
- compliance with special conditions, and

(ii) that researchers report to the HREC immediately any matter that might affect the ethical acceptability of the protocol, such as:
- proposed changes to the protocol
- unforeseen circumstances or events
- adverse effects on participants

The HREC will conduct an audit each year of all projects deemed to be of more than minimum risk. There will also be random audits of a sample of projects considered to be of minimum risk on all campuses each year.

Within one month of the conclusion of the project, researchers are required to complete a *Final Report Form* and submit it to the local Research Services Officer.

If the project continues for more than one year, researchers are required to complete an *Annual Progress Report Form* and submit it to the local Research Services Officer within one month of the anniversary date of the ethics approval.

Signed: K Paoletty Date: 25/7/05
(Research Services Officer, McAuley Campus)

(Committee Approval.dot @ 15/10/04) Page 1 of 1

APPENDIX B

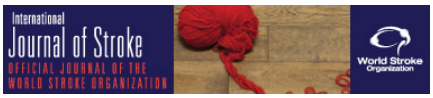
LIST OF PAPERS PUBLISHED/SUBMITTED FOR PUBLICATION ARISING FROM THE RESEARCH PROGRAMME

PAPER 1

Drury P, Levi C, McInnes L, Hardy J, Ward J, Grimshaw J, De'Este C, Dale S, McElduff P, Cheung W, Quinn C, Griffiths R, Evans M, Cadhilac D, Middleton S. Management of fever, hyperglycaemia and swallowing dysfunction following hospital admission for acute stroke in New South Wales, Australia. *International Journal of Stroke.* **Published January 2014 (Vol 9, pg 23-31)**.

PAPER 1 ACCEPTED FOR PUBLICATION:

INTERNATIONAL JOURNAL OF STROKE



05-Aug-2013

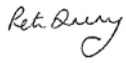
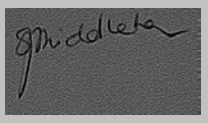
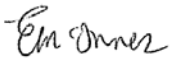
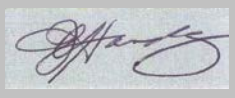
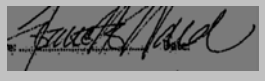
Dear Dr Middleton:

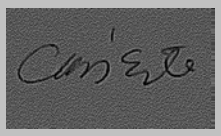
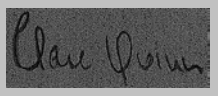
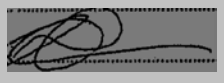
It is a pleasure to accept your manuscript entitled "Management of fever, hyperglycaemia and swallowing dysfunction following acute stroke admission in New South Wales (NSW) Australia: The Quality in Acute Stroke Care (QASC) Trial" in its current form for publication in the International Journal of Stroke. If there are any further comments from the reviewers they will be included at the foot of this letter.

Thank you for your fine contribution. On behalf of the Editors of the International Journal of Stroke, we look forward to your continued contributions to the Journal.

Warm regards
Geoffrey Donnan
Editor-in-Chief
International Journal of Stroke

Declaration of Contribution Study 1: Management of fever, hyperglycaemia and swallowing dysfunction following acute stroke admission in New South Wales (NSW) Australia: The Quality in Acute Stroke Care (QASC) Trial

Authors	Actual Contribution	Estimated Contribution (%)	Author's Signature
Peta Drury (PhD Candidate)	Designed data collection tool Data collection Data analysis Wrote first manuscript draft Wrote all subsequent drafts	53	
Sandy Middleton	Chief investigator of QASC trial Conceived, designed and obtained funding Supervised the study Manuscript revision	20	
Elizabeth McInnes	Supervised the study Manuscript revision	5	
Jennifer Hardy	Supervised the study Manuscript revision	5	
Chris Levi	Helped conceive, design and obtain funding for the study Manuscript revision	5	
Jeanette Ward	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Jeremy Grimshaw	Helped conceive, design and obtain funding for the study Manuscript revision	1	

Catherine De'Este	Helped conceive, design and obtain funding for the study Assisted with data interpretation Manuscript revision	2	
Simeon Dale	Co-ordinated patient recruitment	2	
Patrick McElduff	Assisted with data interpretation Manuscript revision	1	
Wah Cheung	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Clare Quinn	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Rhonda Griffiths	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Malcolm Evans	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Dominique Cadhilac	Helped conceive, design and obtain funding for the study Manuscript revision	1	

PAPER 2

Drury P, McInnes L Hardy J, Dale S, Middleton S. Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey. Submitted to: *International Journal of Nursing Practice*, October 2013.

PAPER 2 CONFIRMATION OF SUBMISSION:

INTERNATIONAL JOURNAL OF NURSING PRACTICE

From: ijn.eo@wiley.com

To: peta.drury@acu.edu.au

CC:

Subject: International Journal of Nursing Practice - IJNP-2013-00465

Body: Dear Ms. Peta Drury,

The manuscript entitled Stroke unit Nurse Managers' views of individual and organisational factors liable to influence evidence-based practice: a survey, for which you are listed as a contributing author, has been received by the International Journal of Nursing Practice Editorial Office and is presently being given full consideration for publication.

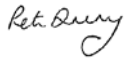
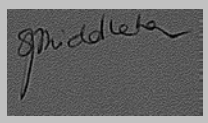
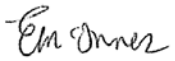
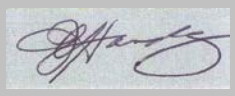
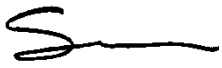
The corresponding author will receive all future communication via email but should you wish to keep track of the status of your manuscript please log on to your Author Centre at http://mc.manuscriptcentral.com/ijnp.

Please remember that you will need to quote your manuscript number in all future correspondence.

Sincerely,
Editorial Assistant
International Journal of Nursing Practice

Date Sent: 27-Oct-2013

Declaration of Contribution Study 2: Nurse Manager's Perceptions of Individual and Organisational Traits Influencing Evidence-based Practice Following Acute Stroke: A Survey

Authors	Actual Contribution	Estimated Contribution (%)	Author's Signature
Peta Drury (PhD Candidate)	Designed data collection tool Data collection Data analysis Wrote first manuscript draft Wrote all subsequent drafts	55	
Sandy Middleton	Chief investigator of QASC trial Conceived, designed and obtained funding Supervised the study Manuscript revision	20	
Elizabeth McInnes	Supervised the study Manuscript revision	15	
Jennifer Hardy	Supervised the study Manuscript revision	8	
Simeon Dale	Co-ordinated stroke unit recruitment	2	

PAPER 3

Drury, P, Levi C, D'Este C, McElduff P, McInnes E, Hardy J, Dale S, Cheung N W, Grimshaw J, Quinn C, Ward J, Evans M, Cadilhac D, Griffiths R, Middleton S. Quality in Acute Stroke Care (QASC): Process evaluation of an intervention to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke. *International Journal of Stroke.* **In press, accepted August 2013.**

PAPER 3 CONFIRMATION OF ACCEPTANCE:

INTERNATIONAL JOURNAL OF STROKE

25-Aug-2013

Dear Ms Drury:

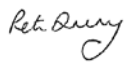
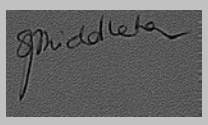
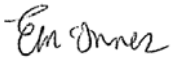
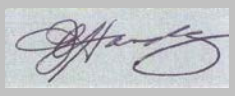
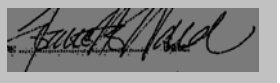
It is a pleasure to accept your manuscript entitled "Quality in Acute Stroke Care (QASC): Process evaluation of an intervention to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke" in its current form for publication in the International Journal of Stroke. If there are any further comments from the reviewers they will be included at the foot of this letter.

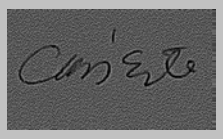
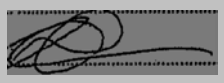
Thank you for your fine contribution. On behalf of the Editors of the International Journal of Stroke, we look forward to your continued contributions.

Ms Carmen Lahiff-Jenkins
International Journal of Stroke

Reviewer(s)' Comments to Author:
Reviewer: 1
Comments to the Author
This is an exceptionally well written paper that provides further detail about the original trial published in Lancet. The authors provide a good deal of data, and these data are well organized on tables for the reader. I see no need for any revisions to the manuscript.

Declaration of Contribution Study 3: Quality in Acute Stroke Care (QASC): Process evaluation of an intervention to improve the management of fever, hyperglycaemia and swallowing dysfunction following acute stroke

Authors	Actual Contribution	Estimated Contribution (%)	Author's Signature
Peta Drury (PhD Candidate)	Designed data collection tool Data collection Data analysis Wrote first manuscript draft Wrote all subsequent drafts	53	
Sandy Middleton	Chief investigator of QASC trial Conceived, designed and obtained funding Supervised the study Manuscript revision	20	
Elizabeth McInnes	Supervised the study Manuscript revision	5	
Jennifer Hardy	Supervised the study Manuscript revision	5	
Chris Levi	Helped conceive, design and obtain funding for the study Manuscript revision	5	
Jeanette Ward	Helped conceive, design and obtain funding for the study Manuscript revision	1	

Jeremy Grimshaw	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Catherine De'Este	Helped conceive, design and obtain funding for the study Assisted with data interpretation Manuscript revision	2	
Simeon Dale	Co-ordinated patient recruitment	2	
Patrick McElduff	Assisted with data interpretation Manuscript revision	1	
Wah Cheung	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Clare Quinn	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Rhonda Griffiths	Helped conceive, design and obtain funding for the study Manuscript revision	1	
Malcolm Evans	Helped conceive, design, and obtain funding for the study Manuscript revision	1	
Dominique Cadhilac	Helped conceive, design and obtain funding for the study Manuscript revision	1	

APPENDIX C

LIST OF REFEREED ABSTRACTS AND CONFERENCE PRESENTATIONS ARISING FROM THE RESEARCH PROGRAMME

Refereed Abstracts

Drury P, McInnes L, Hardy J, Dale S. Organisational influences on evidence-based practice within New South Wales acute stroke units. International Journal of Stroke 2013;8(S2):14.

Drury, P. Middleton S, McInnes L, Dale S, Hardy J. Nurse Unit Managers' views of organizational barriers and enablers within NSW stroke units liable to influence evidence based practice. International Journal of Stroke 2013; 8(S1): 25

Middleton S, **Drury P**, Levi C, D'Este C, McElduff P, Dale S, Evans M, Quinn C, Cadilhac DA, Wah Cheung N. What processes of clinical care are associated with 90-day survival and independence? Results from the Quality in Acute Stroke Care QASC Trial. International Journal of Stroke 2012;7(S1):25.

Drury P, Quinn C, McInnes E, Hardy J, Dale S, Middleton S. Implementation of an evidence-based treatment protocol to manage dysphagia in acute stroke: QASC, a cluster randomised controlled trial. International Journal of Stroke 2012;7(S1):25.

Middleton S, **Drury P**, Levi C, D'Este C, McElduff P, Dale S, Griffiths R, Grimshaw J, Ward J, Evans M, Quinn C, Cadilhac D, Cheung NW. The Quality in Acute Stroke Care

(QASC) Trial: Processes of care associated with 90-day survival and independence. Cerebrovascular Diseases 2012;33(S2):130.

Drury P, Levi C, D'Este C, Dale S, Griffiths R, Grimshaw J, Ward J, Evans M, Quinn C, Cadilhac D, Cheung W, McElduff P, McInnes E, Hardy J, Middleton S. The QASC Cluster Randomised Controlled trial of an intervention to improve management of fever, hyperglycaemia and swallowing dysfunction in acute stroke: Did clinician behaviour change? Cerebrovascular Diseases 2011;31(S2)

Drury P, Levi C, Griffiths R, Ward J, Grimshaw J, D'Este C, Cheung W, McElduff P, Hardy J, McInnes E, Middleton S. Routine practices for fever, hyperglycaemia and dysphagia management in NSW acute stroke units. International Journal of Stroke 2010;5(S1):26

Conference Papers Arising from the Research Programme

Drury P, McInnes L, Hardy J, Dale S. Organisational influences on evidence-based practice within New South Wales acute stroke units. Smart Strokes 2013, 9th Australasian Nursing and Allied Health Stroke Conference. Brisbane, QLD, Australia. 22-23 August 2013.

Drury, P. Middleton S, McInnes L, Dale S, Hardy J. Nurse Unit Managers' views of organisational barriers and enablers within NSW stroke units liable to influence evidence based practice. 24th Annual Scientific Meeting of the Stroke Society of Australasia. Darwin, NT, Australia. July 31st-Aug 2nd, 2013.

Middleton S, **Drury P**, Levi C, D'Este C, McElduff P, Dale S, Griffiths R, Grimshaw J, Ward J, Evans M, Quinn C, Cadilhac D, Cheung W. Improving the quality of care through knowledge translation: The QASC trial. Knowledge Utilisation Colloquium 2012. Melbourne, Australia. 16–17 October 2012.

Middleton S, **Drury P**, McElduff P, Ward J, Grimshaw J, Dale S, D'Este C, Griffiths R, Cheung NW, Hardy J, McInnes E, Levi C,. Doing the simple things well: Good nursing care reduces death and dependency. Honor Society of Nursing, Sigma Theta Tau International 23rd International Nursing Research Congress. Brisbane, Australia. 30 July–3 August 2012.

Middleton S, **Drury P**, Levi C, McElduff P, Grimshaw J, Ward J, D'Este C, Dale S, McInnes E, Hardy J, Griffiths R, Cheung NW, Quinn C, Cadilhac D, Evans M. The Quality in Acute Stroke Care (QASC) trial: A fever, hyperglycaemia and swallowing intervention improved patient outcomes but what was its effect on monitoring and treatment practices? International Stroke Conference. Late-Breaking Science Abstract Poster Session at the conference [Poster]. New Orleans, USA. 1–3 February 2012.

Middleton S, Levi C, D'Este C, **Drury P**, Dale S, Griffiths R, Grimshaw J, Ward J, Evans M, Quinn C, Cadilhac D, Cheung NW, McElduff P. Fever, hyperglycaemia and dysphagia management in acute stroke: Final results of the Quality in Acute Stroke Care (QASC) trial. Stroke Society of Australasia Annual Scientific Meeting 2011. Adelaide, Australia. September 2011.

Drury P, Middleton S, McElduff P, Levi C, D'Este, Grimshaw J, McInnes E, Hardy J, Dale S, Cheung W, Griffiths R, Ward J. The QASC cluster randomised controlled trial of an intervention to improve management of fever, hyperglycaemia and swallowing dysfunction in acute stroke: Did clinician behaviour change? Smart Strokes 2011, 7th Australasian Nursing and Allied Health Stroke Conference. P. 78–79. Surfers Paradise, QLD, Australia. 4–5 August 2011.

Drury P, Levi C, D'Este C, Dale S, Griffiths R, Grimshaw J, Ward J, Evans M, Quinn C, Cadilhac D, Cheung NW, McElduff P, McInnes E, Hardy J, Middleton S. The QASC cluster randomised controlled trial of an intervention to improve management of fever, hyperglycaemia and swallowing dysfunction in acute stroke: Did clinician behaviour change? European Stroke Conference. Hamburg, Germany. 24–27 May 2011.

Drury P, Levi C, Griffiths R, Ward J, Grimshaw J, D'Este C, Cheung W, McElduff P, Hardy J, McInnes E, Middleton S. Routine practices for fever, hyperglycaemia and dysphagia management in NSW acute stroke units. Stroke Society of Australasia 21st Annual Scientific Meeting. Melbourne, Australia. 1–3 September 2010.

APPENDIX D: QASC TRIAL FEVER INTERVENTION

The fever intervention consists of monitoring of patients temperature and the prompt treatment of a temperature $\geq$ 37.5 °C in the first 72 hours using the fever algorithm attached.

Implication for practice

- All patients admitted to the ASU to have a standing order written for paracetamol 1 gram PRN or that paracetamol be included in the nurse-initiated medications list.

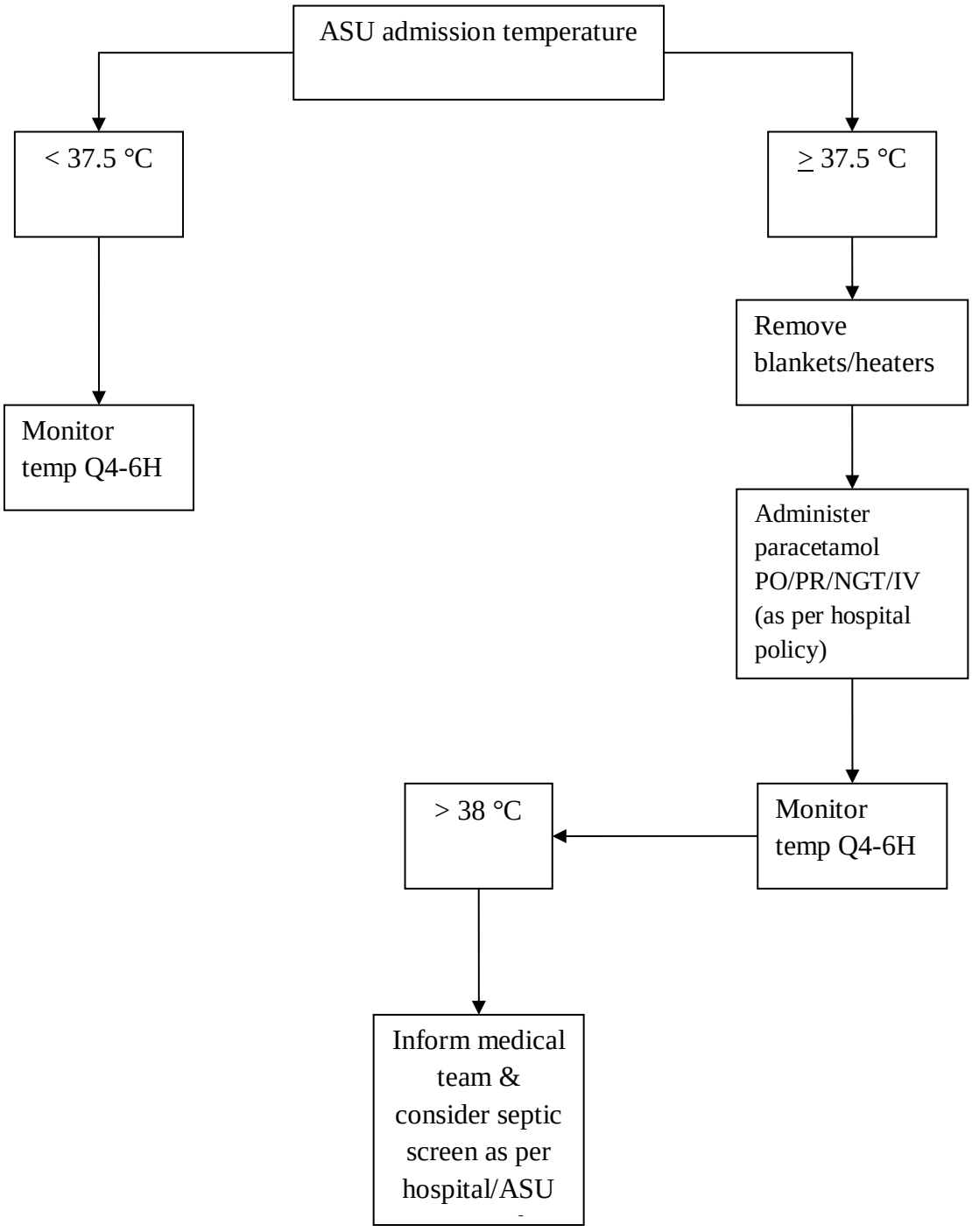
FEVER INTERVENTION ALGORITHM

Target temperature: ≤ 37.5 °C

- Record base line temperature on admission and for the first 72 hours following admission
- Monitor & record every four hours (or according to ASU policy)
- If temperature ≥ 37.5 °C, remove blankets and any heaters etc
- Administer oral paracetamol 1 gram then reassess
- If patient nil by mouth administer paracetamol 1 gram via NGT, PR or IV (according to hospital policy) then reassess
- If temperature > 38 °C:
    - Inform medical team
    - Consider septic workup (as per hospital/unit policy)
        - MSU
        - Blood cultures
        - Chest X-ray
- Continue to monitor temperature four hourly

Note: Patient's clinical condition should always be taken into consideration

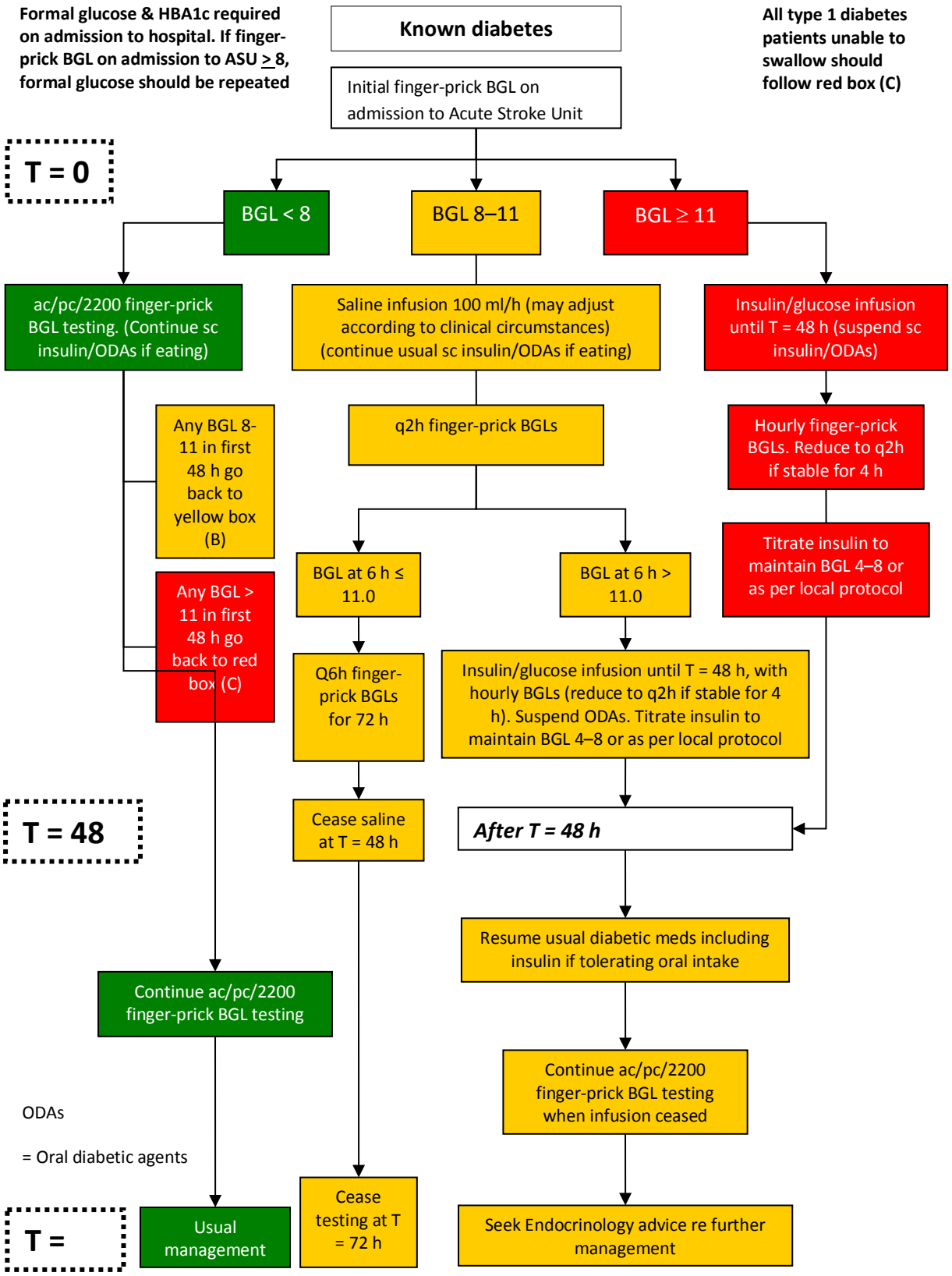
FEVER INTERVENTION ALGORITHM



Note: Patient's clinical condition should always be taken into consideration

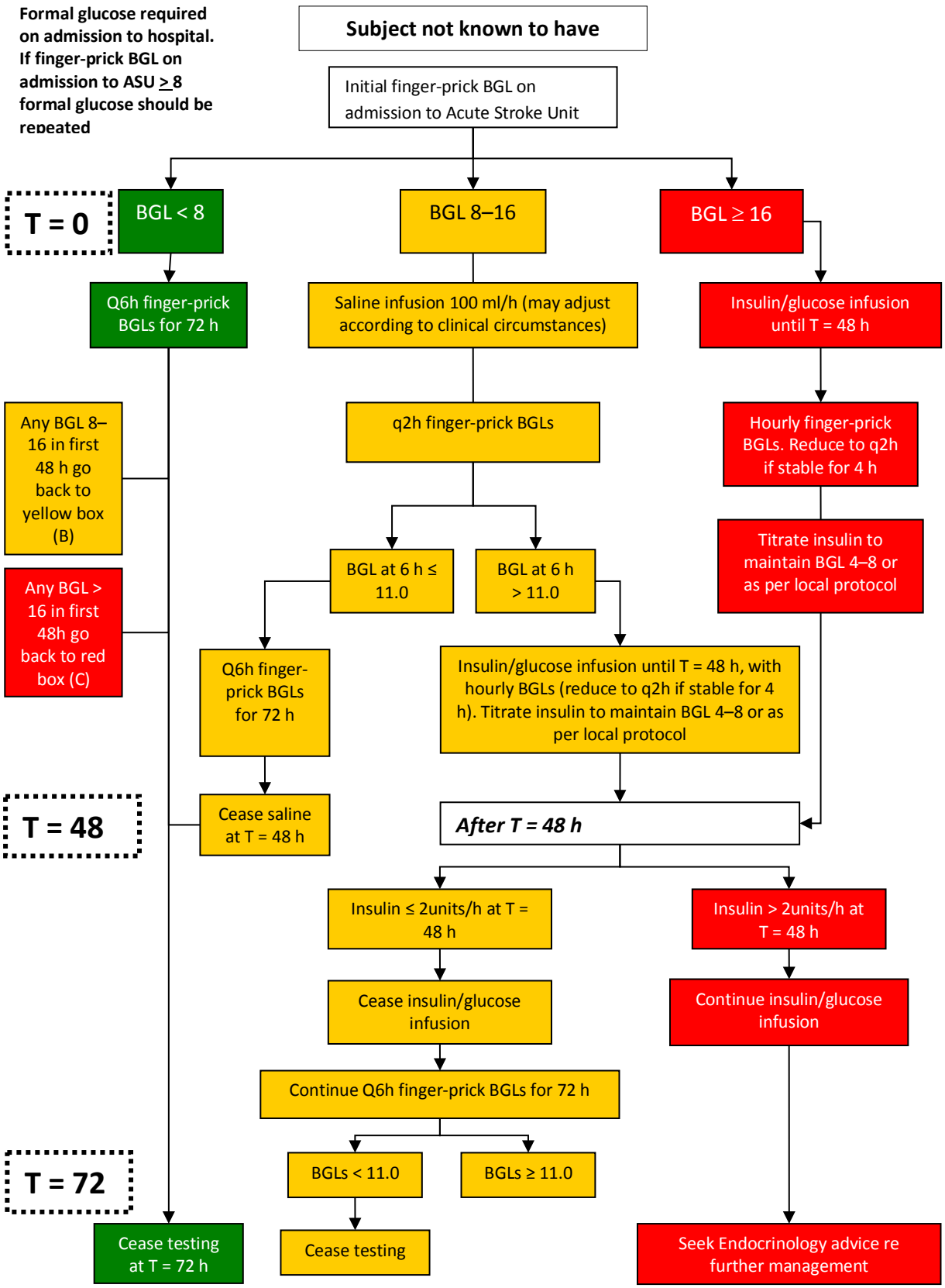
APPENDIX E: QASC TRIAL HYPERGLYCAEMIA INTERVENTION

(Relevant to patients with a history of diabetes)



APPENDIX F: QASC TRIAL HYPERGLYCAEMIA INTERVENTION

(Relevant to patients with no known history of diabetes)



APPENDIX G: QASC TRIAL SWALLOW INTERVENTION

Nurses will undergo education and assessment of competency to enable them to screen patients for swallowing difficulties. The intervention consists of an in-service education package including a PowerPoint presentation, an assessment of knowledge tool, a clinical competencies tool and a written test.

Implications for practice

- Identified nurses will attend an education session. To be considered competent at swallowing screening, nurses must successfully screen three patients using competencies provided and pass a written test.
- Patients should be screened before being given food or drink.
- Patients should be screened within 24 h of admission.
- Patients who fail the swallowing screening should be referred to a speech pathologist.

APPENDIX H: MEDICAL RECORD PRE- AND POST-INTERVENTION AUDIT TOOL AND DATA DICTIONARY

Demographics	
MRN	
Hospital	
Patient Sex	M ❒ F ❒
SSS	Not Documented ❒
OCSP	Not Documented ❒
Modified Rankin Score (mRs)	Date attended _____ Score_____ Date attended _____ Score_____ Date attended _____ Score_____ Not Documented ❒
Hospital Admission Date	
ED Admission Time (24 hour clock)	

Hospital Discharge Date	
Acute Stroke Unit Admission Date	
Acute Stroke Unit Admission Time (24 hour clock)	
Was the patient admitted to the ASU from the ED?	Y ❒ N ❒ ↓ Where was the patient transferred from? _____
Did the patient die during hospital admission?	Y ❒ N ❒ ↓ Date _____

DYSPHAGIA MANAGEMENT

Swallow Screen: Emergency Department					
Documented as attended?	Date attended	Time attended (24 hour clock)	Performed by whom?	Done within 24 hours of admission to hospital	Result
Yes ❒ No ❒ Alertness ❒ CN ❒ Sip test ❒			RN ❒ SP ❒ MO ❒ EEN ❒ Other ❒ _____ Unable to tell ❒	Yes ❒ No ❒ Unsure ❒	Fail❒ Pass ❒ ↓ NBM→ Y❒ N ❒ ↓ SP referral documented Y ❒ N ❒

Swallow Screen: ASU				
Documented as attended?	Date attended	Time attended (24 hour clock)	Performed by whom?	Result
Yes ❒ No ❒			RN ❒ SP ❒ MO ❒ EEN ❒ Other ❒ _____ Unable to tell ❒	Fail❒ Pass ❒ ↓ NBM → Y❒ N ❒ ↓ SP referral documented Y ❒ N ❒

How many times did a nurse attend a swallow screen on the patient while in the ASU? _____

Was the patient given food or drink prior to the first swallow screen? Y ❒ N ❒

Was the patient given oral medications prior to the first swallow screen? Y ❒ N ❒

Swallow Assessment			
Documented as attended?	Date attended	Time attended (24 hour clock)	Result
Yes ❒ No ❒			Fail ❒ Pass ❒

Aspiration Pneumonia	
Documented	Yes ❒ No ❒

HYPERGLYCEMIA MANAGEMENT

History	
Diagnosed Diabetic	Yes ❒ No ❒ ↓ (Type 1) IDDM ❒ or (Type 2) NIDDM ❒

Formal Venous Blood Glucose					
Documented as attended	Date taken	Time blood taken	Time received by Pathology Department	Taken in?	Result (mmol/L)
Yes ❒ No ❒				ED ❒ ASU ❒ Not documented ❒	

HbA1c					
Documented as attended	Date taken	Time blood taken	Time received by Pathology Department	Taken in?	Result
Yes ❒ No ❒				ED ❒ ASU ❒ Not documented ❒	

** FP = finger prick*

BGLs								
FP Date	FP Time	FP Reading	NS Commenced(Y/N)	Time NS Commenced	Insulin given (Y/N)	Insulin mode of delivery SCI or IVI	Time insulin infusion commenced or time injection given	Time insulin infusion ceased

Nil Attended ❒

Temperature Management

Temperature				
Date	Time	Reading	Paracetamol given if temp > 37.5 °C (Y/N)	Time paracetamol administered

Temperature	
Was the patient's temperature taken every 6 hours or more while in the ASU?	Y ❒ N ❒

SYMPTOM ONSET

Date symptoms presented	**Time of symptom onset**	**Did the patient present to the ED < 2.5 hours of symptom onset?**
Not documented ❒	Not documented ❒	Y ❒ N ❒ Not documented ❒

Was the patient on anticoagulation therapy? Y ❒ N ❒

↓

Drug _____

Auditors Comments

_____

_____

Date audit attended _____

Audit completed by _____

Signature _____

Contact details _____

QASC Data Dictionary

The QASC Data Dictionary is comprised of definitions and instructions for data collection using the QASC medical record audit data sheet. Standard definitions and rules are of fundamental importance to data quality and integrity and should be used by all people involved in collecting data. This ensures standardisation of data and allows for comparison of results.

What does the dictionary cover?

The definitions in the dictionary cover the variables that have been included in the FeSS Medical Record Audit Tool. The data dictionary explains each item using some or all of the categories below.

Definition	Gives a brief explanation of the data item
Format	The format of the data item i.e. (dd/mm/yyyy)
Help Notes	Provides guidance for those entering and interpreting the data
Further Information	Shows any further information on the data item. May include context, rationale and/or additional references or links to relevant documents

Adapted with permission from Australian Stroke Clinical Registry (AuSCR) Data Dictionary

Section 1: Patient Details

Hospital Medical Record Number (MRN)

Definition	Person identifier unique within establishment or agency assigned by the establishment or agency. Also known as Unit Number or Patient Record Number.
Format	Alpha numeric code, maximum character length varies. Should be written in the top right hand box on each page.

Gender

Definition	The gender the patient has identified on admission. Also known as Sex.
Format	Tick Male or Female or other.

Section 2: Hospital Details

Hospital Name

Definition	The title by which a hospital is known or called.
Format	Data item is free text.

Hospital Admission Date

Definition	Date of arrival to the Hospital.
Format	Data recorded as DD/MM/YYYY format.

Hospital Admission Time

Definition	Time of arrival to the Hospital.
Format	Data recorded as 24-hour format.

Acute Stroke Unit (ASU) Name

Definition	The location of the patient at the time of the audit.
Format	Data item is free text.

ASU Admission Date

Definition	Date of arrival to the Stroke Unit.
Format	Data recorded as DD/MM/YYYY format.

ASU Admission Time

Definition	Time of arrival to the Stroke Unit.
Format	Data recorded as 24-hour format.

Section 3: Clinical information

Type of Stroke

Definition	The clinical diagnosis of stroke type documented by a medical practitioner.
Format	Tick one category only. If the type of stroke has not been documented, the 'Not Documented' box should be ticked.

Stroke Classification

Definition	The stroke classification should be documented using the Oxfordshire Community Stroke Project classification (OCSP).
Format	Tick one category only. If the classification of the stroke has not been documented, the 'Not Documented' field should be ticked, or Tick Not applicable (NA) if the patient had a TIA.
Further Information	The Oxfordshire Community Stroke Project classification (OCSP, also known as the Bamford or Oxford classification) (Bamford & Sandercock, 1991).

Stroke Severity

Definition	A stroke severity score should be documented using the National Institutes of Health Stroke Scale (NIHSS) Scale.
Format	Data item is free text. If the severity of the stroke has not been documented, the 'Not Documented' field should be ticked.
Further Information	National Institutes of Health Stroke Scale (Goldstein et al., 1989).

If diagnosed with an ischaemic stroke, did they receive thrombolysis?

Definition	For those patients who suffered an ischaemic stroke, there should be documented evidence that intravenous thrombolysis was prescribed and recorded as administered on the patient's medication chart.
Format	Tick Yes, No, or Tick NA if the patient did not have an ischaemic stroke.

Section 4: Past Medical History

Diagnosed with known diabetes

Definition	For those patients who have previously been diagnosed with diabetes, there should be documented evidence in the admission notes.
Format	Tick Yes or No.

If diagnosed with known diabetes, were they Type 1 or Type 2?

Definition	For those patients who have previously been diagnosed with diabetes there should be documented evidence in the medical notes to say whether they were a Type 1 or Type 2 diabetic.
Format	Tick Type 1 or Type 2 diabetes, or If type not documented tick Not Documented box, or Tick NA box if patient not diagnosed with diabetes.

Section 5: Temperature Management

Was the patient's temperature monitored 4–6 hourly for the first 72 hours of ASU admission?

Definition	Patients should have their temperature recorded at least once every 4 to 6 hours for the first 72 hours following ASU admission.
Format	Tick Yes, No, or Tick chart missing if temperature chart is missing from the medical records.
Help Notes	A temperature reading must be documented at least every six hours on the observation chart to meet this criterion.
Further Information	NSF guideline recommendation 4.7 Physiological Monitoring*: Patients should have their temperature ... monitored and documented regularly during the acute phase* (National Stroke Foundation, 2010, p. 13).

Did the patient have a fever (temperature ≥ 37.5 °C) at any time in the first 72 hours of ASU admission?

Definition	All temperature readings 37.5 °C or greater should be documented on the patient's observation chart.
Format	Tick Yes, No, or Tick chart missing if temperature chart is missing from the medical records.

If the patient had a temperature/s ≥ 37.5 °C was paracetamol (anti-pyretic) given for the first high temperature documented?

Definition	For those patients who have a temperature recorded as 37.5 °C or greater, paracetamol should be administered within 1 hour of the documented time of the first febrile event.
Format	Tick Yes, No, or Tick NA if no temperature of 37.5 °C or greater recorded, or Tick chart missing if temperature chart is missing from the medical record.

Help Notes	Paracetamol administration may be documented on the medication chart, either in the PRN section or in the regular medication section.
Further Information	NSF Guideline recommendation 4.11 Pyrexia: *Antipyretic therapy, comprising regular paracetamol and/or physical cooling measures, should be used routinely where fever occurs* (National Stroke Foundation, 2010, p. 13).

If the patient had multiple episodes of fever over the first 72 hours of ASU admission, were all the eligible episodes of fever treated with paracetamol?

Definition	All eligible episodes of fever (temperature 37.5 ℃ or greater) should be treated with paracetamol. Non-eligible febrile event: A febrile event (temperature 37.5 ℃ or greater) that occurs within 4 hours of a prior febrile event (temperature 37.5 ℃ or greater) that has already been treated with paracetamol.
Format	Tick Yes, No, or Tick NA if no temperature of 37.5 ℃ or greater recorded, or Tick chart missing if temperature chart is missing from the medical record.
Further Information	NSF Guideline recommendation 4.11 Pyrexia: *Antipyretic therapy, comprising regular paracetamol and/or physical cooling measures, should be used routinely where fever occurs* (National Stroke Foundation, 2010, p. 13).

Section 6: Hyperglycaemic Management

Did the patient have a formal venous blood glucose sample taken on admission to the hospital?

Definition	All patients should have a venous blood sample taken on admission to the hospital. This blood sample will be sent to pathology for analysis.
Format	Tick Yes or No.
Help Notes	Blood results may be recorded electronically. A venous blood sample may be taken in the ED or on Day 1 in the ASU.

If the patient had a formal venous blood glucose sample taken, where was it taken?

Definition	The location of the patient when the venous blood glucose sample was taken.
Format	Tick Emergency Department (ED), Acute Stroke Unit (ASU), other, or Tick Not documented if the location of the formal venous blood glucose test is unable to be established, or Tick NA if no venous blood glucose sample was taken.

If the patient had a formal venous blood glucose sample taken, what was the result?

Definition	The result of a formal venous blood glucose test should be available via the internal hospital pathology computer network.
Format	Data item is free text (__ __mmols/L). Tick Not documented if sample taken but no result documented, or Tick NA if no venous blood glucose sample was taken.

Did the patient have a finger-prick blood glucose level done on admission to the ASU?

Definition	A nurse should do a finger-prick blood glucose test within first 2 hours of admission to the ASU.
Format	Tick Yes, No, or Tick chart missing if blood glucose chart is missing from the medical record.
Further Information	NSF guideline recommendation: 4.7 Physiological monitoring: *Patients should have their glucose levels monitored and documented regularly during the acute phase* (National Stroke Foundation, 2010, p. 13).

If the patient had a finger-prick blood glucose on admission to the ASU, what was the result?

Definition	A nurse should document the result of a finger-prick blood glucose test in the patient's medical records or on the medication chart.
Format	Data item is free text (__ __mmols/L). Tick NA if no finger-prick blood glucose documented on admission, or Tick chart missing if blood glucose chart is missing from the medical record.
Further Information	NSF guideline recommendation: 4.7 Physiological monitoring: *Patients should have their glucose levels monitored and documented regularly during the acute phase* (National Stroke Foundation, 2010, p. 13).

If the patient had a finger-prick blood glucose taken on admission to the ASU and it was ≤ 10 mmol/L, was his or her blood glucose levels monitored, before and after meals, and at bedtime, during the first 72 hours of ASU admission?

Definition	Finger-prick blood glucose levels should be monitored over the first 72 hours following admission to the stroke unit. This includes before and after meals, and at bedtime.
Format	Tick Yes, No, or Tick NA if no finger-prick blood glucose documented, or Tick NA if BGL greater than 10 mmols/L, or Tick chart missing if blood glucose chart is missing from the medical record.
Help Notes	To meet this criterion, patient must have had his or her blood glucose levels taken at **ALL** possible times, not just some of the time.

Were all finger-prick blood glucose level > 10 mmol\L in the first 48 hours treated with insulin?

Definition	Insulin should be administered for any blood glucose level greater than 10 mmol/L in the first 48 hours of admission to the ASU.
Format	Tick Yes, No, or Tick NA if no finger-prick blood glucose greater than 10 mmol/L was documented at any time during the first 48 hours following admission to the ASU, or Tick chart missing if blood glucose chart is missing from the medical record.

Mode of insulin administration?

Definition	If insulin is administered, the mode of delivery should also be documented in the patient's medical records or medication chart.
Format	Tick either subcutaneous injection (SCI) or intravenous injection (IVI), or Tick NA if no finger-prick blood glucose greater than 10 mmol/L documented at any time during the first 48 hours following

	admission to the ASU, or Tick chart missing if blood glucose chart is missing from the medical record.

If the patient had a glucose level > 10 mmol/L and was commenced on an insulin infusion, were finger-prick blood glucose levels monitored at least 2nd hourly while on the insulin infusion?

Definition	A patient commenced on an insulin infusion should have 2nd hourly finger-prick blood glucose levels documented in the medical notes or medication chart.
Format	Tick Yes, No, or Tick NA if the patient did not have a finger-prick BGL greater than 10 mmol/L at any time during the first 48 hours following admission to the ASU, or Tick NA if patient did have a finger-prick BGL greater than 10 mmol/L but was not commenced on an insulin infusion, or Tick chart missing if blood glucose chart is missing from the medical record.
Help Notes	To meet this criterion, a patient must have had his or her blood glucose levels taken at least 2nd hourly consistently while insulin infusion was being administered.

Section 7: Dysphagia Management

Did the patient receive a swallowing screen within the first 24 hours of being admitted to the hospital?

Definition	All patients should have a swallowing screen or a speech pathologist assessment for dysphagia, within the first 24 hours of being admitted **to the hospital** and before being given any oral intake including food, fluids or medications. *NB: A Swallowing Screen may be conducted by a non-speech pathologist, i.e. a doctor or a nurse. To meet the criteria for a successful swallowing screen, all three of the following must be attended: level of alertness, cranial nerve assessment and a sip test. Documentation in the medical records that 'swallowing screen attended' also is acceptable as is presence in the medical records of a completed swallowing screening tool (i.e. ASSIST).*
Format	Tick Yes or No if a swallowing screen was undertaken by a non-speech pathologist.
Help Notes	This is a **swallowing screen** by a non-speech pathologist, not a speech pathology assessment. Free text that states 'gag intact', 'gag tested' or 'sip test attended' (without the other components) does not constitute a swallow screen. Check emergency department records.
Further Information	NSF guideline recommendation 6.2.1 Dysphagia: *Patients should be screened as soon as possible, but at least within 24 hours of admission* (National Stroke Foundation, 2010. p. 17).

Did the patient receive an SP assessment within the first 24 hours of being admitted to the hospital?

Definition	All patients should have a swallowing screen or a speech pathologist assessment for dysphagia, within the first 24 hours of being admitted **to the hospital** and, before being given any oral intake including food, fluids or medications. *A Swallowing Assessment may only be conducted by a speech pathologist.*
Format	Tick Yes or No if a speech pathology assessment was undertaken, not a swallowing screen by a non-speech pathologist.
Help Notes	This is a **speech pathology assessment,** not a swallowing screen by a non-speech pathologist. Check emergency department records.
Further Information	NSF guideline recommendation 6.2.1 Dysphagia: *Patients should be screened as soon as possible, but at least within 24 hours of admission* (National Stroke Foundation, 2010. p. 17).

If the patient had a swallowing screen, where was it done?

Definition	If the patient had a swallow screen, the location of where it was conducted should be documented in the patient's medical records or on a completed swallowing screen tool.
Format	Tick Emergency Department (ED), Acute Stroke Unit (ASU), or Tick NA if no swallowing screen documented in the patient's medical records or on a swallowing screen tool.
Help Notes	This is a **swallowing screen** by a non-speech pathologist, not a speech pathology assessment. If the location of swallowing screen cannot be determined, and it has been conducted, the Unknown field should be ticked.

If the patient had a swallowing screen, who did the screen?

Definition	For those patients who had a swallowing screen, the designation (i.e. health care professional role: speech pathologist, medical officer, nurse) of the health care professional who did the screen should be documented in the patient's medical records.
Format	Tick relevant category, or Tick NA if the patient did not have a swallowing screen documented or had a speech pathology assessment.

If the patient had a swallowing screen, what was the result?

Definition	For those patients who had a swallowing screen (by a *non-speech pathologist*), the result of the screen should be documented in the patient's medical records.
Format	Tick either Pass or Fail, or Tick NA if the patient did not have a swallowing screen documented or had a speech pathology assessment, or Tick 'Not Documented' if the result cannot be determined from the medical records.

If the patient had a swallowing screen and failed, was he or she referred to the speech pathologist?

Definition	Those patients who fail the swallowing screen should be referred to the speech pathologist for a speech assessment.
Format	Tick Yes or No, or Tick NA if the patient did not have a swallowing screen documented, had a speech pathologist assessment or passed the swallowing screen.
Further Information	NSF guideline recommendation 6.2.1 Dysphagia: *Patients who fail the swallowing screening should be referred to a speech pathologist for a comprehensive assessment* (National Stroke Foundation, 2010)

Was the patient given food or drink before he or she had been screened or had a speech pathology assessment?

Definition	Patients should be screened for dysphagia by a non-speech pathologist (i.e. doctor or nurse) or assessed by a speech pathologist, within the first 24 hours of being admitted to the hospital and before being given food or fluids.
Format	Tick Yes or No, or Tick NA if no swallowing screen or assessment was documented.
Further Information	NSF guideline recommendation 6.2.1: *Patients should be screened for swallowing deficits before being given food, drink, or oral medications* (National Stroke Foundation, 2010).

Was the patient given medication/s before he or she had been screened or had a speech pathology assessment?

Definition	Patients should be screened or be assessed by a speech pathologist for dysphagia within the first 24 hours of being admitted to the hospital before being given any medications.
Format	Tick Yes or No, or Tick NA if no swallowing screen or speech assessment was documented.
Further Information	NSF guideline recommendation 6.2.1: *Patients should be screened for swallowing deficits before being given food, drink, or oral medications* (National Stroke Foundation, 2010).

If the patient did have a screen or speech pathology assessment, did he or she have any subsequent screens during the first 72 hours in the ASU?

Definition	Patients should be re-screened if they deteriorate.
Format	Tick Yes or No, or If Yes, how many were done (free text), or Tick NA is no further screens documented.

APPENDIX I: STUDY 2 NURSE UNIT MANAGER SURVEY

Evidence-based Practice: Enablers and Barriers

Instructions

As part of this study you have consented to completing this survey and participating in an interview. This survey comprises Part A and Part B. Please complete Part A prior to the interview and Part B will be completed during the interview. Please do not hesitate to contact Peta Drury on **9739 2326 or 041 220 3376** if you have any questions**.**

Your participation in this study will allow the research team to identify enablers and barriers towards evidence-based practice.

Thanking you

Peta Drury

PART A

Part A Section 1: Leadership

This first section asks questions pertaining to your own style of leadership, that is, *To what extent do you typically engage in the following behaviours?* Choose a number from the following rating scale that best applies to each statement and record it in the box to the right of that statement.

1 = Almost Never
2 = Rarely
3 = Seldom
4 = Once in a While
5 = Occasionally
6 = Sometimes
7 = Fairly Often
8 = Usually
9 = Very Frequently
10 = Almost Always

		Rating Scale									
1.	I set a personal example of what I expect of others.	1	2	3	4	5	6	7	8	9	10
2.	I talk about future trends that will influence how our work gets done.	1	2	3	4	5	6	7	8	9	10
3.	I seek out challenging opportunities that test my own skills and abilities.	1	2	3	4	5	6	7	8	9	10
4.	I develop cooperative relationships among the people I work with.	1	2	3	4	5	6	7	8	9	10
5.	I praise people for a job well done.	1	2	3	4	5	6	7	8	9	10
6.	I spend time and energy making certain that the people I work with adhere to the principles and standards we have agreed on.	1	2	3	4	5	6	7	8	9	10
7.	I describe a compelling image of what our future could be like.	1	2	3	4	5	6	7	8	9	10

	Rating Scale
8. I challenge people to try out new and innovative ways to do their work.	1 2 3 4 5 6 7 8 9 10
9. I actively listen to diverse points of view.	1 2 3 4 5 6 7 8 9 10
10. I make it a point to let people know about my confidence in their abilities.	1 2 3 4 5 6 7 8 9 10
11. I follow through on the promises and commitments that I make.	1 2 3 4 5 6 7 8 9 10
12. I appeal to others to share an exciting dream of the future.	1 2 3 4 5 6 7 8 9 10
13. I search outside the formal boundaries of my organisation for innovative ways to improve what we do.	1 2 3 4 5 6 7 8 9 10
14. I treat others with dignity and respect.	1 2 3 4 5 6 7 8 9 10
15. I make sure that people are creatively rewarded for their contributions to the successes of our projects.	1 2 3 4 5 6 7 8 9 10
16. I ask for feedback on how my actions affect other people's performance.	1 2 3 4 5 6 7 8 9 10
17. I show others how their long-term interests can be realised by enlisting in a common vision.	1 2 3 4 5 6 7 8 9 10
18. I ask 'What can we learn?' when things don't go as expected.	1 2 3 4 5 6 7 8 9 10
19. I support the decisions that people make on their own.	1 2 3 4 5 6 7 8 9 10
20. I publicly recognise people who exemplify commitment to shared values.	1 2 3 4 5 6 7 8 9 10
21. I build consensus around a common set of values for running our organisation.	1 2 3 4 5 6 7 8 9 10
22. I paint the 'big picture' of what we aspire to accomplish.	1 2 3 4 5 6 7 8 9 10

	Rating Scale
23. I make certain that we set achievable goals, make concrete plans and establish measurable milestones for the projects and programmes that we work on.	1 2 3 4 5 6 7 8 9 10
24. I give people a great deal of freedom and choice in deciding how to do their work.	1 2 3 4 5 6 7 8 9 10
25. I find ways to celebrate accomplishments.	1 2 3 4 5 6 7 8 9 10
26. I am clear about my philosophy of leadership.	1 2 3 4 5 6 7 8 9 10
27. I speak with genuine conviction about the higher meaning and purpose of our work.	1 2 3 4 5 6 7 8 9 10
28. I experiment and take risks, even when there is a chance of failure.	1 2 3 4 5 6 7 8 9 10
29. I ensure that people grow in their jobs by learning new skills and developing themselves.	1 2 3 4 5 6 7 8 9 10
30. I give the members of the team a great deal of appreciation and support for their contributions.	1 2 3 4 5 6 7 8 9 10

Part A Section 2: The Learning Environment

This next section asks you questions about your current workplace. Please respond by circling the number that most closely corresponds to how you feel about each statement.

		1 strongly disagree						**7 strongly agree**
1.	I often have an opportunity to talk to other staff about successful programmes or work activities in order to understand why they succeed.	1	2	3	4	5	6	7
2.	There is widespread support and acceptance for the organisation's vision statement.	1	2	3	4	5	6	7
3.	I can often bring new ideas into the organisation.	1	2	3	4	5	6	7
4.	Failures are seldom constructively discussed in our organisation.	1	2	3	4	5	6	7
5.	Current organisational practice encourages employees to solve problems together before discussing it with a supervisor.	1	2	3	4	5	6	7
6.	From my experience, people who are new to this organisation are encouraged to question the way things are done.	1	2	3	4	5	6	7
7.	Senior managers in this organisation resist change and are afraid of new ideas.	1	2	3	4	5	6	7
8.	Managers in this organisation encourage employees to experiment in order to improve work processes.	1	2	3	4	5	6	7
9.	New work processes that may be useful to the organisation as a whole are usually shared with all employees.	1	2	3	4	5	6	7
10.	Innovative ideas that work are often rewarded by management.	1	2	3	4	5	6	7

		1 strongly disagree						7 strongly agree
11.	Managers and employees in this organisation share a common vision of what our work should accomplish.	1	2	3	4	5	6	7
12.	In my experience, new ideas from staff are not treated seriously by management.	1	2	3	4	5	6	7
13.	Managers in this organisation frequently involve employees in important decisions.	1	2	3	4	5	6	7
14.	We cannot usually form informal groups to solve organisational problems.	1	2	3	4	5	6	7
15.	Managers in this organisation can accept criticism without becoming overly defensive.	1	2	3	4	5	6	7
16.	We have a system that allows us to learn successful practices from other organisations.	1	2	3	4	5	6	7
17.	Managers in this organisation often provide feedback that helps to identify potential problems and opportunities.	1	2	3	4	5	6	7
18.	I do not understand how the vision of this organisation is to be achieved.	1	2	3	4	5	6	7
19.	We have opportunities for self-assessment with respect to goal attainment.	1	2	3	4	5	6	7
20.	The organisation's vision statement identifies values to which all employees must conform.	1	2	3	4	5	6	7
21.	Most problem-solving groups in this organisation feature employees from a variety of functional areas or divisions.	1	2	3	4	5	6	7
22.	There is very little overlap in work between different units in the organisation.	1	2	3	4	5	6	7

		1 strongly disagree						7 strongly agree
23.	Most of our work must adhere to formal rules and procedures.	1	2	3	4	5	6	7
24.	In my opinion, this organisation has too many levels of hierarchy.	1	2	3	4	5	6	7
25.	We require approval in writing for the introduction of new work activities.	1	2	3	4	5	6	7
26.	Our work is usually closely monitored and inspected by management.	1	2	3	4	5	6	7
27.	Information and decision making must always go through proper channels.	1	2	3	4	5	6	7
28.	Standard operating procedures have been established for almost every work situation.	1	2	3	4	5	6	7
29.	I feel I am in a dead-end job.	1	2	3	4	5	6	7
30.	I feel isolated at work.	1	2	3	4	5	6	7
31.	I am satisfied with my supervisor.	1	2	3	4	5	6	7
32.	I do not feel as if I am an integral part of this organisation.	1	2	3	4	5	6	7
33.	I have opportunities to work on challenging assignments.	1	2	3	4	5	6	7
34.	My work makes full use of my skills and abilities.	1	2	3	4	5	6	7
35.	I have opportunities to improve my knowledge, skills and abilities in order to undertake new work assignments.	1	2	3	4	5	6	7
36.	I know that failure will have negative repercussions on my career.	1	2	3	4	5	6	7
37.	My work group is supportive of the work I do.	1	2	3	4	5	6	7

		1 strongly disagree						7 strongly agree
38.	Overall, I am satisfied with this job.	1	2	3	4	5	6	7
39.	Employees in this organisation are frequently provided with work-related skill training.	1	2	3	4	5	6	7
40.	The skill training I receive can be applied to improve my work immediately.	1	2	3	4	5	6	7
41.	Employee training is emphasised equally at all levels in this organisation.	1	2	3	4	5	6	7
42.	Learning to increase my work skills and knowledge is not encouraged in this organisation.	1	2	3	4	5	6	7
43.	Training in this organisation is done in work teams.	1	2	3	4	5	6	7
44.	Training in this organisation is not always relevant to my work.	1	2	3	4	5	6	7
45.	I have opportunities to share my knowledge and skills learned from training with other employees.	1	2	3	4	5	6	7
46.	Management skills such as leadership, coaching and team building are emphasised as much as purely technical work skills in this organisation.	1	2	3	4	5	6	7
47.	Employees in this organisation are required to continuously upgrade and increase their knowledge and educational level.	1	2	3	4	5	6	7

Part A Section 3: Evidence-Based Practice

The following questions relate to your perceptions/attitude towards evidence-based practice. Please place a score in the box below each question.

1. How would you describe your attitude towards the current promotion of evidence-based practice? (0 = 'extremely cynical', 100 = 'extremely positive')

Score =

2. How would you describe the attitude of most of your nurse colleagues towards evidence-based practice? (0 = 'extremely cynical', 100 = 'extremely positive')

Score =

3. How useful are research findings in your day-to-day management of patients? (0 = 'completely useless', 100 = 'extremely useful')

Score =

4. Overall, what percentage of your clinical practice do you consider is currently evidence based? (Scale from 0 to 100)

Score =

5. Practicing evidence-based practice improves patient care (0 = ‘strongly disagree’, 100 = ‘Strongly agree)

Score =

6. Evidence-based practice is of limited value in nursing because much of the primary care lacks a scientific base (1 = ‘strongly disagree’, 5 = ‘strongly agree’)

Score =

7. The adoption of evidence-based practice, however worthwhile an idea, places another demand on already overloaded nurses (1 = ‘strongly disagree’, 5 = ‘strongly agree’)

Score =

Thank you, you have now completed Part A. You are not required to complete Part B because this section will be completed during the interview. However, you may wish to review this section prior to the interview.

PART B

To be completed at interview.

Part B Section 1: Organisation's Readiness to Accept Change

Please answer the following questions from your own perspective and knowledge of your hospital's policies and practices. **Please answer the following questions by ticking *one* box only**. Please feel free to use the comments space provided to give examples or description as appropriate to elaborate on any of the questions.

1. In your experience, is the hospital able to allocate resources (e.g. dedicated staff time for policy development and action planning) for guideline dissemination and implementation? (Please tick *one* box only.)

Always	Sometimes	Never	Unsure
☐1	☐2	☐3	☐4

2. Overall, in your view are the health care professionals in the hospital receptive to using evidence-based guidelines? (Please tick *one* box only.)

Most	Some	Few	None	Unsure
☐1	☐2	☐3	☐4	☐5

3. To what extent has the process of guideline dissemination and implementation been built into the organisational structure/knowledge management systems of the hospital (e.g. responsibility for guideline dissemination and implementation is designated to individuals and/or departments at different tiers of the hospital hierarchy)? (Please tick *one* box only.)

A lot	A little	Not at all	Unsure
☐1	☐2	☐3	☐4

4. Does the hospital have staff whose role is specifically designated to the implementation of guidelines? (Please tick *one* box only.)

Yes	No	Unsure
☐1	☐2	☐3

5. If you answered ***'Yes'*** to question 4, does designated staff have the (a) expertise and (b) dedicated time to lead on the co-ordination of guideline dissemination and implementation? (Please tick *one* box only next to categories a, b and c.)

a) Expertise

Yes	No	Unsure
☐1	☐2	☐3

b) Dedicated Time

Yes	No	Unsure
☐1	☐2	☐3

6. Does the hospital have a strategy to communicate new guideline information (e.g. making staff aware new guidance has been received by the hospital)? (Please tick *one* box only.)

Yes	No	Unsure
☐1	☐2	☐3

7. Are staff given an opportunity to present feedback on the relevance of the guideline recommendations to their practice? (Please tick *one* box only.)

Always	Sometimes	Never	Unsure
☐1	☐2	☐3	☐4

8. Please provide your views about the following statements. (Please tick *one* box only.)

a) My organisation promotes multi-professional forums or networks to:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) Facilitate quality improvement	☐1	☐2	☐3	☐4	☐5
b) Disseminate evidence or guidelines into practice?	☐1	☐2	☐3	☐4	☐5

9. Is there an organised programme of training to develop staff skills to implement guidelines?

Yes	No	Unsure
☐1	☐2	☐3

10. Do managers support staff requests for acquiring new skills and knowledge with regard to the implementation of evidenced-based guidelines?

Always	Sometimes	Never	Unsure
☐1	☐2	☐3	☐4

11. In your view, is there a **positive** culture towards guideline implementation within the hospital?

A lot	A little	Not at all	Unsure
☐1	☐2	☐3	☐4

Part B Section 2: Demographic Details

This first section asks for some demographic details about yourself and the ward of which you are currently nurse unit manager.

1. What is your gender? (Please tick *one* box only.)

Female ..... ☐1

Male ..... ☐2

2. What is your age? (Please tick *one* box only.)

< 20 ..... ☐1

20–29 ..... ☐2

30–39 ..... ☐3

40–49 ..... ☐4

50–59 ..... ☐5

60–69 ..... ☐6

≥ 70 ..... ☐7

3. What is the highest level of education you have attained? (Please tick *one* box only.)

Hospital Certificate ..... ☐1

Associate Diploma ..... ☐2

Diploma ..... ☐3

Bachelor's Degree ..... ☐4

Graduate Certificate ..... ☐5

Graduate Diploma ..... ☐6

Master's Degree ..... ☐7

PhD ..... ☐8

4. How long have you been employed as the NUM in this ward? (Please place a *number* in *one* of the spaces provided below.)

_____ years or _____ months or _____ weeks

5. How many beds on the ward have been allocated to the stroke unit?

_____

6. Are your stroke unit beds part of a larger ward area or a stand-alone unit?

_____