School of Nursing, Midwifery and Paramedicine

Developing an evidence-based practice framework for post operative cardiac surgery patients in the Intensive Care unit

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This thesis is presented for the Degree of
Master of Philosophy
of
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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014.

The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #HRE2023-0263 and Fiona Stanley Fremantle Hospital Group Quality Activity 49688 approved on 8th May 2023 and Quality Activity 52272 approved on 2nd February 2024.

Signature:

Melissa Bedford

19th July 2024

Abstract

Introduction

Cardiovascular disease remains one of the leading causes of death in Australia and coupled with an ageing population has fuelled a continuing demand for interventions such as cardiac surgery which will alleviate or prevent the occurrence of cardiovascular events. Cardiac surgery, incorporating numerous procedures, remains the treatment option for extensive or diffuse disease, blockage or presence of additional structural heart damage.

Refinements in surgical and cardiopulmonary bypass techniques as well as Intensive Care management strategies have improved mortality and morbidity rates whilst making the option of surgery more broadly available to older patients with various co-morbidities. This demand for cardiac surgery corresponds to a continuing demand for Intensive Care Unit (ICU) beds and resources. Efficient and cost-effective resource management remains at the forefront for maintaining a sustainable health care system. Care maps which are evidence and consumer informed and outline expected timelines and task sequencing are predicted to improve transparency of care, reduce practice variations and enable staff to rapidly learn the key components of care.

This project involved four phases which featured a scoping review, benchmarking, assembly of a care map and preliminary evaluation.

Phase 1: Scoping review

A systematic search was undertaken utilising relevant keywords and phrase combinations across five selected databases with a focus on generating a comprehensive overview of published articles including the use of practice frameworks. Eighty-four articles were selected and summarised with major topics being identified then categorised as either a clinical element or influencing factor, collectively forming the care map framework. Data extraction for the remainder of the project was subsequently aligned with the contents of the care map framework.

Phase 2: Benchmarking

Three sources of data formed the benchmarking process commencing with an Australian ICU document review. A purposeful selection of high case volume centres that have been contributing to the ANZSCTS database for >5years were selected. Nine ICU NUMs were contacted requesting policy and procedure documents with six

responses received: two each from Queensland, NSW and Victoria, one each from Canberra, SA and WA. A summative content analysis of the received documents was completed.

The second data source was the ANZSCTS report from the ANZ database. The publicly accessible 2021 annual report was downloaded, explored and relevant data extracted.

The final data source was the current practice review at the study site. A digital medical record audit was undertaken with a randomised sample of 50 CABG surgery patient records from 2022. Data were extracted from the ICU clinical information System (Metavision) and patients' digital medical records (Bossnet) then entered directly into a Redcap database. There were three key areas that were highlighted for improvement. Rewarming times ranged from 0-12.65 hours with 68% patients achieving normothermia within the literature recommended four hours. Adequate pain control with regular pain assessments were achieved in 16% of patients. Early mobilisation practices with 22% mobilised to chair within the literature recommended time frame of within 6-12 hours post extubation or early day one, with 4% initiated by nursing staff.

Phase 3: Care map assembly and preliminary evaluation

The assembly of a draft care map began with identifying the clinical steps or milestones in sequence from admission to ICU until ward transfer. Recommendations from phases one and two were integrated into the milestones prior to a co-design approach incorporating three preliminary assessments prior to finalisation of the evidence informed care map. The key stakeholder assessment clarified and achieved consensus on content and design of the care map.

Acceptability and feasibility were considered from two perspectives. Health consumer assessment ensured the most important aspects of care were met from the consumer point of view with attention on comfort rather than process. A purposeful selection of three health consumers participated. Professional and consistent communication in conjunction with adequate pain control were identified as key aspects. Senior clinical staff assessment aimed at identifying obvious flow issues and determine feasibility and acceptability in the clinical setting. Group consensus that each milestone was clear, concise and sufficient was achieved.

Conclusion

Based on a compilation of research evidence, current practice and consumer feedback, five Milestones were identified in the ICU post operative care for CABG patients: admission to ICU, achieving haemodynamic stability, mechanical ventilation duration, early mobilisation and ward readiness. The creation of the ICU cardiac surgery nursing care map outlines a framework for patient care and provided a visual reminder of key achievements and expected progression across the ICU stay. The prediction is the care map will create transparency and efficiency of care and reduce practice variations.

Acknowledgements

My journey over the past number of years would not have been possible without the support of the following people.

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Thanks to Diana Blackwood, Faculty Librarian, for your assistance and guidance with the scoping review search strategy.

Thanks to Jenny Thompson, Fiona Stanley Hospital ICU Data Administration, for your assistance with retrieving data from the COMET database.

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Finally, to my amazing parents, Ann and John (Ma and Pa). Thanks for your love, support and patience over the past years. Making time to help with cleaning, washing and general household chores has allowed me to maintain focus which has been invaluable. Thanks also to Bullet and Shadow, my handsome Labradors for your company, cuddles and feet warming during my extensive hours on the computer.

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List of Abbreviations

ACCCN	Australian College of Critical Care Nurses
ACT	Activated Clotting Time
ANZ	Australia and New Zealand
ANZSCTS	Australia and New Zealand Society of Cardiothoracic Surgeons
CABG	Coronary Artery Bypass Graft
COMET	Core Outcome Measurement and Evaluation Tool
CPB	Cardiopulmonary Bypass
DMR	Digital Medical Record
GCS	Glasgow Coma Scale
GEKO	Governance, Evidence, Knowledge, Outcomes
HREC	Human Research Ethics Committee
ICU	Intensive Care Unit
iSoBAR	Identification, Situation, Observation, Background history, Agree to plan, Responsibility and risk management
JBI EBP	Joanna Briggs Institute Evidence Based Practice
KPI	Key Performance Indicators
LVEF	Left Ventricular Ejection Fraction
MMAT	Mixed Methods Appraisal Tool
MPhil	Master of Philosophy
NMBA	Nursing and Midwifery Board of Australia
NSQHS	National Safety and Quality Health Service
NUM	Nurse Unit Manager
OPCABG	Off Pump Coronary Artery Bypass Graft
P/F	PaO2/FiO2
PRISMA-ScR	Preferred Reporting Items for Systematic review and Meta-analyses extension for Scoping Reviews
QI-MQCS	Quality Improvement Minimum Quality Criteria Set
RBC	Red Blood Cell
RCT	Randomised Control Trial
Redcap	Research Electronic Data Capture
ROTEM	Rotational Thromboelastography
SIMV	Synchronized Intermittent Mandatory Ventilation
TOE	Transoesophageal echo

Chapter 1 Introduction to Cardiac Surgery Patients in the ICU

Background

Cardiovascular disease remains one of the leading causes of death in Australia and coupled with an ageing population has fuelled a continuing demand for interventions which alleviate or prevent the occurrence of cardiovascular events.[1] Advancements in technology, minimally invasive surgery and interventional radiological procedures offer a broad range of treatment options. Cardiac surgery, incorporating numerous procedures, remains the treatment option for extensive or diffuse disease, blockage or presence of additional structural heart damage.[2] Refinements in cardiopulmonary bypass techniques and intensive care management strategies of the cardiac surgery patient have improved mortality and morbidity rates whilst making the option of surgery more broadly available to older patients with co-morbidities.[3,4] This high demand for cardiac surgery corresponds to a continuing demand for Intensive Care Unit (ICU) beds and resources.[5] Efficient and cost-effective resource management remains the forefront for maintaining a sustainable health care system.

In the 1990s the volume of cardiac surgery cases soared due to the many innovations and improvements in procedures, anaesthetic techniques, and ICU post operative management. This ignited research activities surrounding the post operative care of the cardiac surgical patient attempting to improve patient flow and bridge the gap between demand and supply.[6-8] The predominant focus was length of mechanical ventilation times, particularly weaning from mechanical ventilation, early extubation protocols and comparing different post procedural care settings.[5-7,9,10] At this time the term “fast track pathway” appeared to collectively describe early extubation approaches. Most studies were medically driven, quantitative in nature and focused on care segments rather than the holistic post operative journey. Subsequently it has been well documented in the literature that reduced mechanical ventilation times can lead to reduced ICU length of stay without compromising patient safety.[5,9,10] It is worth noting, duration of mechanical ventilation is not the only factor affecting ICU length of stay.

Post operative management of the cardiac surgery patient can be considered in two stages: the immediate post operative stage and the de-escalation stage. The immediate post operative stage entails assessment, stabilisation, and management of early post operative consequences from surgery. Body system-based assessments

are performed on patient arrival to ICU to establish a baseline and then intermittently to assess and guide any required treatments.[11-13] Haemodynamic monitoring including continuous ECG monitoring, arterial blood pressure and pulse oximetry forms an essential component of patient assessment.[11,14] Haemodynamic instability can be caused by hypovolaemia, myocardial dysfunction and hypothermia resulting from the effects of cardiopulmonary bypass.[11,14,15] Stabilisation of haemodynamic status encompasses fluid resuscitation, manipulation of vasoactive support, post operative arrhythmia control and management of pain.[11] Monitoring and early management of surgical complications such as excessive bleeding from chest drains, cardiac tamponade, low cardiac output states and neurological impairment are paramount during the initial post operative phase.[15,16] Following stabilisation, weaning of mechanical ventilation and patient extubation can be achieved.[11,17]

The de-escalation stage changes the focus from patient recovery to the commencement of rehabilitation. Weaning of vasoactive support, removal or capping of pacing wires, removal of drains and mobilisation are amongst some of the processes that occur in this stage. The re-establishment of consciousness and cognition are essential for the patient to participate in self-care, recommence diet and physical rehabilitation as this becomes the priority for patients to continue their journey toward ICU transfer and subsequent discharge home.

Optimal care engages not only the processes and procedures to achieving readiness for transfer from the ICU in a timely manner but also enhancing the patient experience through their active participation. Partnering with consumers, which is one of the Australian National Safety and Quality Health Service (NSQHS) standards, is an essential component for ensuring a positive experience for both the patient and their family.[18] A small number of qualitative studies have explored topics such as family satisfaction, experiences of pain and patient experiences in the post operative setting.[19-21] Family satisfaction has been reported to rely on staff courtesy, waiting room comfort and compassionate care of their loved one.[20] From the patient perspective communication about medications and care transition were of the highest importance.[19] Activities causing the most pain included the presence of chest drains, the experience of endotracheal suctioning, dressing changes and repositioning on an air mattress.[21] Based on the reviewed literature consumer engagement appears to be limited to patient and family satisfaction and experiences with an absence of active participation within research activities.

Providing a framework for delivery of efficient care for the post operative cardiac surgery patient that accounts for health consumer input is predicted to contribute to

improving the patient experience as well as reducing both ICU and hospital costs.[18,20-22] Care maps which outline expected timelines and sequencing of tasks in the post operative period improve transparency of care, reduce practice variation and enable staff to rapidly learn the key components of care.[22-24] Active patient participation and satisfaction can also be linked to the understanding of the expectations in the post operative period.[23] Additionally, efficient care promotes prompt treatment alleviating the risk of organ damage which subsequently reduces morbidity and mortality.[22]

The terms interdisciplinary clinical pathway, goal directed haemodynamic therapy, clinical pathway and integrated pathways are all practice frameworks that have been used to describe a standardised approach to post operative care. The particulars of standardisation differ between each of them with integrated pathways appearing the most holistic providing multidisciplinary task orientation throughout the entire post operative period. By applying a structured approach to the vital aspects of care, consistency and efficiency can be created.[22,25,26] Benefits that can be achieved by enhancing patient progression through the ICU include early mobilisation and cardiac rehabilitation, improving the patient experience and reducing ICU and hospital costs.[23-26]

Fiona Stanley Hospital is a major tertiary hospital within South Metropolitan Health Service, Perth, Western Australia which officially opened March 2015. The 40 bed Intensive Care Unit specialties include general medical, general surgical, major burns, cardiac surgery, heart and lung transplantation and Extra Corporeal Membrane Oxygenation. Nursing practice standards and other documents were initially transitioned from alternative hospitals sites during opening. Clinical governance at Fiona Stanley Hospital then transformed focus from nursing practice standards to policy and procedure documents. Revisions into the new format were made establishing the post operative care in the Intensive Care Unit Post Cardiothoracic Surgery procedure document which provides an overview of care. Specific guidelines and expectations of the cardiac surgery patient admission are absent. However, an extubation protocol exists which will be examined in the benchmarking process.

Preoperative education for cardiac surgery patients at Fiona Stanley Hospital include a heart surgery patient information booklet. Contents incorporate education on the heart and type of surgeries, introductions to the medical and nursing teams, preparing for heart surgery guidelines including preoperative instructions. The Intensive Care Unit is featured in the information booklet but limited to two paragraphs with a vague overview. The remaining content includes information related to their hospital recovery, discharge, recovering at home and follow up appointments.

Thesis aim and objectives

The aim of this project is to develop a care map to facilitate a timely transition through the ICU recovery and enhance the patient experience. The objectives include:

- Undertake a scoping review to identify best practice for care of post operative cardiac surgery patients.
- Examine current practices in ICU for the post operative recovery of cardiac surgery patients.
- Develop a draft care map for patients post operative recovery in ICU.
- Refine and achieve consensus on the draft care map with key stakeholders.
- Assess feasibility and acceptability of the care map workflow with clinical nursing and medical staff.
- Engage with previous cardiac surgery patients and their families to include a health consumer perspective in the care map.
- Make recommendations for practice and implementation of the care map.

The philosophical basis for this project is embedded in the principles of evidenced based practice: informed by research (the scoping review), tailored to the practice context (benchmarking process) and refined by consumer feedback (Staff and patient preliminary review).[24,107]

Justification

Cardiovascular disease remains one of the leading causes of death in Australia and with an ageing population the demand for cardiac surgery remains high resulting in a continuing demand for ICU beds and resources.[1] Efficient and cost-effective resource management is at the forefront for maintaining a sustainable health care system. Development of an efficient care map for post operative care in the cardiac surgery patient cohort imparts valuable information about the expected care and predicted progression through to recovery.[23] A care map, if implemented, has potential to enhance patient and family engagement and improve satisfaction levels whilst reducing patient ICU length of stay contributing to a reduction in both ICU and hospital costs.[23-26]

Ethical considerations

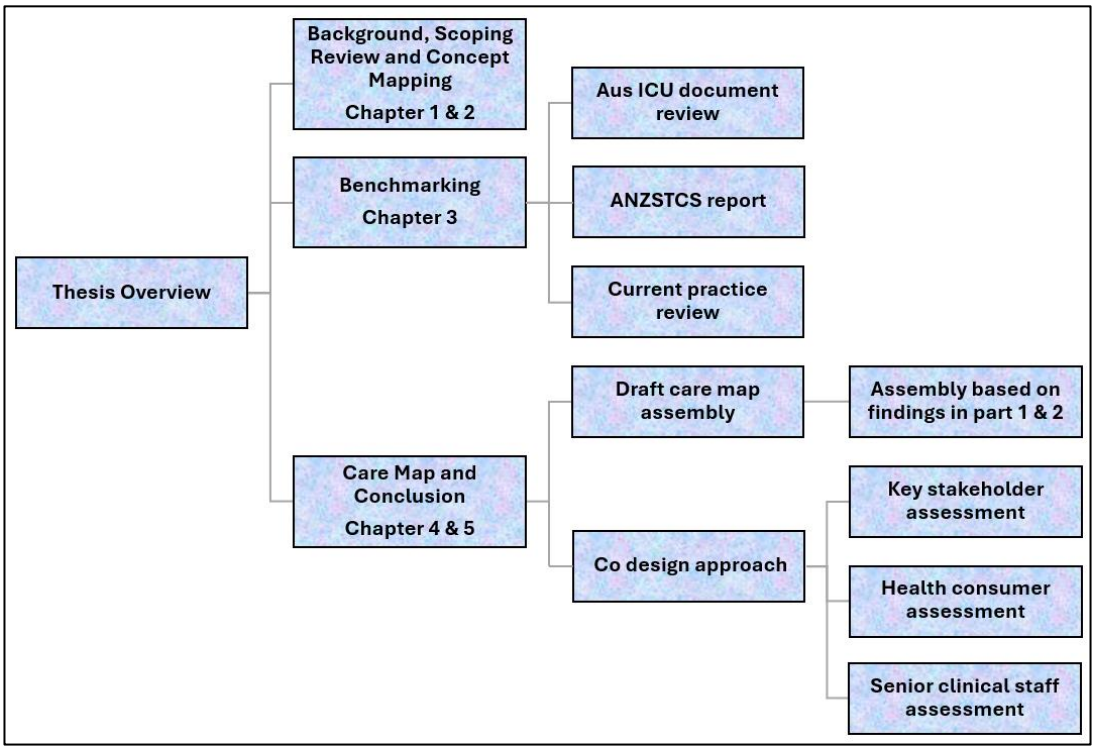
This project has been conducted in accordance with the ethical guidelines of the National Health and Medical Council of Australia.[27] Primary areas for ethical consideration include data security and confidentiality for patients and participants.

With no intention to introduce novel treatments, tests or clinical approaches this project met the requirements of a quality improvement activity and therefore did not require Human Research Ethics Committee (HREC) review at the study site. Quality improvement activities for the study site are conducted through the WA Health Department Governance, Evidence, Knowledge, Outcomes (GEKO) web application. Anonymity and confidentiality for patients, participants and retained data were maintained with all requirements for the storage of research data adhered to as outlined in the Data Management Plan (see Appendix 1). As a student project, reciprocal research approval was obtained from the Curtin University HREC. Specific ethical considerations related to each part of the project are outlined in each corresponding chapter.

Thesis overview

This project involved three phases which featured a scoping review, benchmarking process, assembly of a care map and the preliminary evaluation (see Figure 1.1).

Figure 1.1 Thesis structure



Chapter One provides an introduction incorporating the background of cardiac surgery and rationale for this project. Aims, objectives and project justification are outlined, and ethical considerations described.

Exploration of current literature surrounding the project research question is reported in Chapter Two as a scoping review. The chapter outlines the search strategy, selection process, data extraction process and critical appraisal of selected articles. Study characteristics such as research design, dates of publications, geographical distribution, and health disciplines are presented. Major topics identified from the literature enabled the development of a care map framework outlining clinical elements, influencing factors and their interrelationships. Recommendations from the literature, based on the care map framework, are summarised.

Benchmarking current practice is the focus for Chapter Three. Data were collected from; clinical practice guidelines of selected Australian ICUs, key performance indicators outlined in the Australia and New Zealand Society of Cardiothoracic Surgeons (ANZSCTS) 2021 report and current practice was examined at the study site. This purposeful collection of data from different perspectives enabled integration of data for the development of an evidence-based care map. Data from each source were extracted and mapped to the clinical elements from the care map framework developed in Chapter Two. Recommendations from the literature and benchmarking process were combined with the care map framework to formulate the revised care map framework which shapes the key features of the care map.

In Chapter Four the final phase of the project involves the development of a draft care map. The formation of a draft care map began with the identification of the clinical steps or milestones in sequence from admission to ICU until ward transfer. The findings and recommendations from Chapter Two and Three were then integrated into the milestones prior to formatting into a graphical display for the draft care map. A co-design approach in assessment of the draft care map included key stakeholders from the study site who provided valuable feedback and opinion. Content and design decisions were made with the name formalised to ICU cardiac surgery nursing care map. A preliminary assessment of the draft care map was evaluated from different perspectives; a health consumer assessment to ensure their needs were considered and senior clinical staff assessment incorporating senior clinical nursing and medical staff for clinical feasibility and acceptability.

Chapter Five provides an overall summary of the project and reflects on the achievements, strengths and limitations of the project. Implications for clinical practice and future research are identified.

Chapter 2 Establishing Evidence-Based Practice: A Scoping Review of the Literature

Introduction

Post operative management of the cardiac surgery patient is a complex process and with a continuing demand for these health services the focus remains on improving service efficiency. The demand for services is due to numerous factors including an ageing population along with a high population incidence of cardiovascular disease.[1] As cardiac surgery evolved, there has been a range of research activity surrounding the post operative care of cardiac surgical patients aiming to improve patient flow and bridge the gap between demand and supply.[6-8] A problem with the available research are conflicts in either results or opinions can occur.[28] For example, Anger et al[29] and Karaman[30] et al have both compared the use of dexmedetomidine to propofol and the effect on mechanical ventilation duration. Anger et al[29] found no difference whereas Karaman et al[30] observed significantly shorter mechanical ventilation duration. Furthermore, the use of isolated or single studies fail to provide a comprehensive overview on a given topic[28]. The purpose of a literature review is to provide a comprehensive overview of research to inform the theoretical background and highlighting existing knowledge on a given topic.[31-33] A broad range of literature review types exist with selection dependent on both the intent of a project and the quality and extent of existing research.[33,34] Given the possible shortcomings of existing research, the scoping review method was chosen to determine the extent, volume, and scale of literature on the post operative management of the cardiac surgery patient. This review focused on generating a comprehensive overview of published articles addressing the characteristics of the post operative journey for the cardiac surgery patient, including the use of practice frameworks, in the early post operative period up to transfer from the ICU to the ward.

Research review question

What evidence exists on the post operative care of the adult cardiac surgery patient in ICU including perspectives of care, patient and family experiences and their satisfaction levels.

Methodology

Search strategy

A scoping review protocol was developed following the Preferred Reporting Items for Systematic reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR)[35] and the Joanna Briggs Institute scoping review methodology.[36] The protocol was registered with the Open Science Framework prior to commencing the review in December 2021. Registration DOI: https://osf.io/ea9hw[37]

Eligibility criteria for inclusion comprised of peer reviewed published articles, English language, adult participants >18 years, post cardiac surgical care in an Intensive Care Unit, Intensive Therapy Unit or Post Anaesthetic Care Unit with a date range from 1st January 1990 to 31st May 2022. The 1990s were a period where significant innovations and improvements in procedures, anaesthesia, and post operative care management occurred along with a marked increase in the volume of cardiac surgery cases.[6-8] Articles reporting research using qualitative, quantitative, mixed methods research and quality improvement research were considered for inclusion. Every attempt was made to source full text copies by searching the University library catalogue, Google Scholar© and South Metro Health Service Library.

The initial search strategy identified concepts with keywords and phrases drafted by the student researcher and refined through supervision team discussion (see Table 2.1).

Table 2.1 Initial search concepts

Concept 1	Concept 2	Concept 3	Concept 4
Cardiac surgery	Practice framework	Patient experience	Intensive Care Unit
Heart surgery	Care map	Patient satisfaction	ICU
Coronary artery bypass	Clinical pathway	Family satisfaction	Critical Care
Cardiovascular surgery	Care pathway	Patient reported outcome measures	Critical Care Unit
Valve surgery	Integrated pathway		Post Anaesthetic Care Unit
Valve replacement	Clinical protocols		Intensive Therapy Unit
Post operative	Fast track protocol		
Post surgery	Patient care planning		
Cardiovascular surgical procedures	Advance care planning		
	Case management		
	Critical pathways		

An initial preliminary search was conducted using Medline (Ovid) which enabled the identification of additional keywords and phrase combinations in the title, abstract and index terms or subject headings used to describe the retrieved articles. The draft search strategy was then reviewed by a university librarian who provided advice and guidance for additional terms and phrases including the use of MeSH terms for the search strategy. Subsequently, a broader systematic search was undertaken utilising the relevant keywords and phrase combinations from Table 2.1 and MeSH terms across selected databases. Key information sources interrogated included Medline (Ovid), CINAHL Plus with full text (EBSCO), Cochrane database, ProQuest, and the Joanna Briggs Institute Evidence Based Practice (JBI EBP) database. These databases covered a broad range of health disciplines. The Medline full search strategy including limitations and filters is outlined in Table 2.2 below, for all other database searches see Appendix 2.

Table 2.2. Medline search strategy

1.	(cardiac surgery or heart surgery or coronary artery bypass or valve surgery or valve replacement or post operative or post surgical or cardiovascular surgical procedures).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
2.	(practice framework or care map or clinical pathway or care pathway or integrated pathway or clinical protocols or fast track protocol or patient care planning or advance care planning or case management or critical pathways).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms
3.	(patient experience or patient satisfaction or family satisfaction or patient reported outcome measures).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
4.	(intensive care unit or ICU or critical care or critical care unit or post an* unit or PACU or intensive therapy unit).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
5.	1 and 2 and 4
6.	1 and 3 and 4
7.	5 or 6

Following the search, all identified articles were collated and exported into Endnote 20©, folders were used to categorise retrieved articles by database and all retrieved articles. Duplicate articles were removed. References within Endnote 20© were

checked to ensure all elements were present, if full text articles or abstracts were missing from the reference, the databases were re-explored to locate and attach to the Endnote library. If unable to locate through electronic search on the University Library or Health Service Library sites a document delivery request was made.

Reference lists of identified articles were explored for inclusion consideration. Grey literature were not searched as eligibility criteria for inclusion comprised peer reviewed published articles.

Article selection

All retrieved and included articles were assessed for eligibility by the student researcher and reviewed by the research supervision team. All retrieved articles were reviewed by title and abstract for relevance to the review question. A Microsoft Excel© spreadsheet documented a summary of all retrieved articles; retrieved articles considered not to be relevant to the research question were identified, counted and a rationale for exclusion was recorded. All selected and excluded articles were discussed between the student researcher and the supervision team. Discrepancies on decisions related to the inclusion criteria were addressed at research supervision team meetings to reach consensus.

Data extraction

A data extraction tool was created using Microsoft Excel© by the student researcher, this was trialled on five papers to ensure data extracted addressed the aim of the scoping review. The trialled data extraction tool and extracted data was reviewed by the research supervision team. Adjustments to the data extraction tool were made with the final extraction tool compiling data relating to article characteristics of; author(s), year of publication, title, journal name, aim/purpose, study design/methodology, study population/sample size/sampling technique, country of origin for publication/clinical setting (e.g. ICU or Post Anaesthetic Care Unit), study inclusion and exclusion criteria (see Appendix 3).

Inclusion and exclusion criteria were collected allowing for comparison of patient cohorts and procedures within each research article. Extracted data also included study focus (medical, nursing, pharmacy, or allied health), study design (qualitative, quantitative, mixed methods or quality improvement), outcomes measured, key findings related to scoping review question and limitations.

All included full text articles were read, data extracted and recorded in the data extraction tool. The student researcher used a traffic light system to the included articles to demonstrate transparency of article decision making and ensure verification by the research supervision team (see Figure 2.1). The traffic light system was green denoting inclusion, orange denoting discussion required and red denoting article exclusion.

Figure 2.1 Traffic light system

Research Supervisor	Student Researcher	Author(s)
27		Capuano, T. A., Sullivan, K., Rothenberger, C., Meeker, C., Gallagher-Sabo, M., & Sebastian, M.
28		Carey, M. G., Qualls, B. W., & Burgoyne, C.
29		Carr, J. M., Sellke, F. W., Fey, M., Doyle, M. J., Krempin, J. A., del la Torre, R., & Liddicoat, J. R.
5		Casida, J. M., David, J. E., Shpakoff, L., & Yarandi, H.
30		Checketts, M. R., Gilhooly, C. J., & Kenny, G. N. C.
31		Chen, L., Zheng, J., Kong, D., & Yang, L.

Quality assessment

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews provide the option of completing the critical appraisal process.[35] The rationale for conducting this critical appraisal was to gain insight into the quality of the articles given the broad date range. The methodological quality and possible risk of bias for the selected articles was assessed utilising the Joanna Briggs Institute Critical appraisal tools.[36] The validity and reliability of these tools has been well established.[36] The JBI checklists for randomised control trials, cohort studies, analytical cross sectional, qualitative and quasi experimental were used. The score was based on the total number of Yes answers out of the total number of checklist items with each critical appraisal tool varying in question type and numbers. The maximum score for the critical appraisal was based on the total number of questions and percentages were calculated. Additional tools were selected where an appropriate JBI Tool was not listed, these included the Quality Improvement Minimum Quality Criteria Set (QI-MQCS),[38] a tool for critical appraisal of quality improvement

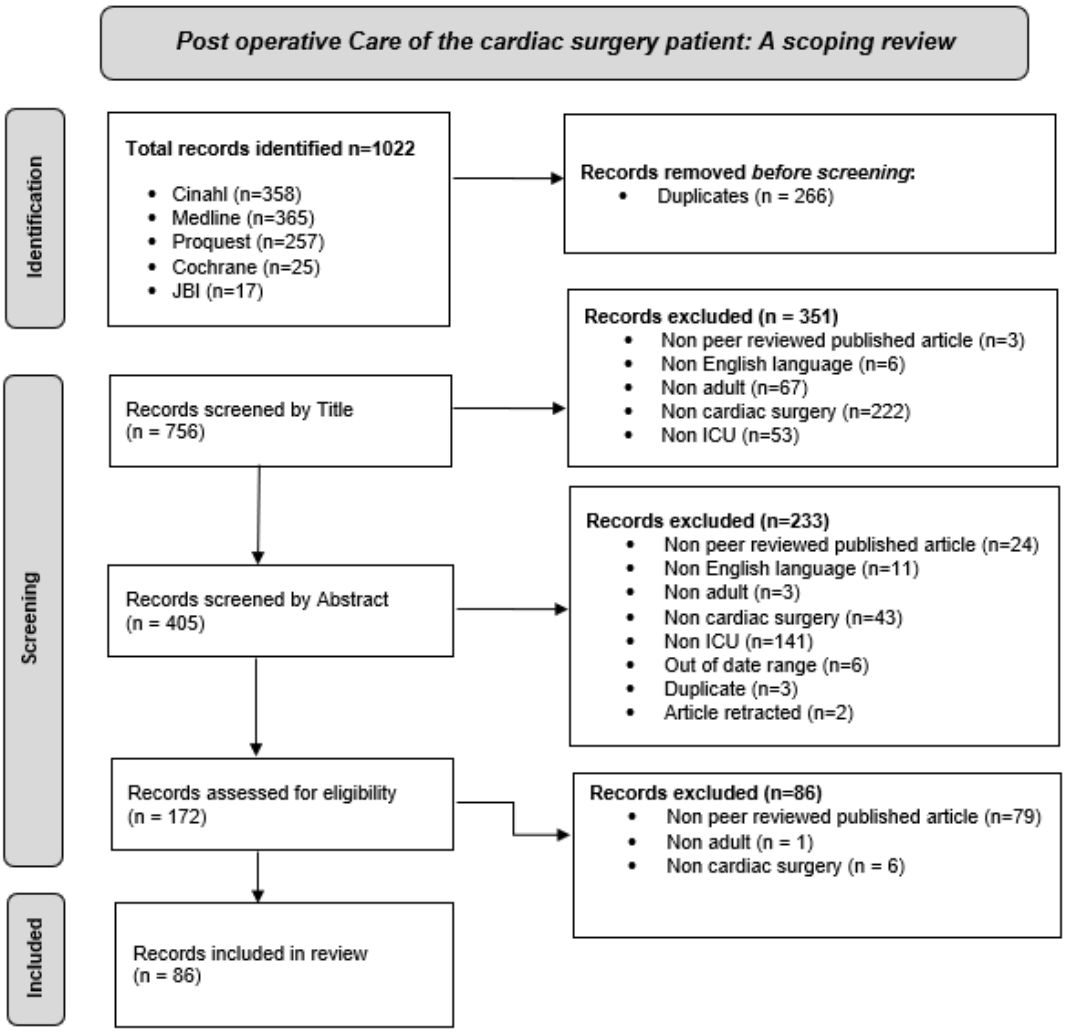
intervention publications and the Mixed Methods Appraisal Tool (MMAT).[39] The QI-MQCS tool outlines sixteen domains that have been tested to ensure reliability and validity. Each domain outlines the minimal standard required which is scored as either met of not met.[38] The MMAT is comprised of two components: screening questions and methodological quality criteria questions. The screening questions are to indicate if the MMAT is appropriate to use. The methodological quality criteria questions are divided into categories of study design such as qualitative or mixed methods, where only the appropriate category is addressed. Responses to each of the criteria range from yes, no or can't tell. Overall scores and excluding studies with low methodological quality for the MMAT is discouraged.[39]

Additional columns on the data charting form were created to incorporate the quality appraisal assessment tool questions. Each article was allocated an appropriate tool based on study methodology, grouped according to that tool then arranged on the excel spreadsheet according to the JBI level of evidence hierarchy. Clarification on selections of appropriate tool selection were made during research supervision team meetings. The final articles were summarised, and data inserted into the data charting tool before the creation of the QI appraisal tables which summarises each JBI tool, QI-MQCS and MMAT score. All selected articles were critically appraised with the intention of including in the review due to their potential influence on decision making during the development of the draft care map. Articles that were identified as low-quality studies (meeting less than 50% of the criteria) were reviewed by the research supervision team to ensure rigor and decisions to exclude articles were based on clinical relevance for the research project. Individual articles and decisions to discard are discussed in the critical appraisal results section.

Results

Of the 1,022 records identified 86 articles were selected and included in this scoping review. Figure 2.2 highlights the findings of the PRISMA flow diagram.

Figure 2.2 PRISMA flow diagram

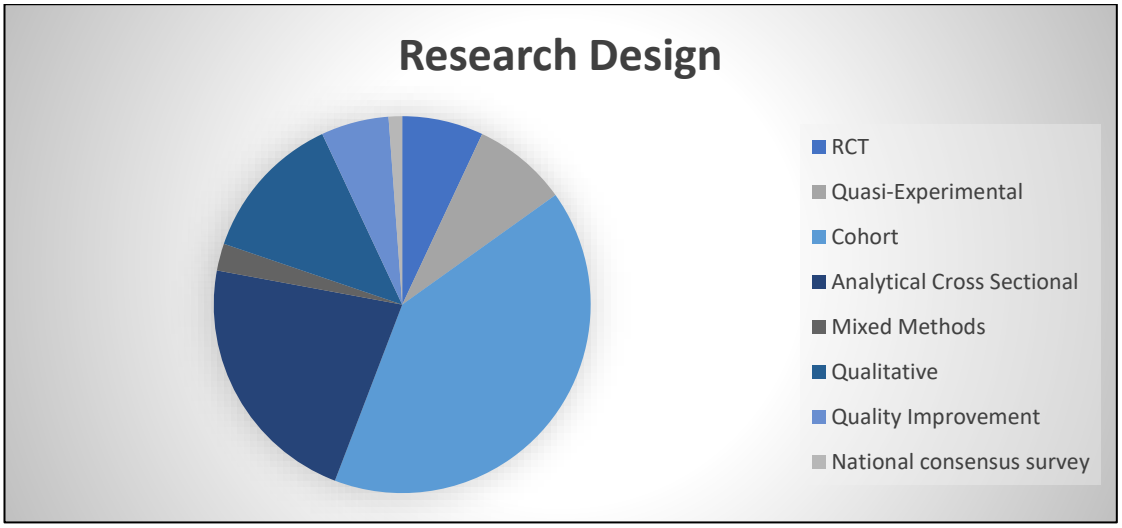


Characteristics of included articles

Research design

Of the 86 included articles six were randomised control trials, seven were quasi-experimental studies, 35 were cohort studies, 19 were analytical cross-sectional studies, two mixed methods, 11 were qualitative studies, five were quality improvement activities and one was a consensus survey (see Figure 2.3).

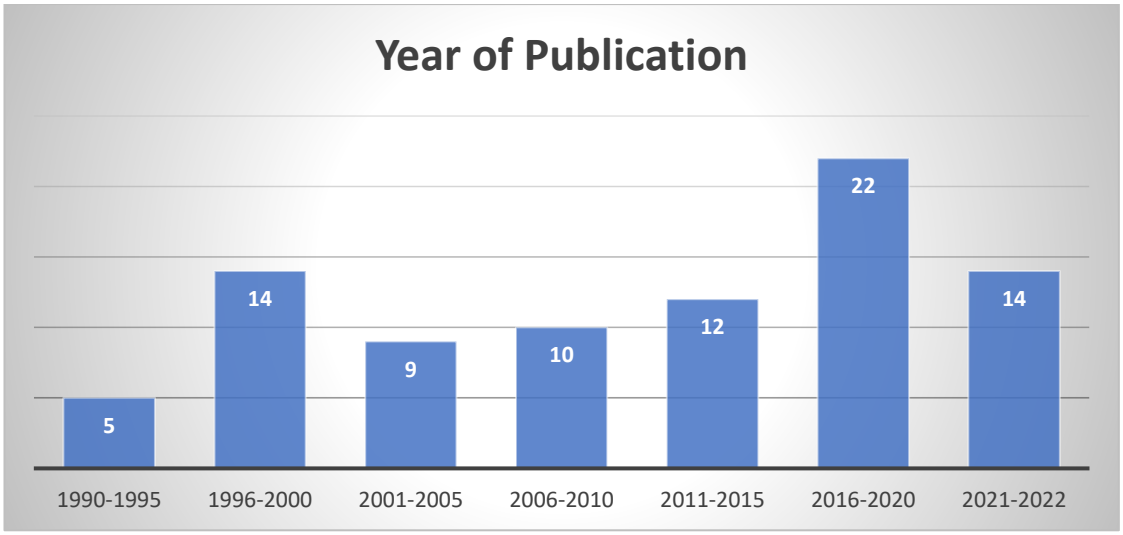
Figure 2.3 Research designs



Date of publication distribution

Reports of research activity relating to cardiac surgery initially surged in the late 1990s and then again in the late 2010s. In the two years from 2020 to 2022 there were 14 articles published internationally compared with 22 the previous five years anticipating that there will be continued contemporary research output in the coming years (see Figure 2.4).

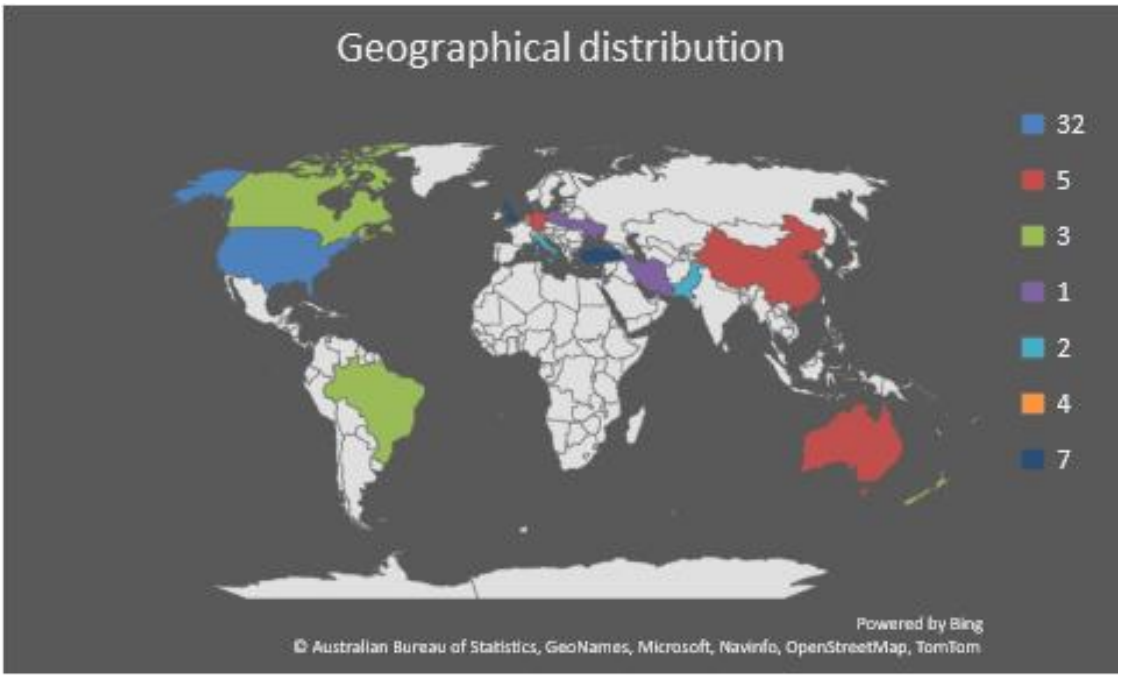
Figure 2.4 Date of publication distribution



Geographical distribution – country of origin

There is widespread international distribution of articles. The Unites States of America is the dominate country of origin publishing 32 research articles with others published in 19 countries including Denmark, Iran, Qatar, Turkey, Australia, China, and New Zealand (see Figure 2.5).

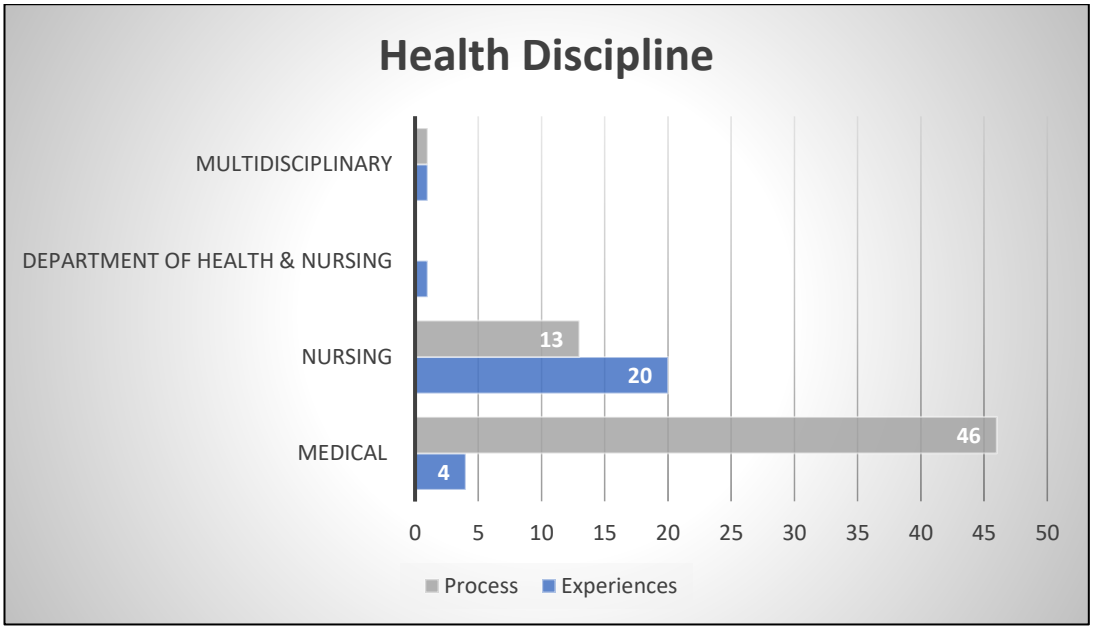
Figure 2.5 Geographical distribution – country of origin



Health discipline

Articles were grouped according to discipline: medicine, nursing, or multidisciplinary and further categorised into processes (quantitative) or experiences (qualitative), see Figure 2.6.

Figure 2.6 Health discipline/categories



The greatest number of included articles are quantitative designs led by medicine. Included nursing and multidisciplinary articles are both quantitative and qualitative designs.

Critical appraisal

The following section discusses the critical appraisal processes conducted in the scoping review. Given the range of study designs revealed in the included articles a variety of critical appraisal tools were selected to complete the appraisal process. The following information represents the findings of the critical appraisal process by study design.

Randomised control trials

Each of the six randomised control trials (RCTs) were assessed using the JBI critical appraisal checklist for RCTs which consisted of 13 questions (see Appendix 4). Overall scores ranged from 6 (46%) to 12 (92%) out of a possible 13 (see Table 2.3).

Table 2.3. Critical appraisal results of eligible studies using the JBI critical appraisal checklist for randomised controlled trials

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total No Y/%
Lai et al (2021)[41]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	**12 92%**
Parke et al (2021)[44]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	**12 92%**
Gilder et al (2020)[40]	Y	Y	Y	Y	N	U	Y	Y	Y	Y	U	Y	Y	**10 77%**
Lai et al (2016)[42]	Y	U	Y	Y	N	Y	Y	Y	U	Y	N	Y	Y	**8 61%**
Pazar et al (2020)[45]	Y	U	Y	N	U	U	Y	Y	U	Y	N	Y	Y	**7 54%**
McKendry et al (2004)[43]	U	U	Y	U	Y	U	Y	Y	U	Y	U	N	Y	**6 46%**
Total No. Y	**5**	**3**	**6**	**3**	**2**	**3**	**6**	**6**	**3**	**6**	**2**	**5**	**6**	

Y, Yes; N, No; U, Unclear. JBI critical appraisal checklist for randomized controlled trials.

Strengths of the RCTs included similarities between the baseline groups prior to the intervention and the identical treatment of groups other than the intervention of interest.[40-45] Follow up was complete and outcomes were measured in the same way for treatment groups. The chosen topics and trial designs were appropriately matched for all RCTs. Weaknesses of the RCTs included lack of blinding of those delivering treatment and reporting reliability of outcome measures. Despite lack of blinding appearing as a weakness, in the clinical context blinding for health professionals delivering interventions in three RCTs would not have been practical. Reliability of outcome measures and details surrounding the blinding procedures were either omitted or there was unclear reporting. The article with the lowest score (46%) lacked clarity in reporting which could be attributed to the historical age of the article. Over the years, requirements and reporting structures for research activities have become more robust improving the quality of articles.

Quasi-experimental studies

There were seven studies assessed using the JBI critical appraisal checklist for Quasi-experimental studies which consisted of nine questions (see Appendix 4). Overall scores ranged from five (55%) to nine (100%) out of a possible nine (see Table 2.4).

Table 2.4. Critical appraisal results of eligible studies using the JBI critical appraisal checklist for quasi-experimental studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total No Y/ %
Chen et al (2020)[46]	Y	Y	Y	Y	Y	Y	Y	Y	Y	**9 100%**
Kebapci et al (2018)[49]	Y	Y	Y	Y	Y	U	Y	U	Y	**7 78%**
Markham et al (2019)[50]	Y	Y	Y	Y	Y	U	Y	U	Y	**7 78%**
Yoo et al (2021)[52]	Y	Y	Y	Y	Y	N	Y	N	Y	**7 78%**
Velasco et al (1996)[51]	Y	Y	U	Y	Y	U	Y	U	Y	**6 67%**
Gooi et al (2007)[47]	Y	N	Y	Y	Y	U	Y	U	N	**5 56%**
Halpin et al (2006)[48]	Y	Y	U	Y	Y	U	Y	U	N	**5 56%**
Total No. Y	7	6	5	7	7	1	7	1	5	

Y, Yes; N, No; U, Unclear. JBI critical appraisal checklist for Quasi-Experimental studies.

Numerous strengths identified included clear explanations regarding the cause and effect, the presence of a control group, outcome measures compared in the same way as comparison groups and multiple outcome measures in both pre and post intervention of interest. Study weaknesses were related to inadequate or unclear descriptions involving participant follow up and reliability of outcome measures.

Cohort studies

There were 35 cohort studies assessed using the JBI critical appraisal checklist for cohort studies which consisted of 11 questions (see Appendix 4). There is a vast range of quality amongst the cohort studies with scores ranging from three (27%) to 10 (90%) out of 11 (see Table 2.5).

Table 2.5. Critical appraisal results of eligible studies using the JBI critical appraisal checklist for cohort studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total No Y/%
Ford et al (2020)[61]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	**10 91%**
Lee et al (2013)[8]	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	**9 82%**
Stevens et al (1995)[78]	Y	Y	Y	Y	Y	Y	Y	Y	U	N/A	Y	**9 82%**
Trussell et al (2008)[81]	Y	Y	U	Y	Y	Y	U	Y	Y	Y	Y	**9 82%**
Van Der Kolk et al (2017)[24]	Y	Y	Y	Y	Y	Y	N	Y	Y	N/A	Y	9 82%

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total No Y/%
Ender et al (2008)[59]	Y	Y	N	Y	Y	Y	N	Y	Y	U	Y	**8 73%**
Grutzner et al (2021)[62]	Y	Y	N	Y	Y	Y	N	Y	Y	N/A	Y	**8 73%**
Guo et al (2020)[63]	Y	Y	N	Y	Y	Y	N	Y	Y	N/A	Y	**8 73%**
Hansen et al (2015)[64]	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	**8 73%**
London et al (2000)[66]	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	**8 73%**
London et al (1998)[67]	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	**8 73%**
Meehan et al (1995)[71]	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	**8 73%**
Vitomskyi et al (2021)[82]	Y	Y	Y	Y	Y	Y	N	Y	N	N/A	Y	**8 73%**
Yazdchi et al (2021)[84]	Y	Y	Y	Y	Y	Y	U	Y	U	N/A	Y	**8 73%**
Alhan et al (2003)[53]	N	Y	Y	Y	N	Y	N	Y	Y	N/A	Y	**7 64%**
MacLeod et al (2022)[62]	Y	Y	N	Y	Y	Y	N	Y	N	N	Y	**7 64%**
Miller (1998)[72]	N	Y	Y	Y	N	Y	Y	Y	N	N/A	Y	**7 64%**
Richey et al (2018)[75]	Y	Y	U	Y	Y	Y	U	Y	U	N/A	Y	**7 64%**
Smith et al (2010)[77]	Y	Y	U	N	Y	Y	N	Y	Y	N	Y	**7 64%**
Williams et al (2019)[83]	Y	Y	Y	Y	N	Y	N	Y	U	N/A	Y	**7 64%**
Anderson et al (1999)[54]	Y	U	U	Y	N	N	Y	Y	Y	Y	N	**6 55%**
Capdeville et al (2001)[56]	N	Y	N	Y	Y	Y	N	Y	N	N/A	Y	**6 55%**
Engelman (1996)[60]	Y	Y	N	Y	N	Y	N	Y	N	N/A	Y	**6 55%**
Thomson et al (2014)[79]	Y	Y	U	N	N	Y	U	Y	Y	U	Y	**6 55%**
Van Der Kolk et al (2019)[22]	N	Y	N	Y	N	Y	N	Y	Y	N/A	Y	6 55%
Constantinides et al (2006)[57]	N	Y	N	Y	Y	N	N	Y	N	N/A	Y	**5 45%**
Naughton (2005)[73]	Y	N	N	Y	N	Y	N	Y	Y	U	N	**5 45%**
Quigley et al (1997)[74]	Y	Y	U	Y	N	Y	U	Y	U	N/A	N	**5 45%**
Borys et al (2020)[55]	Y	Y	N	N	N	N	N	Y	Y	N	Y	**4 36%**
Johnson et al (1997)[65]	N	U	Y	N	N	Y	Y	Y	N	N/A	N	**4 36%**
London et al (1997)[68]	N	U	N	Y	N	Y	N	Y	N	N/A	Y	**4 36%**
Marquez et al (1995)[70]	U	Y	N	Y	N	Y	N	Y	N	N/A	N	**4 36%**
Sedrakyan et al (2003)[76]	Y	Y	U	N	N	Y	U	Y	U	N/A	N	**4 36%**
Cove et al (2016)[58]	N	N	N	N	Y	U	N	Y	N	N/A	Y	**3 27%**

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total No Y/%
Tierney et al (2019)[80]	Y	N	U	N	N	Y	U	Y	U	N/A	U	**3 27%**
Total No. Y	24	29	11	27	19	31	7	35	16	5	28	

Y, Yes; N, No; U, Unclear; N/A, Not applicable. JBI critical appraisal checklist for Cohort Studies.

All studies reported on the follow up and the time to follow up was sufficient for the anticipated outcomes to occur. The majority of articles clearly defined the exposure measures which were similar for both the intervention and control groups. Study participants were free of the outcome at the beginning of the study and appropriate statistical analysis was used in a large portion of cohort studies. The validity of the measurement tool was mentioned in most studies however, omission or unclear descriptions encompassing the reliability of the outcome measurement tool was evident, making this checklist item a weakness for cohort studies. The reporting of follow up time was evident in 16 articles; the remaining 19 articles were unclear or did not report follow up time. Strategies to address loss to follow up therefore was not applicable for those 19 articles with a further two articles not clearly reporting strategies to address incomplete follow up.

Ten of the 35 articles received a score of less than 50% which was considered as a low-quality article. Some of these articles were dated from the 1990s when publishing guidelines did not exist and may account for the lack of clarity/critical appraisal. This difference in finding could also be explained by country of origin and varying journal publication standards of that time period. Following the critical appraisal process the supervision team determined that Sedrakyan[54] article would be excluded from the scoping review. The rationale for this decision was based on low quality coupled with the subject of volume expansion and mortality. Cove[58] and Tierney[80] were retained despite their low-quality assessment as the topic of mechanical ventilation remains of interest.

Analytical cross-sectional studies

There were 19 Analytical cross-sectional studies assessed using the JBI critical appraisal checklist for analytical cross-sectional studies which consisted of eight questions (see Appendix 4). Scores ranged from two (25%) to seven (88%) out of a possible eight (see Table 2.6).

Table 2.6 Critical appraisal results of eligible studies using the JBI critical appraisal checklist for analytical cross-sectional studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total No Y/ %
Wang et al (2015)[100]	Y	Y	Y	Y	Y	Y	N	Y	**7 88%**
Yorke et al (2004)[101]	Y	Y	Y	Y	Y	N	Y	Y	**7 88%**
Al-Daakak et al (2016)[87]	Y	Y	Y	Y	Y	N	Y	N	**6 75%**
Göktas et al (2016)[90]	Y	N	Y	Y	Y	Y	U	Y	**6 75%**
Haanschoten et al (2012)[7]	Y	Y	U	Y	Y	Y	U	Y	**6 75%**
Nickerson et al (1999)[94]	Y	Y	N	Y	Y	Y	U	Y	**6 75%**
Simpson et al (1996)[97]	Y	Y	Y	Y	Y	N	N	Y	**6 75%**
Zakhary et al (2015)[102]	Y	Y	N	Y	Y	Y	N	Y	**6 75%**
Akhtar et al (2016)[86]	Y	Y	U	Y	Y	N/A	U	Y	**5 63%**
Aslan et al (2015)[88]	Y	Y	N	Y	Y	N	U	Y	**5 63%**
Kiessling et al (2013)[91]	Y	Y	U	Y	Y	Y	U	Y	**5 63%**
Marosti Dessotte et al (2016)[92]	Y	Y	Y	Y	N	N	U	Y	**5 63%**
Valdix et al (1995)[99]	Y	N	Y	Y	N	N	Y	Y	**5 63%**
Mazer et al (1993)[93]	N	Y	Y	Y	N	N	Y	N	**4 50%**
Paarman et al (2012)[95]	N	Y	U	Y	Y	N	U	Y	**4 50%**
Shadvar et al (2015)[96]	Y	Y	N	Y	N	N	N	Y	**4 50%**
Toraman et al (2005)[98]	N	Y	U	Y	Y	N	U	Y	**4 50%**
Carey et al (2019)[89]	Y	N	N	Y	N	N	U	Y	**3 38%**
Ahmed et al (2010)[85]	N	Y	U	Y	N	N	U	N	**2 25%**
Total No. Y	15	16	8	19	13	6	4	16	

Y, Yes; N, No; U, Unclear; N/A, Not applicable. JBI critical appraisal checklist for Analytical Cross-Sectional Studies.

Five of the eight critical appraisal questions were addressed well by majority of the studies. The criteria utilised for measuring the condition of interest was objective, the study subjects and setting were described in adequate details, appropriate statistical analysis was used, and the inclusion criteria was clearly defined for the sample population. Checklist items poorly achieved were the reliability of the outcome measures and the exposure measures. The articles addressed validity but lacked

clarity around the reliability of the measurements. Strategies to deal with confounding factors was omitted in most articles. Two articles were highlighted as low-quality scoring less than 50%. Poor reporting structure and patient selection with possible bias are the reasons for exclusion of Ahmed et al.[85] The article by Carey et al[89] was retained in the scoping review as the topic remains of interest but the small sample size will limit the generalisability of findings.

Qualitative research

Eleven studies were assessed using the JBI critical appraisal checklist for qualitative research which consisted of 10 questions (see Appendix 4). Scores ranged from eight (80%) to 10 (100%) out of a possible 10 (see Table 2.7).

Table 2.7 Critical appraisal results of eligible studies using the JBI critical appraisal checklist for qualitative research

	Domains										
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total No Y /%**
Lupieri et al (2016)[110]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**10 100%**
Gardner et al (2005)[106]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	**9 90%**
Gilder et al (2022)[40]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	**9 90%**
Hunt (1999)[108]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	**9 90%**
Schou et al (2008)[112]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	**9 90%**
Albanesi et al (2022)[103]	Y	Y	Y	Y	Y	N	N	Y	Y	Y	**8 80%**
Doering et al (2002)[104]	Y	Y	Y	Y	Y	N	Y	Y	N	Y	**8 80%**
Dunckley et al (2007)[105]	Y	Y	Y	Y	Y	N	N	Y	Y	Y	**8 80%**
Hancock et al (2006)[107]	Y	Y	Y	Y	Y	N	N	Y	Y	Y	**8 80%**
Lisboa Gois et al (2012)[108]	Y	Y	Y	Y	Y	U	U	Y	Y	Y	**8 80%**
Milani et al (2018)[111]	Y	Y	Y	Y	Y	N	N	Y	Y	Y	**8 80%**
Total No. Y	11	11	11	11	11	1	6	11	10	11	

Y, Yes; N, No; U, Unclear; N/A, Not applicable. JBI critical appraisal checklist for Qualitative Research.

There was an overall high standard with only two domains scored poorly; the values, beliefs, and influence of the researcher on the proposed research lacked clarity or was omitted in most articles.

Quality improvement

Five articles were assessed using the quality improvement minimum quality criteria set (QI-MQCS) which consisted of 16 domains that were either met or not met (see Appendix 4). Scores ranged from nine (56%) to 14 (88%) out of the possible 16 (see Table 2.8).

Table 2.8 Critical appraisal results of eligible studies using the Quality Improvement Minimum Quality Criteria Set (QI-MQCS)

	Domains																
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Total No M/%**
Starks et al (2011)[115]	M	M	M	M	M	M	M	N	N	M	M	M	M	M	M	M	**14 88%**
Ellis et al (2021)[113]	M	M	M	M	M	M	M	M	M	N	M	N	M	M	N	M	**13 81%**
Jacob et al (2021)[114]	M	M	M	M	M	N	M	M	M	N	M	M	M	M	N	M	**13 81%**
Hartjes et al (2018)[25]	M	M	M	M	M	M	N	M	N	M	M	M	M	M	N	M	**12 75%**
Jacavone et al (1999)[26]	M	N	M	N	M	M	M	N	N	M	M	M	N	M	N	N	**9 56%**
Total No. M	5	4	5	4	5	4	4	3	2	3	5	4	4	5	1	4	

M, Met; N, Not Met. Quality Improvement Minimum Quality Criteria Set (QI-MQCS).

Domains that were addressed in all articles were the organisation's motivation for the intervention of interest along with an adequate description of this intervention, the implementation, health related outcomes and sustainability of the intervention of interest. Domains less well addressed were due to omission of information about the ability of the intervention to replicate in other settings and the timing of the evaluation in relation to the intervention implementation.

Mixed methods

Two articles were assessed using the MMAT consisting of four sections; two screening, five qualitative, five quantitative and five mixed method questions (see Appendix 4). Scores ranged from 15 (88%) to 17 (100%) out of 17 (see Table 2.9).

Table 2.9 Critical appraisal results of eligible studies using the Mixed Methods Appraisal Tool (MMAT)

	Screening		Qualitative					Quantitative					Mixed Methods					Total No Y/ %
	1	2	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Kuperberg et al (1997)[117]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**17 100%**
Edeer et al (2020)[116]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	**15 88%**

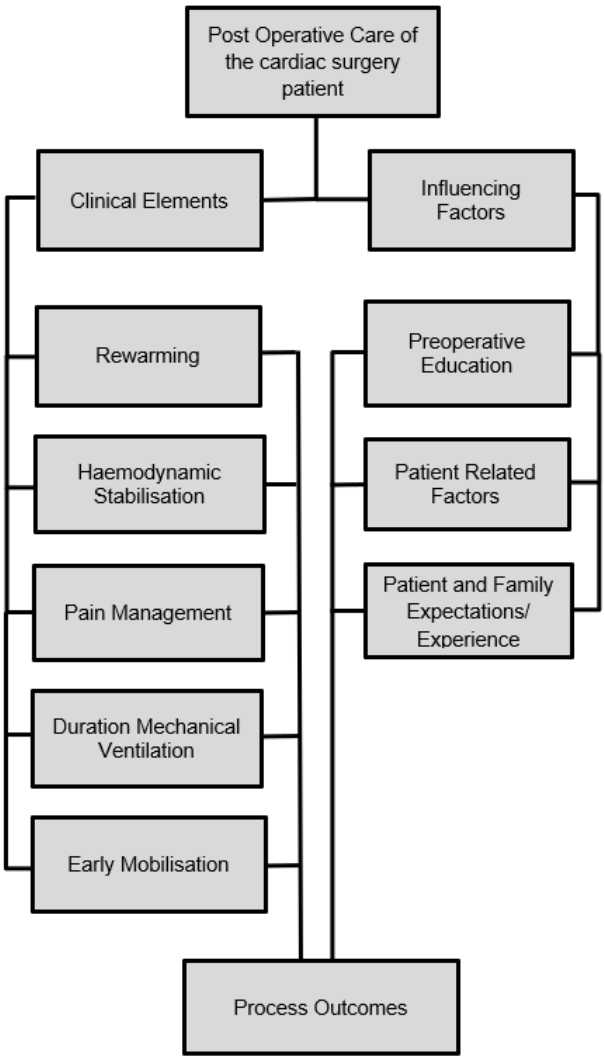
Y, Yes; N, No; C, Can't tell. Mixed method Appraisal tool.

The mixed method studies were of high quality, with one article having two criteria not being met. Lack of reported information regarding rationale for the mixed method design and the interpretation of the combined components.[116]

Included article summary

Eighty-six articles were found and following the critical appraisal process two articles were excluded, eighty-four articles remained. Major topics in each of the eighty-four included articles were identified and labelled in the data charting form. Categories were created and components of post operative care of the cardiac surgery patient organised as clinical elements and influencing factors. Each component has a direct effect on the process of care outcomes. A care map framework was developed to illustrate the interrelationships of components and process outcomes (see Figure 2.7).

Figure 2.7 Care map framework for post operative care of the cardiac surgery patient



Clinical elements

***Rewarming*.** Hypothermic Cardiopulmonary bypass (CPB) is a traditional component for the majority of cardiac surgical procedures. The purpose of hypothermia is to slow cellular metabolism and decrease oxygen consumption and energy demand.[118] Metabolic protection offered by hypothermia enables safe circulatory arrest during cardiac surgical interventions. Consequences of hypothermia include coagulopathy due to platelet dysfunction leading to an increased risk of bleeding, arrhythmias, electrolyte depletion, increase systemic vascular resistance and an increased risk of infection as the immune response is suppressed.[2,118] Consequences also include shivering and an increased oxygen demand coupled with a shift in the oxygen disassociation curve to the left reducing oxygen availability to tissues.[2,118] Rewarming results in vasodilation increasing vascular space and

reducing cardiac preload. Electrolyte imbalances occur as intravascular volume is manipulated causing haemodynamic instability. Only one article, dated mid 1990s[78] specifically examined protocols for patient rewarming post operatively. Several articles mention warming patients using external convective warming systems[47,53,59,62] but no article has compared rewarming techniques in the cardiac surgical patient cohort. Rewarming the ICU post operative hypothermic patient is addressed in the literature but not specifically for the cardiac surgery patient including the ideal time frame for rewarming.[59]. Given the literature directions it is recommended that:

- Normothermia (36 to 37 degrees Celsius) within 2-4 hours of arrival in ICU to reduce the complications associated with hypothermia which is a strong recommendation.[47,53,59,62,78,85,119]

***Haemodynamic stabilisation*.** Cardiopulmonary bypass (CPB) provides oxygenated blood and organ perfusion during cardiac surgery procedures. The heart is arrested and lungs deflated to facilitate an expansion of the surgical field allowing the surgeon improved access to the heart.[98] A systemic inflammatory response is activated when blood comes in contact with the synthetic tubing, oxygenator and filters of the CPB circuit leading to activation of the vascular endothelial and possible damage.[2,118] The oxygenator and blood pump also contribute to red blood cell and platelet destruction causing the creation of small emboli which may result in ischaemic cell death, increased capillary permeability and vasodilation.[2]

Fluid management and vasopressor therapy are two components that contribute to haemodynamic stability management. Five articles from 2005 to 2021 addressed goal directed therapy using stroke volume variation,[44] stroke index[43] or stoke volume[79,120] to guide administration of fluids. This produced an overall reduction in fluid administration with no significant difference in duration of vasopressor therapy[44] or incidence of acute kidney injury.[79] Various methods for measurement include transoesophageal echo (TOE),[120] oesophageal doppler,[43] Flowtrac system[44] or LidCO monitors.[79]

The aim of fluid administration guideline review in the post operative period is to avoid fluid overload and associated complications. Therefore, recommendations from the literature include:

- Use of goal directed therapy for fluid administration which is a medium recommendation.[43,44,79,120,121]
- Fluid bolus volumes to commence at 250mls which is a medium recommendation.[43,44,79,121]

Key stakeholder discussion to determine goals to be achieved and method of measurement will be required.

***Pain management*.** Patient experiences of pain and relevant pain management strategies were explored in seven articles dated 1995 to 2019. Healthcare professionals play a crucial role in managing post operative pain yet a variation in the frequency of pain assessments and pain relief mismanagement have been identified.[101,117] Evidence was also found that nurses were dispensing considerably less pain relief than prescribed and patients aged over 65 years received significantly less than those under 65 years despite increased pain scores.[101] Patients' declared pain as the most stressful component in their post operative recovery[89] yet there is a reluctance by patients to report it to nursing staff.[101,117] Reasons for this reluctance include fear of overdose, fear of addiction and the belief that nurses were already dispensing what was prescribed.[71,117] Evidence also suggests pain mismanagement prior to pain provoking activities such as drain removal and mobilisation.[117] A multimodal approach commencing in the preoperative period has been utilised in early recovery after surgery programs with positive results.[50,83]

Recommendations from the literature include:

- Multimodal analgesia regimen which is a strong recommendation.[50,83]
- Pain management initiation in the preoperative phase which is a medium recommendation.[50,71]
- Frequent prompts for nurses to complete a postoperative pain assessment which is a medium recommendation.[71,117]
- Patient education on importance of adequate pain control which is a strong recommendation.[83,99,101,117]

***Mechanical ventilation*.** Early extubation has been a dominant topic in the literature over the past 30 years with 38 articles dated 1995 to 2022. The definition of early extubation shifted over time with earlier articles defining early extubation as between 10-12 hours[67,70] progressively decreasing to eight hours[58,26] and more recent research defining early extubation as within six hours.[75,80,86,113] This is most likely linked to improvements in anaesthetic techniques and drugs. The consensus covering either fast-track protocols or solely the extubation process was that early extubation is safe. In fact, the use of an extubation protocol is a useful tool in streamlining the process and reducing any barriers that may prolong ventilation times.[58,75,80,113]

Given the vast range of literature on this topic it is recommended that:

- Extubation within six hours of arrival to ICU (Can aim for shorter time dependent on surgery) with the use of an extubation protocol which is a strong recommendation.[53,58,60,67,74,75,80,86,113]

***Early mobilisation*.** Early mobilisation plays an integral role in the physical and psychological recovery of patients post cardiac surgery. Benefits of early mobilisation include reduced risk for thrombosis, hospital acquired infections, pressure injuries and delirium.[25,114] Seven articles addressed early mobilisation, two are dated in 1999 with the remaining five from 2017 to 2022. Adequate pain management is crucial to ensure patient participation and cooperation.[114] Mobilisation progresses from sitting on edge of bed to sitting in chair to walking with physiotherapists or nurses. The primary aim of sitting in a chair is to improve patients' physical and psychological recovery and can be achieved within 6-12 hours post extubation[49,114] or day one post surgery.[24,26] Early ambulation has been shown to reduce the risk of complications such as atelectasis or deep vein thrombosis therefore reducing the ICU length of stay along with enhancing the patients psychological recovery from surgery so should begin at the earliest time.[25,54,114,119]

Recommendations from the literature include:

- Mobilise to chair within 6-12 hours post extubation or day one post surgery which is a strong recommendation.[24,26,49,114]
- Ambulation with the assistance of an appropriate healthcare worker within first 24 hours post-surgery which is a strong recommendation.[25,54,114,122]
- Preop patient education about importance of and to understand how to mobilise postoperatively which is a weak recomendation.[119]

Influencing factors

***Preoperative education*.** Preoperative education can have a positive effect for both patients and families in the post operative setting. Three recent articles (2021-2022)[41,45,52] specifically addressed the influence of preoperative education. Positive effects include reduced anxiety, improved satisfaction, and increased patient comfort which lead to enhanced ventilator synchrony and haemodynamic stability.[41,45,52]

Articles related to preoperative education have begun to emerge due to an increasing interest in patient centred care. Recommendations from the literature include:

- Ensure adequate preoperative education including:[41,42,45,52]
  - What to expect when in ICU.
  - Importance of good pain control.

***Patient related factors*.** Successful outcomes when utilising clinical pathways rely on appropriate patient selection.[57] Thirteen articles, between 1997 to 2021 addressed risk factors related to either clinical pathway use or prolonged mechanical ventilation. Patient demographic variables such as advanced age and gender were linked to poorer outcomes. The definition of advanced age varies from 65 years[7,91] to 70 years[67,72,102] with some articles not providing a definition.[7,63] Females are considered to be at higher risk of complications due to coronary artery disease developing after menopause which equates to older age, more comorbidities and different pathology then males.[102] Preoperative assessments to identify left ventricular dysfunction with an ejection fraction <35%,[7,54,57] renal insufficiency, pre op Intra-Aortic Balloon Pump,[57] redo operations,[57] New York Heart Association class >3,[91] length of operation time, [91,102] aortic cross clamp times[102] and higher serum creatinine or renal impairment [57,102] have all been contributed as predictors to failure of a clinical pathway.

Patient inclusion criteria for 11 articles comprised low risk, non-complex surgeries such as Off Pump Coronary Artery Bypass Graft (OPCABG), Coronary Artery Bypass Graft (CABG) +/- valve or isolated non-complex surgeries which were conducted under controlled circumstances (elective surgery). Only two articles integrated high-risk patients into their studies; defined as a EuroSCORE© 6[53] or emergent cardiac surgery.[74] Results indicated that high risk patients had slightly longer intubation times and more pulmonary complications which led to extended ICU length of stay[53,74].

Recommendations from the literature to improve the likelihood of success in utilising a care map include:

- Inclusion criteria to consider age limits[7,63,67,72,91,102], preoperative medical history[7,54,57,91,102], and intraoperative times[91,102]. To be discussed with key stakeholders as a weak recommendation.

Patient and family expectations/experiences. Twenty-three articles addressed at least one aspect of either expectation or experiences for patients or relatives. There were four main areas of concern for patients which included discomfort related to mechanical ventilation, lack of sleep, pain, and excessive thirst.[92,100,109] Specific issues with mechanical ventilation included the discomfort of the endotracheal tube and communication barriers.[89,103,106,109,116] Sleep deprivation was common in the post operative period which increased the risk for delirium.[92] Noise, pain and care interventions were the key factors affecting the quality of sleep.[92,97,100,104,108] Patient and family satisfaction levels were closely linked to the

above concerns. Additionally, satisfaction was associated with understanding of the recovery principles and the level of family/patient involvement.[41,52,83,88,96,110]

Health consumer involvement is increasing with recommendations from the literature including:

- Patient preoperative education to include:
  - Recognition of potential communication barriers and alternate ways to communicate.[89,103,106,109,116]
  - Identifying barriers to sleep and ways to overcome.[92,97,100,104,108,109]
- Family involvement:[41,42,52,83,88,96,110]
  - Outline level of involvement for families during ICU stay.
  - Educate healthcare workers to ensure adequate family involvement.

***Process outcomes*.** Nineteen articles evaluated the effectiveness and safety of clinical pathways for a variety of cardiac surgical procedures including CABG (with or without the use of CPB), valve repair and replacements and complex aortic root repairs or a combination. Each article reported encouraging or favourable improvements in outcome measures such as reduction in ICU length of stay, hospital length of stay and costs without increasing complication rates, morbidity or mortality. A clinically significant reduction in ICU length of stay of between 10 to 72 hrs was reported in 16 articles with the remaining three reporting a reduction of four hours or less which equates to less than a clinical nursing shift[24,50,53] and maybe less clinically important (see Table 2.10).

Table 2.10 Variations in ICU length of stay

Author	Year	Country	Pre protocol	Post protocol
Marquez et al[70]	1995	USA	48hrs	24hrs
Velasco et al[51]	1996	USA	48hrs +/- 67hrs	36hrs +/- 21 hrs
London et al[68]	1997	USA	96hrs	49hrs
Quigley et al[74]	1997	USA	62hrs	41 hrs
Alhan et al[53]	2003	Turkey	25.6 hrs	21.5hrs
Halpin et al[48]	2006	USA	Male: 25hrs Female: 32hrs	Male: 15hrs Female: 12 hrs
Gooi et al[47]	2007	Australia	26hrs	8hrs
Ender et al[59]	2008	Germany	ICU/PACU 20hrs	ICU/PACU 4hrs
Van Der Kolk et al[24]	2017	Netherlands	23hrs	22hrs
Hartjes et al[25]	2018	UK	96 hrs	48 hrs
Kebapci et al[49]	2018	Turkey	50.7hrs	38.9hrs
Li et al[120]	2018	China	20.9hrs	22hrs

Author	Year	Country	Pre protocol	Post protocol
Van Der Kolk et al[22]	2019	Netherlands	96hrs	24hrs
Markham et al[50]	2019	USA	96hrs	72 hrs
Williams et al[83]	2019	USA	43 hrs	28 hrs
Borys et al[55]	2020	Poland	48hrs	20hrs
Chen et al[46]	2020	China	51.78 +/- 23.69 hrs	50.18 +/- 10.11 hrs
Yazdchi et al[84]	2021	USA	48 hrs	28 hrs
MacLeod et al[69]	2022	Canada	20.4hrs	7.8hrs

Sixteen articles reported decreased Hospital length of stay by more than 24 hours with the use of clinical pathways. The remaining four articles reported no significant difference (see Table 2.11).[24,50,53,62]

Table 2.11 Variations in hospital length of stay

Author	Year	Country	Pre protocol	Post protocol
Marquez et al[70]	1995	USA	13 days	10 days
Engelman et al[60]	1996	USA	26% discharged at 3-5 days	48% discharged at 3-5 days
Velasco et al[51]	1996	USA	11.1 +/- 6 days	7.7 +/- 2.3days
London et al[68]	1997	USA	10 days	7 days
Quigley et al[74]	1997	USA	7.5 days	6.4 days
Jacavone et al[26]	1999	USA	8 days	7 days
Alhan et al[53]	2003	Turkey	5.8 days	5.6 days
Halpin et al[48]	2006	USA	Male: 5 days Female: 6 days	Male: 3 days Female: 4 days
Gooi et al[47]	2007	Australia	7 days	5 days
Ender et al[59]	2008	Germany	11 days	10 days
Van Der Kolk et al[24]	2017	Netherlands	7 days	6.9 days
Hartjes et al[25]	2018	UK	7 days	6 days
Kebapci et al[49]	2018	Turkey	6.7 days	6 days
Li et al[120]	2018	China	7 days	6 days
Van Der Kolk et al[22]	2019	Netherlands	13 days	7 days
Markham et al[50]	2019	USA	9 days	8 days
Williams et al[83]	2019	USA	7 days	6 days
Borys et al[55]	2020	Poland	10 days	7 days
Chen et al[46]	2020	China	8.79 +/- 4.76 days	8.64 +/- 2.82 days
Yazdchi et al[84]	2021	USA	6 days	5 days

Three articles included an economic evaluation reporting cost difference with the reduction in hospital and ICU length of stay in Chinese Yuan[46,120] and United States

dollars[51,53]. The remaining did not report cost implications of a reduction in ICU and/or hospital length of stay.

Post operative care of the cardiac surgery patient has been a topic of discussion since the 1990s.[1,123] Financial cost savings and improved quality of care with a patient centred approach are the key drivers for this continuing debate.[69,93,119] Despite the overwhelming positive influence that care pathways have, there are still many barriers to their implementation. Strong individual surgeon and intensivist based preferences along with complex systems of care are amongst the main barriers to the introduction of enhanced recovery principles.[83] Traditional research focused on outcomes such as mortality and morbidity rather than the more sophisticated outcome of enhanced recovery. Within the current economic climate to improve longevity of the healthcare system it is essential that we maintain efficiency of care which can be achieved by supporting the introduction of a structured pathway for cardiac surgery patients. Enhanced recovery after surgery concepts have been linked to improved outcomes such as patient and family satisfaction and reduced ICU length of stay.

Patient experience and family satisfaction account for one quarter of the total number of articles included in this review so by working in partnership, positive solutions can be negotiated leading to effective participation and satisfaction by all parties in the post operative recovery process. Patient satisfaction can potentially be influenced by discomfort and distress from the inability to communicate with an endotracheal tube insitu, unsatisfactory pain levels, excessive thirst and sleep deprivation in the ICU. Family satisfaction has been linked to understanding the recovery process along with visiting and receiving information related to their loved one in the ICU.

Recommendations from the literature include:

- Introduction of a care map.[22,24,25,47-49,51,53,54,59,60,62,65,68,73,74,80,83,98]
- Monitor impact on process measures.[22,46,49,69,84,120]

Conclusion

The aim of the scoping review was to provide a summary of available research on post operative cardiac surgery patients which included the use of practice frameworks, patient and family experiences and their satisfaction levels in the intensive care unit. Eighty-six articles were reviewed and critically appraised with eighty-four articles selected and summarised outlining key components of the post operative period. Key components were divided into clinical elements and influencing factors which were illustrated in a care map framework (see Figure 2.7) showing their

interrelationship. Identified clinical elements included rewarming, haemodynamic stabilisation, pain management, mechanical ventilation duration and early mobilisation. Factors influencing outcomes associated with the care map include preoperative education, patient related factors such as current medical history or patient demographics and experiences or expectations of both patients and families.

Article characteristics were displayed according to research design, date of publication distribution, geographical distribution and health discipline. All selected articles followed a critical appraisal process and given the range of study designs a variety of critical appraisal tools were selected including the Joanna Briggs Institute critical appraisal tools. Low quality articles were defined as meeting less than 50% of the criteria with 13 low quality articles found with only two excluded. The remaining articles were included regardless of quality as strengths and weaknesses of articles will give guidance to the development of a draft care map.

Recommendations based on the literature were formulated for each of the clinical elements and influencing factors. Findings from the scoping review revealed that potential omissions in the literature exist which included cardiac surgery specific rewarming techniques and the timing of tasks required for ward readiness. Perhaps one of the reasons for this omission is that site specific guidelines and surgeon preferences may influence practice.

Chapter 3 Benchmarking Current to Evidence-Based Practice

Introduction

Facilitation of the timely transition through ICU and enhancement of patient experience were amongst the aims of this project. This can be achieved through the process of benchmarking with the review of current practice being the foundation. Benchmarking was first introduced over 30 years ago and has become an integral component of todays' healthcare system[124,125]. Benchmarking is a practice where an organisations activity is compared against a predetermined acceptable or established standard of practice for the purpose of identifying if inefficiencies are evident.[124,126] These comparisons allow healthcare facilities to evaluate their activities and devise strategies to improve their clinical services and also reputation.[125] Established standards of practice can be sourced from recognised, highly rated, or efficient facilities with similar services.[126] Sharing best practice guidelines amongst healthcare providers is an essential component to ensuring high quality healthcare.[127]

Determination of the best standard of care for post operative cardiac surgery patients can be achieved by reviewing published patient data.[126] The Australia & New Zealand Society of Cardiac & Thoracic Surgeons (ANZSCTS) is a professional organisation that represents the interests within this specialty with memberships available for medical and nursing professionals. The society aims to ensure quality outcomes in this highly technical surgical specialty.[128] Goals for ANZSCTS include improving the quality of patient management with continuing education, monitoring morbidity and mortality rates in addition to encouraging and supporting ongoing research which can potentially improve patient outcomes.[128] Benchmarking is undertaken through collaboration of 60 cardiothoracic centres across Australia and New Zealand where data collected enables performance comparison between centres. The cardiac surgery database was established in 1999[129] and currently includes 26 public and 34 private hospitals contributing data from approximately 15,000 cardiac surgeries per year. Initial Key Performance Indicators (KPIs) in 2001 included outcome metrics of 30-day mortality rate, bleeding with return to theatre, new onset renal insufficiency, permanent stroke and deep sternal wound infections[130]. In 2018, adjustments were made to include more clinically specific data such as blood product usage, ICU length of stay, ventilation time and hospital length of stay.[129]

The ANZSCTS monitor blood transfusion use and refer to the Australian National Blood Authority's guidelines which were developed in 2012, outlining preoperative blood management strategies. The aim of the guidelines were to rationalise and reduce the administration of blood transfusions in the perioperative patient as a link to increased hospital length of stay for patients who received a blood transfusion in perioperative period was evident.[8] The prevention and management of hypothermia is a post operative specific recommendation for blood management.[131] These guidelines have led to more efficient use of blood with substantial financial and economic benefits.[132]

Australian ICU Nurses are governed by the Nursing and Midwifery Board of Australia (NMBA) who ensure professional registration to suitably qualified and safe practitioners. Protecting the public is one of their key roles and is achieved by the development of professional standards, codes and guidelines for the profession.[133] The NMBA have an active role in the approval of accreditation standards and the accreditation of educational courses.

The Australian College of Critical Care Nurses (ACCCN) represent nurses working in educational, management, research or clinical roles within the specialty of critical care[134]. The ACCCN aims include supporting nursing research with evidence-based practice at the forefront, improving the quality of care and therefore outcomes for the critically ill patient and their families and providing valuable educational programs to improve the knowledge and skills of the critical care nurse.[134] These organisations outline professional standards with evidence-based practice being a vital component for improving patient care and clinical decision making for nurses. Although there is no direct contribution to benchmarking these organisations advocate for evidence-based practice which forms a component of the benchmarking process.[126]

For this project, benchmarking was based on a comparison between literature, current practice at the study site, ANZ database statistics and various Australian ICU document/guidelines. The NSQHS standards advocate for the monitoring of delivered care and adherence to policies within an organisation.[135] Reviewing current practice will assist in identifying any existing inefficiencies when compared with benchmarking policy documents and ANZ database key performance indicator data.

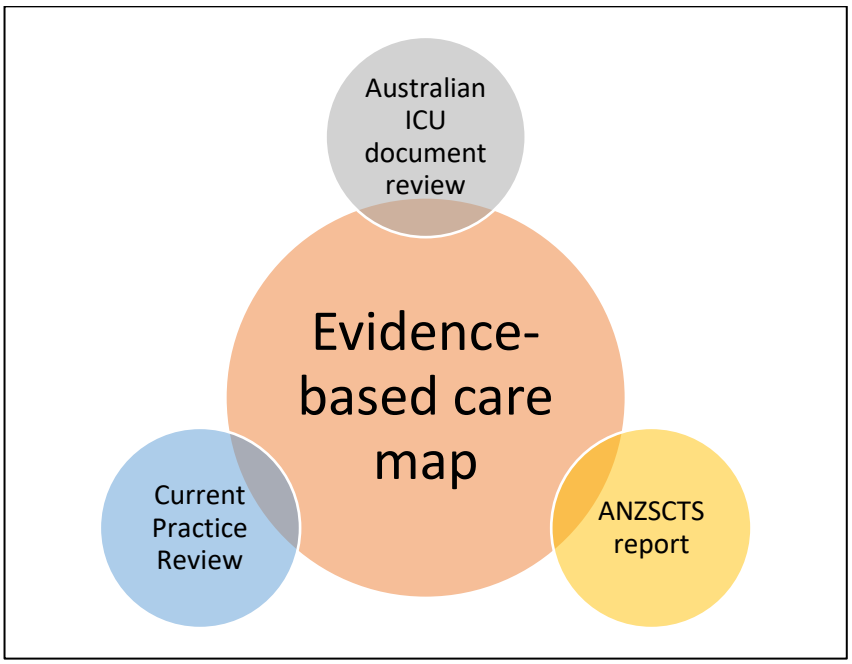
The optimising of ICU patient care engages not only the processes and procedures to achieving readiness for ward transfer, but also enhances the patient experience through their active participation. The facilitation of a smooth ward transfer in a timely manner relies on patient readiness and the availability of beds within the ward.[2]

Additional stress is not only placed on the healthcare staff but also patients and their families when transfers are delayed, rushed or don't occur during daylight hours with the significant difference in level of care between the wards and the ICU.[2] Facilitating timely transition improves patient flow subsequently reducing the ICU stay and maintaining an efficient and cost-effective management of valuable resources.

Data Sources

Three sources formed the benchmarking process for this study with source one ensuing a document/guideline review from Australian ICUs to determine current practice in each context; source two consisted of a review of the latest available ANZSCTS annual report and source three, a current practice review with the completion of a retrospective observational study at the study site. Each source was designed to examine data from a different perspective to ensure a comprehensive chain of evidence was determined to inform combining of data[136] in the development of an evidence-based care map (see Figure 3.1).

Figure 3.1 Sources of data



As discussed in Chapter Two, the care map framework determined from the literature, identified the interrelated post operative elements and processes. Data extracted for each data collection source were based on the elements presented in the care map framework for post operative care of the cardiac surgery patient (see Figure 2.7). Blood transfusion data is incorporated into haemodynamic stabilisation to capture

input from all three sources. Although each clinical element is interrelated, the reporting structure for the benchmarking process followed the same format illustrating the clinical flow of recovery goals in the post operative period.

Ethical considerations

A quality improvement project application was submitted to Fiona Stanley Fremantle Health Group using the GEKO database and included activity reason, relevant accreditation standard and criterion, objectives, inclusion and exclusion criteria and methodology for obtaining data for all sources. The application (Quality Activity 49688) was approved on 8th May 2023 (see Appendix 11). Subsequent, reciprocal recognition and approval was obtained from Curtin University Human Research Ethics Committee on 26th May 2023, (HRE2023-0263 approval number) (see Appendix 12).

Confidentiality and data security were the primary ethical considerations for this portion of the project. Participating hospital sites for the ICU document review and patient identifiers for the current practice review were each coded prior to the data extraction process. Documents from participating ICUs and the Microsoft Excel© spreadsheet containing the master patient list including patient identifiable data were stored separately in a WA Health w:drive folder which is a secure database with limited staff access. For additional security and confidentiality, the folder was password protected which also followed the institutional guidelines regarding storage and retaining of data in a confidential and secure manner. All data was then separated from patient identifiers and reported collectively, with no reference to individual or identifiable information.

Source 1: Australian ICU document review

Objectives for this data collection were to:

- Locate policy and procedure documents related to the care of the post operative cardiac surgery patient from selected Australian ICUs.
    - Compare and contrast the content within the post operative care documents.

Methodology

Sampling. Purposeful sampling limited participation to two hospital sites per Australian state.

Inclusion criteria. Hospital sites were considered based on their contribution to the cardiac surgery database for more than five years, demonstration of high cardiac surgery caseloads per annum (>600 cases/year) and/or one of the largest ICUs in their state or territory specialising in cardiothoracic care.

Search strategy. A systematic and logical search for Australian policy and procedure documents related to care of the post operative cardiac surgery patient in the Intensive Care Unit was conducted. The Google© search engine was explored using the phrase combination "cardiothoracic surgery society" which located the Australian & New Zealand Society of Cardiac & Thoracic Surgeons' official website. Exploration of this website identified all Australian hospital sites contributing to the cardiac surgery database.128 Individual hospital websites were searched to identify range of services, training centre or referral centre status with additional details such as volume of cases per year obtained from the 2020 ANZSCTS annual reports. All hospital sites were assessed against the inclusion criteria for eligibility status. The search for policy and procedure documents from eligible hospital sites were initiated by exploration of the Google Scholar© search engine using combinations of search terms such as hospital name, cardiac surgery, policy and procedures or standards but did not locate any publicly available policy and procedure documents. Intensive Care Unit Nurse Unit Managers (NUMs) from selected sites were contacted by email. An information letter outlining the aim, purpose, and methods of the project and assurance of confidentiality and privacy of the document(s) process was advised. A request for current policies and/or procedure documents related to the care of cardiac surgery patients at their hospital was sent to each NUM (see Appendix 5). A follow up request was sent if no response was received within 2 weeks.

To ensure confidentiality and privacy of participating hospital data, records were de-identified and assigned a code (Letter A-F). A separate sheet containing the original hospital, records obtained and assigned code were kept in a separate electronic password protected file.

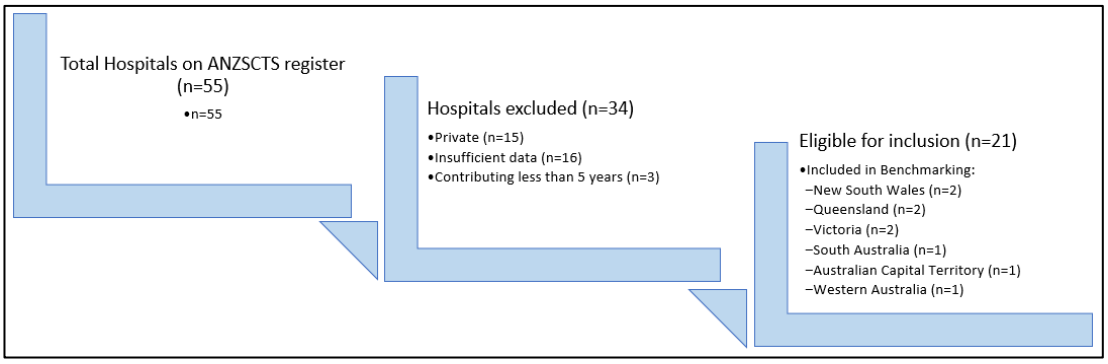
Data extraction. The framework for data extraction and reporting was based on the care map framework (see Figure 2.7) developed in Chapter Two. A summative content analysis approach was employed with keywords identified apriori based on the care map framework. Extracted data were further categorised into the specific topics within the clinical elements and displayed in a table format. Employing this framework aligned benchmarking data with the literature findings. Summative content

analysis relies on credibility to achieve trustworthiness which is demonstrated by displaying the raw data in the table format prior to the analysis[137], see Tables 3.1-3.9.

Results

Sampling. Fifty-five hospitals were identified from the 2020 ANZSCTS database; exclusions included 16 hospitals due to insufficient data contribution, 15 private hospitals due to not having a high case load, three hospitals due to data contribution less than five years, leaving 21 hospitals across 5 states and 1 Territory eligible for inclusion. Two hospitals from New South Wales, Queensland and Victoria; one hospital from South Australia, the Australian Capital Territory and Western Australia were chosen based on the largest caseloads in their respective state or territory (see Figure 3.2).

Figure 3.2 Hospital selection process



Nine ICU NUMs were contacted requesting current policies and/or procedure documents, six ICU NUMs responded to this request. The remaining three ICU NUMs were contacted a second time; however, no response was received. Thus, documents from a total of six hospitals were included in this source of study.

Characteristics. Six responses were received from the emailed request for current policies and/or procedure documents: one each from Australian Capital Territory, New South Wales, Queensland, South Australia, Victoria and Western Australia. All hospital sites were public tertiary centres with high volumes cardiac surgery caseloads. Document content and elements including the type and number of documents for each hospital are shown in Table 3.1 below.

Table 3.1 Documents received

Hospital site	Documents	Year
A	Care of the adult post-operative cardiothoracic patient guideline.	2021
	Management of patients with temporary epicardial pacing procedure.	2021
B	Epicardial pacing procedure document.	2020
	Vasoactive drugs procedure document.	2020
	Cardiac surgery procedure document.	2020
	Chest drain management procedure document.	2019
	Resus postop cardiac ICU procedure document.	2020
C	Cardiac thoracic surgery early mobilisation information pamphlet.	No date
	Cardiac surgery routine clinical pathway.	No date
	Temporary invasive pacing, patient management procedure.	2022
	Pleural drain management procedure.	2021
D	ICU management of post operative cardiothoracic patients' policy.	2021
E	Advanced haemodynamic monitoring policy and procedure.	2019
	Central venous pressure monitoring with the Intensive Care Unit procedure (2021).	2021
	Continuous cardiac output monitoring in the ICU using the Hemosphere procedure document.	2019
	Extracorporeal membrane oxygenation in the ICU policy and procedure.	2019
	Inhaled nitric oxide in ICU guidelines.	2018
	Clinical pathway for coronary artery bypass graft or cardiac valve repair/ replacement.	2018
F	Post-operative care in the Intensive Care Unit post cardiothoracic surgery procedure.	2022
	Cardiothoracic clinical workflow algorithm.	2019
	Pulmonary artery catheter management procedure.	2019
	Nursing practice standard for temporary epicardial pacing.	2020

Two existing clinical pathways were available with one pathway designed around CABG or cardiac valve surgery repair/replacement surgeries and covered the entire hospital journey from pre-admission to hospital discharge. The second pathway was a routine cardiac surgery pathway that outlined targets for ICU admission only. In the pre-operative stage, each patient was risk stratified and the decision made to follow the routine clinical pathway or be referred to a complex pathway which is currently under development at that hospital site. A stand-alone extubation protocol exists for hospital site F named the cardiothoracic clinical workflow algorithm.

Rewarming. Temperature targets were described for four hospitals. Targets ranged from normothermia to specified temperatures and hospital site D specified a time limit for achieving the target. Warming techniques were not described for three hospitals. These hospitals specified similar warming techniques using a convective hot air warming device. There was a variation between hospitals in level of details and a summary is presented in Table 3.2.

Table 3.2 Rewarming goals

Hospital	Rewarming
A	**Temperature target:** • 36 degrees Celsius. **Warming technique:** • Actively warm with convective hot air warming blanket.
B	**Temperature target:** • No mention. **Warming technique:** • No mention.
C	**Temperature target:** • Normothermia. **Warming technique:** • No mention.
D	**Temperature target:** • Normothermia (35-37 degrees Celsius) within 2 hours ICU admission. **Warming technique:** • Warming blanket at 38 degrees setting until patient temperature 36 degrees Celsius, then turn off to avoid overshoot.
E	**Temperature target:** • No mention. **Warming technique:** • No mention.
F	**Temperature target:** • Greater than 37 degrees Celsius. **Warming technique:** • Rewarming device with disposable rewarming blanket.

Hospital A referred to a temperature cable and probe. Methods for monitoring temperatures were not specified for five hospitals.

***Haemodynamic stabilisation*.** Four categories are presented in this section: haemodynamic management, bolus fluids, fluid and blood management. Variations in specific haemodynamic management details exist with specified standard parameters for the initial post operative period for three hospitals and four hospitals referred to use of vasoactive medications if required. Hospital E included an additional atrial fibrillation treatment algorithm.

Fluid bolus choices were outlined in five hospital documents with Hospital D including the rationale for requiring bolus fluids. No documents indicated predicted bolus volumes. Three hospitals referred to transfusion triggers and one hospital mentioned use of a blood warming device if more than two units of blood were required. Two hospitals specified use of bedside Activated Clotting Time (ACT) testing and one hospital used early rotational thromboelastography (ROTEM) testing for bleeding in the immediate post operative period. Specific use of maintenance fluids outlined in five hospital documents with a variation in details from weight-based volumes to no volume details or as per Medical Officer. A summary can be seen in Table 3.3.

Table 3.3 Haemodynamic stabilisation goals

Hospital site	Haemodynamic stabilisation
A	**Haemodynamic Management:** • Parameters: – Mean Arterial Pressure 65-75mmHg. – Coronary Artery Bypass Graft surgery: mean arterial pressure 70-80mmHg. – Valve surgery: Systolic Blood Pressure 100-110mmHg. – Heart Rate 70-90bpm. • Vasopressors after adequate optimisation of preload. • Cardiac output studies on admission then as per Medical Officer. • Potassium replaced as required with aim of 4.5-5mmol/L. • Nurse not to wedge Pulmonary Artery Catheter. **Bolus fluids:** • Plasmalyte 1 Litre x2 available at bedside. • 4% albumin x 2 ordered pre-admission. • Fluid resuscitation with plasmalyte or 4% albumin. **Fluid management:** • Maintenance fluid at 1ml/kg/hr of: – 5% dextrose 500mls with 30mmol Potassium & 20mmol Magnesium. – 4% glucose & 0.18% Sodium Chloride with 30mmol Potassium. – 4% glucose & 0.18% Sodium Chloride. **Bleeding management:** • Bedside Activated Clotting Time +/- Protamine.
B	**Haemodynamic Management:** • Vasoactive meds given according to clinical need. • Vasoactives prescribed and recorded in mcg/min. **Bolus fluids:** • 4% albumin. **Fluid management:** • Glucose 3.3% Saline 0.3% 1000mls, infusion rate titrated so total fluid intake (mls/hr) = body weight (kg). – Magnesium 20mmol to 1st 1000mls bag only. – If Potassium <4.0mmol on 1st ABG then premix 20mmol Potassium in 1Litre is used. • Day 1 post op: Total fluid intake restricted to 2Litres (oral and Intravenous). **Bleeding management:** • Administration of Blood products must be discussed with ICU Consultant/Surgeon. • If more than two units then blood warmer MUST be used.
C	**Haemodynamic Management:** • Parameters: – Coronary Artery Bypass Graft surgery: Systolic Blood Pressure less than 140mmHg. – Valvular surgery: Systolic Blood Pressure less than 120mmHg. – Heart Rate 50bpm to 100bpm. – Mean Arterial Pressure 65-85mmHg. – Lactate less than or equal to 2mmol/L. • Positive fluid balance chart, urine output greater than 0.5mls/kg, Lactate less than 2mmol/L. **Bolus fluids:** • Not documented. **Fluid management:** • Positive Fluid Balance Chart. • Urine output greater than or equal to 0.5mls/kg/hr.

Hospital site	Haemodynamic stabilisation
	• Maintenance fluids. **Bleeding management:** • Trigger Haemoglobin less than 80g/dl. • Early ROTEM and escalation for excessive bleeding. • International Normalising Ratio less than 1.5. • Fibrinogen greater than or equal to 2.5grams/Litre.
D	**Haemodynamic Management:** • Parameters: – Paced rhythm (80-86bpm) if intrinsic rate <80bpm. – Systolic Blood Pressure less than 130bpm, Mean Arterial Pressure greater than or equal to 70mmHg. – Central Venous Pressure 6-12mmHg. – Cardiac index greater than or equal to 2.2 (ideally greater than 2.5). • Commence noradrenaline if hypotension + adequate Cardiac Index. **Bolus fluids:** • Most patients will require some filling in the first 2-4 hours of ICU admission. Discuss with Intensivist and surgical team. • Initial choice – 4% albumin (should be available at bedside). **Fluid management:** • No maintenance fluids. • Notify Cardiothoracic team if 2Litres positive fluid balance within 24 hours. **Bleeding management:** • Transfusion trigger less than 7g/dl. • Activated Clotting Time checked post admission; if greater than 150secs protamine given.
E	**Haemodynamic Management:** • No documented parameters. • Inotropes as required. • Atrial Fibrillation treatment algorithm. • Separate advanced haemodynamic monitoring policy (Pulmonary Artery catheters). **Bolus fluids:** • Replace blood loss with blood products/ colloid as indicated. **Fluid management:** • Maintenance therapy, no specifics. **Bleeding management:** • Trigger Haemoglobin less than 80g/dl. • Replace blood loss with blood products/ colloid as indicated.
F	**Haemodynamic Management:** • No initial parameters documented. • Readiness to wean criteria: Systolic Blood Pressure greater than 100mmHg, Mean Arterial Pressure greater than 70mmHg. • IV vasoactive infusions titrated as per clinical condition by MO **Bolus fluids:** • Gelofusion 4% succinylated gelatine 500mls at bedside **Fluid management:** • Compound Sodium Lactate as prescribed by Medical Officer. **Bleeding Management:** • Pump Blood given.

***Pain management*.** Variations in described pain management details existed with desired pain score goals for four hospital documents and two hospitals identified the pain assessment tool utilised. Pain management strategies ranged from regular

paracetamol to Patient Controlled Analgesia of either Fentanyl of Morphine with two hospitals not describing any detail. The transition from intravenous to oral pain medication at the earliest convenience was a common theme in all documents. A summary can be seen in Table 3.4.

Table 3.4 Pain management goals

Hospital site	Pain management
A	**Pain rating scale:** • Numerical rating scale. **Management strategies:** • Fentanyl Patient Controlled Analgesia with clinician override bolus until patient able to cooperate and respond. • Aim Richmond Agitation Sedation Scale 0-1.
B	**Pain rating scale:** • No mention. **Management strategies:** • Morphine or fentanyl Patient Controlled Analgesia – minimal doses given, set up on admission, bolus admin when required. • Regular Paracetamol.
C	**Pain rating scale:** • Pain scores greater than 3 with chest physio. **Management strategies:** • Medical Officer to review if pain score greater than 3 and/or sedation score greater than 2 on maximal therapy.
D	**Pain rating scale:** • No mention. **Management strategies:** • Fentanyl infusion (10-20mcg/hr) + Nurse Initiated bolus every 5 minutes if required during and after extubation. • Regular paracetamol. • Tramadol 25-100mg every 6 hours. • Targin (Oxycodone/Naloxone) 10/5mg for three days. • For poorly controlled pain add: – Gabapentin for 5 days. – Ketamine infusion. – Referral to Acute Pain Service.
E	**Pain rating scale:** • Visual analogue pain scale 4-6 hourly. **Management strategies:** • Regular analgesia (Intramuscular/Intravenous/Oral), no specifics.
F	**Pain rating scale:** • Pain score ≤ 4, no rating scale mentioned. **Management strategies:** • Cessation of continuous Fentanyl infusion and commencement of oral analgesia or Patient Controlled Analgesia as soon as practicable. • Adequate analgesia during physio important to assist with maximal patient participation. • No other specifics.

***Mechanical ventilation duration*.** Sedation plans were not described for three hospitals. Propofol was outlined by two hospitals as the choice for sedation and

hospital site F stated a generic intravenous sedation as prescribed. Three hospital sites described ventilation weaning processes and two hospitals sites specified readiness to wean criteria. No description of ventilation weaning processes for two hospital sites however hospital site C referred to a nurse-initiated checklist for extubation. Expected extubation time frames were described for four hospitals, no extubation time frame described for three hospitals. A summary can be seen in Table 3.5.

Table 3.5 Mechanical ventilation goals

Hospital site	Mechanical ventilation duration
A	**Sedation plan:** • Sedate as required with Intravenous propofol and boluses as required until patient stable, allow patient to wake to assess neurological status. **Weaning technique:** • Aim to wean Fraction inspired Oxygen and change from Pressure Regulated Volume Control to Pressure Support when appropriate (in first four hours). • Wean to pressure support ventilation as soon as possible. • Readiness to wean checklist for nurses, if met to notify ICU medical team and decision to extubate is made. **Extubation timeframe:** • Aim to wake, wean and extubate within 6 hours of admission to ICU. • If patient not for early extubation, Cardiothoracic or ICU team to document this including reasons for delayed extubation (difficult or prolonged surgery or haemodynamic instability).
B	**Sedation plan:** • No mention. **Weaning technique:** • No mention. **Extubation timeframe:** • No mention.
C	**Sedation plan:** • No mention. **Weaning technique:** • Mentions a Nurse initiated extubation checklist. **Extubation timeframe:** • Wake, wean & extubate in 4-6 hours post op.
D	**Sedation plan:** • Propofol until haemodynamically stable if not bleeding and haemodynamic stable. **Weaning technique:** • Encourage early (after 2-4 hours) spontaneous breathing. • If triggering ventilator (on Synchronised Intermittent Mandatory Ventilation) or waking from anaesthesia attempt trial of Continuous Positive Airway Pressure (with pressure support). • Spontaneous breathing is associated with improved haemodynamics. • Criteria for extubation stated and displayed. **Extubation timeframe:** • No mention.
E	**Sedation plan:** • No mention. **Weaning technique:**

Hospital site	Mechanical ventilation duration
	• No mention. **Extubation timeframe:** • Extubate within 4-6 hours.
F	**Sedation plan:** • IV sedation as prescribed. • Sedation score hourly. **Weaning technique:** • Readiness to wean sedation criteria stated and displayed. • Reduce Fentanyl rate as tolerated by patient, ideally <40mcg/hr. • Wean propofol off (over 10 minutes). • Once patient triggering ventilator, switch to Spont mode, maintain PEEP at 5cmH2O, wean FiO2 maintaining SpO2 >95% until 30%, wean Pressure support to 5cm H20. **Extubation timeframe:** • Within 6 hours of ICU admission. • Readiness to extubate criteria stated.

***Early mobilisation*.** Instructions to sit out of bed on Day 1 post surgery were described for five hospitals, early mobilisation practices were not defined for one hospital. Three hospitals provided a detailed mobilisation plan with physiotherapist involvement, a summary is presented in Table 3.6.

Table 3.6 Early mobilisation goals

Hospital site	Early mobilisation
A	Encourage deep breathing and coughing 2nd hourly post extubation. Provide patient education on mobilising to protect sternal wound. Sit out of bed and mobilise at 5am Day 1.
B	Nothing mentioned.
C	Early mobilisation protocol Day 1: • Sit out of bed in the morning and afternoon. • March on spot every 2-3 hours with staff. • Walk 10 metres with staff twice.
D	Sit out of bed each morning including Day 1 unless haemodynamically unstable.
E	Sit out of bed if stable post extubation. Day 1 post operative: • Assessment and treatment of respiratory status and mobilisation by physiotherapist. • Sit out of bed and assist walk around bed by physiotherapist. Day 2 post operative: progress mobilisation to walk 3-4 times/day. Day 3 post operative: encourage mobilisation around ward.
F	Early mobilisation is prescribed after cardiothoracic surgery to prevent postoperative complications, decrease length of hospital stay, and improve functional capacity. The aim is that, once extubated, all un-complicated cardiothoracic surgery patients will ambulate away from the bedside with assistance from a physiotherapist, and a nurse, on the first day following surgery. **Mobilisation Considerations**: If the patient is alert and stable from a cardiovascular and respiratory point of view, the aim is to ambulate away from the bedside on the first day following surgery. However, there is a graded progression of activity if this is not able to be achieved safely:

Hospital site	Early mobilisation
	1. Sit on the edge of the bed. 2. Stand. 3. March on the spot. 4. Step transfer to a chair. 5. Ambulate away from the bedside. • Aim to achieve the highest level of mobility whilst optimising patient safety. • Any significant and detrimental changes in the patient's objective vital signs (particularly cardiovascular system) should be attended to closely, and mobilisation should be abandoned if necessary until the patient is more stable.

Preoperative education. Two hospitals describe information relating to preoperative education, hospital site E and F include clinical pathways which cover the entire hospital journey. A summary is presented in Table 3.7.

Table 3.7 Preoperative education goals

Hospital site	Preoperative education
A	Nothing mentioned.
B	Nothing mentioned.
C	Nothing mentioned.
D	Nothing mentioned.
E	Preoperative education for patient and family/carers by nursing, video or booklet. Mentioned in both pre-admission clinic and admission day sections. Surgery Day: • Reassure patient and discuss recovery process and interventions. • Encourage deep breathing, coughing and limb exercises. • Explain stages of progress both pre-post extubation.
F	Teach supported cough preoperatively. Education and discharge Planning section for each day.

***Patient related factors*.** Pathway exclusion criteria were described for one hospital, past medical history and risk factors prior to surgery were described for another hospital. A summary is presented in Table 3.8.

Table 3.8 Patient related factors

Hospital site	Patient related factors
A	Nothing mentioned.
B	Nothing mentioned.
C	Exclusion criteria stated.
D	Nothing mentioned.
E	Past medical history and risk factors documented on page 1.
F	Nothing mentioned.

***Family involvement*.** Four hospitals included next of kin or carers with focus on education, visiting and orientation to the ICU environment. A summary is presented in Table 3.9.

Table 3.9 Family involvement

Hospital site	Family Involvement
A	Bring accompanying family to visit when appropriate.
B	Nothing mentioned.
C	Patient/family involvement in plan and education prior to ward transfer.
D	Nothing mentioned.
E	Education as per patient.
F	Orientate Next of Kin. (In admission to ICU section) Next of Kin notified of ward transfer

Clinical handover. Handover guidelines were illustrated for three hospitals; two hospitals specified use of a hands-off handover utilising the structured iSoBAR (Identification, Situation, Observation, Background history, Agree to plan, Responsibility and risk management) approach, one hospital specified a clinical handover without interruptions. Role delineation between nursing and medical staff during patient admission and criteria for patient discharge from the ICU were identified as additional components.

Source 2: ANZSCTS report

The focus from this source was on identifying benchmarks based on the care map framework developed in Chapter Two.

Objectives for this stage of data collection were to:

- Determine applicable benchmark data to develop measures for clinical elements.
- Use the ANZ database benchmarks to inform metrics for the applicable clinical element.

Methodology

Sampling. Purposeful sampling of the latest available ANZSCTS annual report.

Search strategy. The Google© search engine was explored using the phrase combination “cardiothoracic surgery society” to locate the ANZSCTS official website. Exploration of this website found the cardiac surgery database with publicly

accessible annual reports from 2017 to 2021 which were explored including the key performance indicator definitions.

Data extraction. Key performance indicator data related to the clinical elements of the care map framework (see Figure 2.7) were extracted from the 2021 annual report. Coronary artery bypass graft (CABG) surgery is the largest procedural group accounting for over fifty percent of the total cardiac surgery cases per year.[128] Data related to CABG patients were extracted due to the homogeneous and representative nature of this group with data extraction results summarised and reported in the same format and order as the care map framework.

Results

Characteristics. The ANZSCTS Cardiac Surgery database program 2021 annual report outlined data collected in the database. The report included a summary of each cardiac surgery procedure including patient characteristics, case volumes, the influence that co-morbidities have on complications and the influence that patient characteristics have on mortality. During 2021 isolated on pump CABG surgery accounted for 94.2% of cases and off pump isolated CABG surgery were 5.8%. In elective CABG cases 50.4% were elective and 46.1% were urgent surgical status.

Key clinical outcomes addressed include mortality, return to theatre for bleeding, deep sternal wound infection rates, derived new renal insufficiency and incidence of permanent stroke. The clinically relevant KPIs pertinent to this project included blood transfusion usage, duration of mechanical ventilation, proportion of patients extubated within the expected six-hour window and ICU length of stay. Blood transfusion usage was divided into three categories for reporting purposes: Red Blood Cell (RBC), non RBC and combination of RBC and non RBCs.

The ANZ database focus on specific outcome metrics and multiple aspects of post operative patient care relevant to the care map framework remain unmeasured. Clinical elements such as rewarming, pain management, early mobilisation, haemodynamic stabilisation and fluid and vasoactive management are not reported in the ANZ database.[128] Influencing factors such as preoperative education and patient and family expectations or experiences are also not reported in the ANZ database.[128]

The care map framework developed in the scoping review became the framework for data collation. Extracted data from each source were linked together reflecting post operative care of the cardiac surgery patient components.

***Haemodynamic stabilisation*.** The ANZSCTS report and monitor overall usage of blood products which is an alternative fluid bolus choice which is a clinically specific key performance indicator in the ANZSCTS report. During 2021 one third of isolated Coronary artery bypass graft patients received a blood transfusion. Comparison between public and private centres showed similar usage in all transfusion types. For public hospitals 64% of patients did not receive any transfusions, 18% received RBCs only, 6.7% patients received non RBCs and 11.3% received both RBCs and non RBCs.

***Mechanical ventilation duration*.** Initial post operative mean ventilation time for isolated CABG surgery in the public sector were 15.6 hours, median 8.3 hours, interquartile range 5.8 to 14.7 hours. The cumulative proportion of patients extubated within six hours for isolated CABG surgery in the public sector were 30.2% and 68.8% within the first 12 hours post operatively.

Patient related factors. Males represented the largest gender group with 83.4% of patients and females accounted for 16.6%. The largest represented age group in males were between 60-70 years and the largest age group represented in females were between 70-80 years. Ejection fractions were divided into normal (LVEF >45%) observed in 81% of patients, moderately reduced (LVEF ≥30%-≤45%) observed in 15.8% of patients and severely reduced (<30%) observed in 3.4% of patients.

Resource utilisation. Intensive Care Unit length of stay varied dependent on the type of surgery performed. Isolated valves or CABG surgery both have significantly shorter duration of ICU stay than combined procedures equated to more than a clinical shift. Length of stay for a public ICU had a mean of 29.7 hours and median of 44.5 hours. The ANZSCTS report ICU length of stay as a cumulative proportion of patients with 11 (0.1%) patients discharged within 12 hours, 1,536 (19%) patients discharged within 24 hours, 4,239 (52.5%) patients discharged within 48 hours, 5,969 (74%) patients discharged within 72 hours, 7,654 (94.8%) patients discharged within 288 hours, 8,055 (99.8) patients discharged within 576 hours and 8,070 (100%) of patient discharged within 1,008 hours.

Source 3: Current practice review

A digital medical record audit at Fiona Stanley Hospital Intensive Care Unit (the project site) was undertaken to gain an understanding of current ICU practice in

relation to post operative recovery of the cardiac surgery patient. The current practice review objectives were to:

- Determine the practices and site performance in relation to the care map framework.
- Compare site practice data with other source data to establish relevant clinical element indicators.
- Formulate draft practice recommendations for clinical elements, influencing factors and established performance indicators.

Methodology

Current practice review design. A Retrospective Observational study design was chosen due to the availability of data for analysis. The extraction of preexisting data from digital medical records allowed for comparing current practice with benchmarks captured in data source 1 & 2.

Inclusion and exclusion criteria. The study population included elective and urgent CABG surgeries (as per ICU diagnostic code) in 2022. The elective status was defined as where no risk of compromised cardiac outcome was to occur in the event that the procedures were to be postponed.[128] The urgent status of cases were defined as surgery during acute hospitalisation or within 72 hours of angiography or unplanned admission.[128] All eligible patients had been assigned an Acute Physiology and Chronic Health Evaluation III-J diagnostic code of 1207.[138]

Based on the review of the literature factors that contribute to clinical pathway failure were identified as the exclusion criteria. Post operative related exclusion criteria included patient cases that required post operative mechanical circulatory support devices and complications that necessitated a return to the operating theatre. Preoperative related exclusion criteria included patients who were dialysis dependent or Creatinine >200 or Left Ventricular Ejection Fraction (LVEF) <35%. The final exclusion criteria were complex surgeries requiring more than one procedure and emergency or salvage CABG surgery.

Sampling. In 2022, there were 605 cardiac surgery patients; of these 254 patients underwent CABG surgery. Total number of eligible cardiac surgery patients were 211, 43 were excluded based on the above exclusion criteria. A final sample size of 50 patient records which accounts for one quarter of eligible patients was considered by the project group as a representative of clinical practice outcomes. The clinical information system and digital medical records for each patient were examined by the

student researcher to determine eligibility prior to selection of every fourth eligible patient which was determined apriori to ensure unbiased selection of patient records. Selected patient records were allocated a study number prior to the data collection process.

Data sources. Sources of data examined included the ICU Clinical information system, Digital Medical Records (DMR) and the Core Outcome Measurement and Evaluation Tool (COMET) database. The COMET database is a web-based application from the Australia and New Zealand Intensive Care Society where adult ICU patient admission datasets are collected and analysed.[138]

Data extraction. The methodology and reporting of the electronic healthcare records were guided by the Reporting of studies Conducted using Observational Routinely collected health Data[139] and the Strengthening the Reporting of Observational Studies in Epidemiology[140] checklists.

Using Redcap© (Research Electronic Data Capture), a secure web-based data management program, a project was created by the student researcher to collect and manage research data.[141,142] Five data extraction tools were created including demographics, preoperative data, operative data, ICU admission data and ward readiness data (see Appendix 6-10). The ICU admission and ward readiness data extraction tools were based on the care map framework (see Figure 2.7). Each Redcap© data extraction tool was reviewed by the research supervision team to ensure data were objective and able to address the research aims and objectives that were set. Testing of the data extraction tool was undertaken prior to data extraction to ensure full functionality and completeness of data extraction variables. A master list with all patients' identifiable data was requested through the study site data management administration assistant which was extracted from the COMET database. Each data source was systematically explored with extracted data recorded directly into the Redcap© data extraction tool by the student researcher.

Data analysis. Reports were generated for each data extraction tool through the "My reports and exports" link in Redcap©. Each report included descriptive statistical analysis such as total count, missing data count, minimal, maximum, mean, standard deviation and frequencies including percentages for the collected data. Raw data with no identifiable features were exported into a Microsoft Excel© spreadsheet and relevant charts were created to illustrate statistics for reporting purposes. Both descriptive analyses with graphical illustrations were reported.

Results

Sampling. Two hundred and fifty-four patients underwent CABG surgery in 2022. Forty-three were ineligible based on the exclusion criteria leaving 211 eligible patients. Fifty patients were included as per the predetermined selection process. Forty-three patients (86%) underwent CABG surgery and seven patients (14%) underwent off pump CABG. Thirty-six (72%) of surgeries were elective and 14 (28%) were urgent. The incidence of the clinical status (elective versus urgent) was reported separately to demonstrate the higher proportion of elective cases which have a lower risk of a compromised cardiac outcome.

***Rewarming*.** Recorded patient admission temperatures ranged from 34° to 37.9°C with a mean of 35.78°C (standard deviation 0.73). The target temperature was 36.5°C and rewarming times ranged from 0 to 12.65 hours. For 34 (68%) patients normothermia was acheived in four hours or less, nine (18%) patients between four and six hours, four patients (8%) within six to eight hours and three (6%) patients normothermia was acheived in over eight hours. Mean rewarming time was 3.5 hours (standard deviation of 2.62 hours). Rewarming techniques were not collected.

***Haemodynamic stabilisation*.** Vasoactive therapies were required in the first 24 hours of ICU admission for 49 patients (98%). Noradrenaline infusions were the most common vasoactive medication used with 45 patients (92%). In the first six hours of ICU admission Noradrenaline infusions ranged from 0 to 0.23 mcg/kg/min, mean of 0.09 mcg/kg/min and standard deviation of 0.06 mcg/kg/min. Between 6 to 12 hours of ICU admission noradrenaline infusions ranged from 0 to 0.29 mcg/kg/min. Between 12 to 24 four hours post ICU admission 12 (24%) patients remained on noradrenaline infusions with ranges between 0 to 0.20 mcg/kg/min. Dobutamine was administered to 11 patients (22%) with ranges in the initial six hours of ICU admission between 0 to 7mls/hr. Ten patients required dobutamine between 6 to 12 hours with rates ranging from 0.5 to 7mls/hr. At 24 hours only five patients (10%) required dobutamine with rates ranging from two to three mls/hr. Glyceryl Trinitrate infusions were required for 14 patients (28%).

Blood loss from subcostal drains ranged from 25 to 450mls in the first 6 hours of ICU admission, mean of 211mls and standard deviation of 91mls. The recorded cumulative blood loss in the first 12 hours ranged from 62 to 620mls, mean of 318mls and standard deviation of 131mls. The recorded cumulative blood loss in the first 24 hours ranged from 79 to 1204mls, mean of 510mls and standard deviation of 203mls.

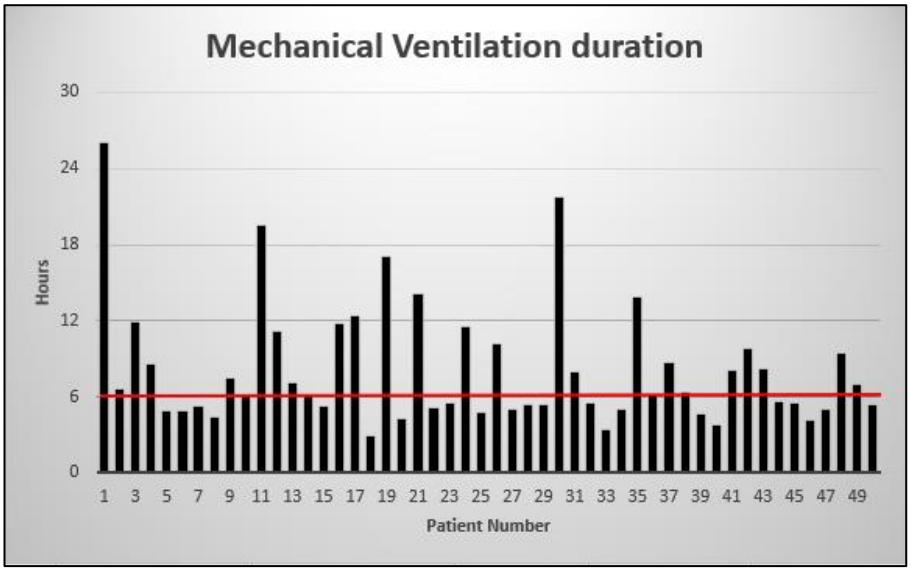
Ten patients (20%) were administered a blood transfusion in ICU with five (50%) transfused in the first six hours of ICU admission. Transfusion requirements were divided into Red Blood Cells (RBC) and non RBC which were defined as the transfusion of Cryoprecipitate, platelets or Fresh Frozen Plasma. The overall ICU admission transfusion requirements included RBCs for six patients, non RBCs for three patients and one patient required both RBC and non RBCs.

***Pain management*.** Documented pain score assessments within 12 hours following extubation occurred between 0 to 10 times, mean of 2.58 and standard deviation of 1.94. Lowest pain scores ranged from 0 to 7 and higher pain scores between 0 to 10 using the numerical pain scoring system. Two patients had no documentation of pain assessments in the electronic charting system however severe pain or pain score 6 out of 10 and no mention of pain assessment times were documented in the patients' nursing notes. Both patients received regular pain relief with an intravenous bolus or additional pain medication.

Pain assessments were completed on shift change only for 21 patients (42%) and post extubation then on shift change only for five patients (10%). Good pain control defined as pain score less than five out of ten with pain assessments every three hours were documented for eight patients (16%). One patient had regular pain assessments but with a pain score of nine out of ten with a documented restriction of a limited English-speaking patient. Eight patients (16%) had limited pain assessments documented despite additional pain medications being administered. Two patients (4%) had minimal pain assessments documented with pain scores less than five out of ten and a further two patients (4%) with minimal pain assessments and pain scores greater than five out of ten. Three patients received regular pain assessments with poor control with pain scores between six to ten out of ten.

***Mechanical ventilation duration*.** Sedation length of time ranged from 3.05 hours to 25.98 hours, mean of 7.92 hours and standard deviation of 4.83 hours. Mechanical ventilation duration ranged from 2.88 hours to 26.1 hours, mean of 8.14 hours and standard deviation of 4.83 hours. Mechanical ventilation duration less than six hours were achieved in 23 (46%) of patients with the remaining 27 (54%) of patient extubated after the six-hour period (see Figure 3.3).

Figure 3.3 Mechanical ventilation duration



The number of patients extubated between six to eight hours were nine (18%) and between eight to ten hours were six (12%). Delays in extubation were determined in 27 (54%) of patients with rationales ranging from oversedation (n=8, 29.6%), prolonged hypothermia (n=2, 7.4%), agitation (n=1, 3.7%), haemodynamic instability (n=13, 48.1%) and cause unclear (n=8, 29.6%). Comments related to the unclear category included:

- Sedation and pain relief bolus for “comfort”, Glasgow Coma Scale (GCS) 11/15 2 hours post admission, rediscuss with surgeon 7.5 hours later re: appropriateness for extubation.
- Aim to extubate requested my medical staff 2.5 hours post admission, mandatory mode ventilation for 10 hours, slow propofol wean.
- Synchronized Intermittent Mandatory Ventilation (SIMV) and GCS 3/15 until 15 minutes prior to extubation, sedation and pain relief bolus given for turns and patient waking. Extubated post nursing handover.
- Assess suitability for extubation requested at 6 hours, gradual wean sedation.
- Extubated post medical and nursing handovers.
- Sedation and 25mls/hr then slow wean. GCS 3/15 until just prior to extubation.
- Extubated post nursing handover.
- Possibly waking inappropriately.

Overnight extubation occurred for 35 patients (70%), 27 (77%) between 6pm and midnight and the remaining eight (23%) between midnight and 6am. Seven of the

extubations between midnight and 6am resulted from delays. Twelve patients (24%) remained on a mandatory ventilation mode until 15 to 30 minutes prior to extubation.

PaO2/FiO2 (P/F) ratios at six hours post ICU admission ranged from 154 to 497mmHg, mean of 323mmHg and standard deviation of 76mmHg. At 12 hours post ICU admission the P/F ratio ranged from 207 to 613mmHg, mean of 342mmHg and standard deviation of 104mmHg. At 24 hours or prior to ICU discharge the P/F ratio ranged from 180 to 579mmHg, mean of 318mmHg and standard deviation of 89mmHg.

***Early mobilisation*.** Mobilisation to a chair occurred for 43 (86%) of patients with only 11 (22%) that occurred within 12 hours of extubation. Initiation of mobilising to a chair by physiotherapists for 38 (76%) patients with missing nursing documentation in 16 patient records. Mobilisation to chair times ranged from 5 to 41 hours, mean of 16 hours and standard deviation of 8.23 hours. Ambulation with physiotherapists occurred for 48 (96%) patients with the remaining two patients unable to mobilise due to uncontrolled pain. Two patients (4%) ambulated with physiotherapists just prior to ward transfer and it was noted that physiotherapy was limited by pain for 10 (20%) patients.

Patient related factors. Forty-one (82%) of patients were male, nine (18%) were female and no classifications as other. Patient age ranged from 36 to 79 years, mean of 62 years and standard deviation of 9.48. Preoperative ejection fraction ranged from 35-66%, five patients had no recorded EF with rationales such as no preoperative cardiac echo to technician unable to estimate EF. New York Heart Association classification ranged from Class 1 (n=15, 30%), Class 2 (n=8, 16%), Class 3 (n=3, 6%), Class 4 (n=1, 2%) and no documented classification (n=23, 46%). Renal impairment status was not documented in all patients. In the twenty-four hours prior to surgery antiplatelet therapy was administered for 37 (74%) patients and withheld for 13 (26%) patients.

Urine output in the first six hours ranged from 330mls to 1535mls, mean of 840mls and standard deviation of 257mls. Large volumes were detected on admission which possibly indicates an inconsistency in documentation with the additional inclusion of urine output during theatre. The cumulative twelve-hour urine output ranged from 585mls to 1980mls, mean of 1242mls and standard deviation of 436mls. Cumulative urine output totals at 24 hours ranged from 987mls to 3197mls, mean of 1972mls and standard deviation of 550mls.

Resource utilisation. Intensive Care Unit length of stay ranged from 20.27 hours to 292.6 hours, mean of 56.15 hours and standard deviation of 48.45 hours. Medical discharge decision time were documented in 45 (90%) patient records, no documentation of medical discharge decision time for five (10%) patients. The medical discharge decision time ranged from 9.63 hours to 113.50 hours, mean of 33.23 hours and standard deviation of 24.72 hours. Actual ICU length of stay within 24 hours (n=8, 16%), within 36 hours (n=22, 44%) and within 48 hours (n=31, 62%).

***Operative data*.** Cardiopulmonary bypass times ranged from 47 to 143 minutes, mean of 91.30 minutes and standard deviation of 25.76 minutes. Cross clamp times ranged from 27 to 117 minutes, mean of 59.3 minutes and standard deviation of 18.55 minutes. Intraoperative complications occurred for 19 patients (38%) which included cardiac arrest (n=1, 5.3%), bleeding requiring blood products (n=12, 63.2%) to other (n=7, 36.8%).

***Ward readiness*.** The timeline between cessation of vasoactive therapy and removal of arterial lines ranged from 0.55 hours to 49.88 hours, mean of 15.21 hours and standard deviation of 12.14 hours. Removal of arterial lines post medical discharge decision time ranged from 0.2 to 68 hours, mean of 8.44 hours and standard deviation of 11.72 hours. Five patients had missing data related to medical discharge decision times. Subcostal catheter drain removal in ICU for 36 (72%) patients. Time difference between initial ICU request and actual drain removal ranged from 0.25 to 6.91 hours, mean of 2.19 hours, standard deviation of 1.73 hours, 26 (72%) were removed within three hours of request. Missing documentation included four surgical team requests and two from the ICU medical team. The difference between the surgical team request and ICU confirmation ranged from 0.1 to 24 hours, mean of 2.73 hours, standard deviation 4.58 hours and only six requests with a difference of greater than three hours.

Discussion

The analysis and discussion of results explored the similarities and differences between best practice as outlined in the scoping review, benchmark documents and actual practice as reflected through the current practice review. This was then interpreted into the care map framework based on the literature review which in turn formed the basis of recommendations for a draft care map.

Benchmarking standards of practice strengthens the link between the literature and clinical practice with the aim of improving the quality of healthcare delivery. Each

element identified in the care map framework remain interrelated despite being addressed separately in this project. The aim of benchmarking this project was to identify areas of improvement for the study site by reviewing policies and procedures from various centres of excellence across Australia. Similarities exist across the sample of documents with variations in the level of detail that is provided. Some elements are often addressed but not always written in an ICU specific policy or procedure document which is dependent on at which stage the element occurred. For example, preoperative education, normally completed prior to surgery so may not be included in the ICU documents. Temperature monitoring methods and rewarming techniques lack detail but local practice standardises this. Another consideration is that documents within a healthcare facility are overseen by hospital committees which can potentially restrict the inclusion of certain details.

Clinical Handover

The handover process is a critical time to ensure accurate information is exchanged and appropriate treatment plans are adhered to.[2,143,144] Ineffective communication or avoidable interruptions can lead to communication errors resulting in inappropriate care and possible misuse of valuable resources. The Australian Commission on Safety and Quality in Healthcare's NSQHS[135] included Clinical handover in the Communicating for Safety Standard. A structured handover tool using the iSoBAR framework is publicly available for clinical use.[135]

Hands off handover using a structured approach with clear communication regarding expectations and treatment plans is a key concept that has been captured from the benchmarking documents. Literature regarding clinical handover in the cardiac surgery cohort is limited to textbooks rather than journal articles with different terminology such as hands off handover or hand off communication.[2] Other additions from benchmarking documents worthy of consideration include discharge from ICU criteria, an outline of the roles for the multidisciplinary team, haemodynamic targets and family involvement.

Rewarming

Rewarming to normothermia is a priority in the immediate post operative period to reduce the incidence of complications associated with hypothermia.[2,118] This is supported within the literature with four hospital documents outlining the plan to reach normothermia however only one specifies a time frame. Definitions of normothermia varied amongst the Australian ICU documents and the target for the current practice

review was 36.5ºCelsius. The Adult Patient database data dictionary from the Australian and New Zealand Intensive Care Society defines the normal range between 36 to 38.4ºCelsius.[138] Reaching normothermia can be dependent on the initial temperature on ICU admission and how promptly rewarming techniques are initiated. Rewarming should commence following admission to ICU but has not been elaborated on in the literature or benchmarking documents. Unpredicted variations in rewarming times existed in the Current Practice Review. A rewarming time of five hours was required for the lowest recorded temperature of 34°C on ICU admission. Whereas an admission temperature of 35.9°C or 36.1°C required over 10 or 12 hours respectively to reach normothermia.

Haemodynamic stability

Goals for haemodynamic parameters vary dependent on the type of surgery performed hence there is an advantage to outlining standard parameters to guide bedside nurses which were demonstrated in documents from three hospital sites. Haemodynamic stabilisation including guidelines for fluid management has revealed the greatest variations amongst the hospital sites. Fluid management were divided into three sections including maintenance, bolus fluids and blood management. Five hospitals outlined maintenance fluids; two centres outlined weight-based volumes, two centres with a two-litre fluid restriction and one stating a positive fluid balance is expected. The literature recommends the use of goal directed therapy[44,79] potentially preventing fluid overload. The removal of maintenance fluids and reliance on bolus fluids until the patient is able to commence oral hydration needs to be considered.

It is anticipated that as the patient returns to normothermia a fluid bolus will be required as preload is reduced during hypothermia.[2] Variations in the type of fluid bolus is evident amongst the benchmarking documents ranging from plasmalyte, compound sodium lactate, albumin to blood products as required. What is not mentioned in the benchmark documents is the anticipated volume or rationale for their choices. Goal directed therapy using stroke volume variations, stroke index or stoke volume is the focus within the literature with volumes of 250mls for each bolus[43,79,120,121]. When determining fluid bolus volumes consideration of the patients age and current renal function may be required and should refer to medical staff however this communication must occur early in the admission.

Blood product usage

Blood product usage in the Current Practice Review is substantially less with only 20% of patients receiving any product in comparison to the ANZSCTS which estimates one third in the isolated CABG category. Transfusion triggers are evident in three benchmark documents and can be a useful guide. However, the minimisation of bleeding by following the National Blood Authority guidelines will reduce the likelihood of blood product usage which has greater positive effects for patients and is demonstrated well in the study site. Additionally, with blood products not prescribed by nursing staff there was no need to include in the care map recommendations.

Pain management

Multimodal pain management strategies are important for patient satisfaction, successful extubation and early mobilisation. Early implementation of pain strategies is important and should commence ideally in the preoperative phase.[50,83] Adequate pain management is an essential component to ensure patient cooperation especially with early mobilisation.[117] Regular pain scoring with a specific pain rating scale once patient extubation achieved would be ideal to monitor pain levels however only one benchmark document has included directions such as medical review if pain >4 with no mention of which pain rating scale is used and another only mentions the use of numerical pain scales. Each hospital routinely utilises pain assessment scales but not necessarily documented in their policies. Each hospital has outlined a multimodal analgesia regime with Fentanyl a common intravenous choice and a variety of oral medications which are all appropriate for use with acute pain. Frequent pain assessments are warranted as patients can be reluctant to report increasing pain to nursing staff for reasons such as fear of overdose or addiction and patient belief that nurses are already dispensing what is prescribed.[172,101,117] There is also evidence that healthcare professionals have mismanaged pain relief particularly with pain provoking procedures such as drain removal and mobilisation.[101,117] The important factor to be considered is constant reassessment of pain which has only been mentioned in one of the benchmarking documents. What is evident from the Current Practice Review and consistent with the literature findings is the mismanagement of pain whether by omission of pain assessments, lack of additional pain relief or the reassessment of pain following analgesia to assess effectiveness. Prompts for nursing staff to improve their engagement in pain assessment and management to improve the patient experience may be required. Pain management education preoperatively would benefit patients but is not within the scope of this project.

Mechanical ventilation duration

Expected extubation times and guidelines for weaning ventilation or sedation are sporadically documented in the hospital documents. Achieving the goal of extubation within six hours of ICU admission is achievable and supported in the literature,[75,80,86,113] but it is interesting that although some hospital documents state the six-hour goal only 30% of patients are extubated within this window according to the 2021 ANZSCTS report. What would be beneficial is clear guidelines encompassing weaning techniques and criteria for extubation. Striving to achieve this goal will improve patient satisfaction by removing communication barriers and discomfort from mechanical ventilation which was highlighted as a negative experience in the literature.[89,103,106,109,116] Prolonged rewarming times, haemodynamic instability or lack of direction for bedside nurses are potential reasons why extubation within the six-hour goal is not always achieved. The study site utilises both a ready to wean and extubation checklist within the clinical workflow algorithm which provides that direction for bedside nurses. The Current Practice Review demonstrated an achievement of 46% of patients extubated within the six-hour time goal which is above the national average. Areas for improvement remain with 54% of extubation delays triggered by oversedation and 29.6% with an unclear cause. Slow sedation weaning and the use of mandatory ventilation modes until just prior to extubation possibly contribute to these delays.

Early mobilisation

Early mobilisation is essential in the surgical recovery phase.[25,114] Mobilisation to chair within 6-12 hours post extubation or Day 1 post-surgery aligns with the literature.[24,26,49,114]. Hospital site C's early mobilisation pamphlet is an idea worth considering and could be part of preoperative education which has the advantage of increasing patient compliance. Other preoperative education that would be beneficial is the supported cough and pain management strategies allowing patients to have more control and involvement. Preoperative education has historically not been part of the ICU documents but would be worth chasing up at later date. The Current Practice Review showed a lack of nursing initiative with physiotherapists instigating sitting in a chair following ambulation in 76% of patients with a total of 43 (86%) mobilising to chair. With limited physiotherapists this would explain the delay in mobilisation as only 11 (22%) of patients were mobilised within 12 of extubation. Nursing documentation regarding mobilisation is inadequate with missing data in 16 patient records, unclear whether patient not mobilised or lack of documentation. Pain

mismanagement directly affects mobilisation with physiotherapists noting that 10 (20%) patients were limited by pain. Prompts to offer analgesia prior to mobilisation may be required to ensure more efficient management.

Ward readiness

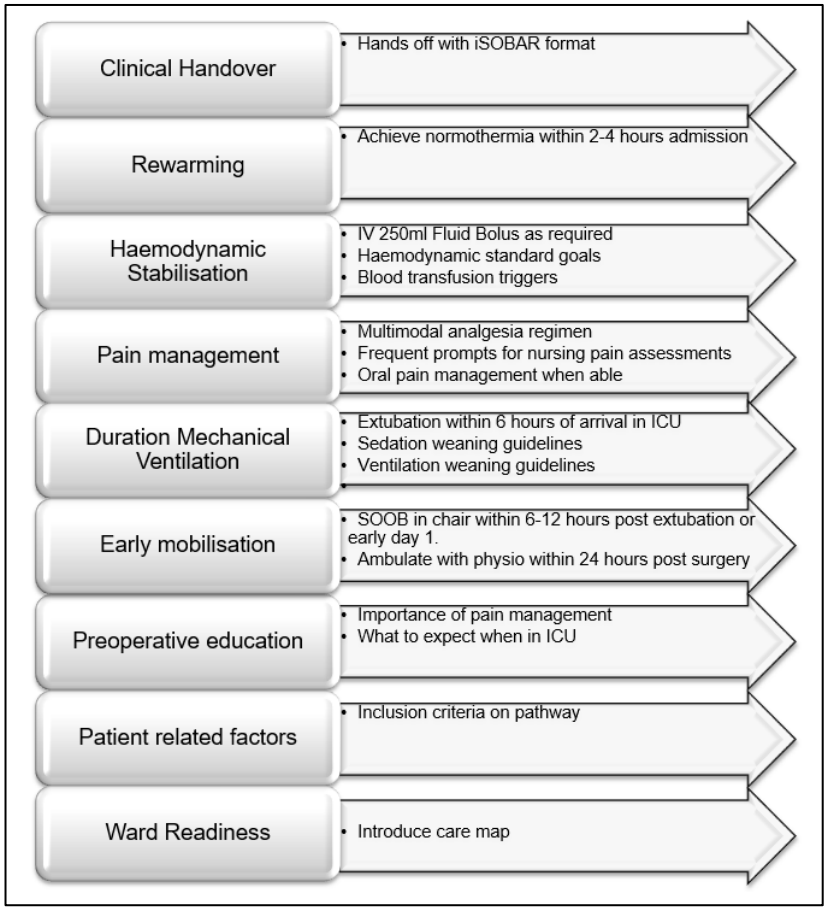
Ward readiness tasks that have historically delayed ward readiness are absent in the benchmark documents and literature, these tasks include removal of subcostal drains, invasive line removals and cessation of vasopressor therapy. Subcostal catheter removal confirmations between ICU medical and cardiothoracic surgical team remains reasonable with of mean of 2.73 hours. Actual removal times varied up to 6.91 hours with 10 drains removed in a time frame greater than three hours and with no documentation explaining why these tasks were prolonged. One possible explanation relates to delays in mobilising as the expectation at the study site is for patients to be mobilised and sat in a chair which aids any residual drainage from the subcostal catheters prior to removal. With each interrelated component experiencing delays the cumulative effect can be substantial.

Appropriate weaning of vasoactive therapy is guided by patient condition with the removal of invasive lines guided partly by cessation of vasoactive therapy. The ideal time frame for removing an arterial line is not within the scope of this project but worth considering at a later date. Medical discharge decision is when the patient is deemed medically fit for transition to ward level care. The removal of lines at this stage would assist with the timely ward transfer and avoid rushing which provides additional stress on patients and relatives. In the Current Practice Review, a mean time of eight hours from medical discharge decision to line removal is a significant time frame and with eight arterial lines removed in a time frame greater than 10 hours.

Recommendations for pathway

Detailed guidelines including expected time frames and clear communication on expectations during ICU admission is required. Key information gained in the benchmarking process will be shared with the key stakeholder group so clarification on expectations can be sought. Amendments have been made to the care map framework (see Figure 2.7) to include recommendations from both the scoping review and benchmarking to formulate the revised care map framework (see Figure 3.4).

Figure 3.4 Revised care map framework for post operative care of the cardiac surgery patient



This framework outlines elements from current practice coupled with the literature and additional detail reflecting the benchmarking process. Key measures of performance for the framework will revolve around timings such as mechanical ventilation duration, early mobilisation targets and ward readiness.

Recommendations include a reminder that hourly temperature measurements are required until normothermia is reached. Urine output measurements need to be consistent and only to include output following ICU admission. Clarification on fluid bolus recommendations including volumes and triggers and a discussion on excluding maintenance fluid is required.

Education and guidelines on post operative weaning of propofol is required as slow weaning is unnecessary due to its short acting nature. Education and guidelines for both pain management and nurse initiated early mobilisation is highly recommended due to the poor performance during the Current Practice Review. Consensus on time limits for invasive line and drain removals will need to be achieved. Patient related factors to be included in the pathway as inclusion or exclusion criteria with clarification from the key stakeholder group.

Chapter 4 Developing an ICU Care Map to Standardise Clinical Practice

Introduction

The goal with standardising clinical practice is to reduce practice variations which can potentially improve patient outcomes and cost effectiveness.[145-148] Chapter Four outlines the development and preliminary assessment process employed to create the ICU care map for post operative cardiac surgery patients. Findings reported in previous chapters were synthesised to develop the evidence-based care map.

Ethical considerations

Confidentiality, data security and anonymity were the primary ethical considerations for this portion of the project. Health consumer identifying details were not collected and interview data were deidentified with the allocated a code (Consumer A, B and C) for reporting purposes. Senior clinical staff participant identifying details were also not collected. Meeting notes with non-sensitive data for both health consumer and senior clinical staff assessments were stored in a password protected folder.

A quality improvement project application was recommended and submitted to Fiona Stanley Fremantle Health Group using the GEKO database and the proposal included activity reason, relevant accreditation standard and criterion, objectives, inclusion and exclusion criteria and methodology for obtaining data. The application (Quality Activity 52272) was approved on 2nd February 2024 (see Appendix 16). This project was also recognised by the reciprocal approval from Curtin University Human Research Ethics Committee on 26th May 2023, (HRE2023-0263 approval number) (see Appendix 12).

Draft care map assembly

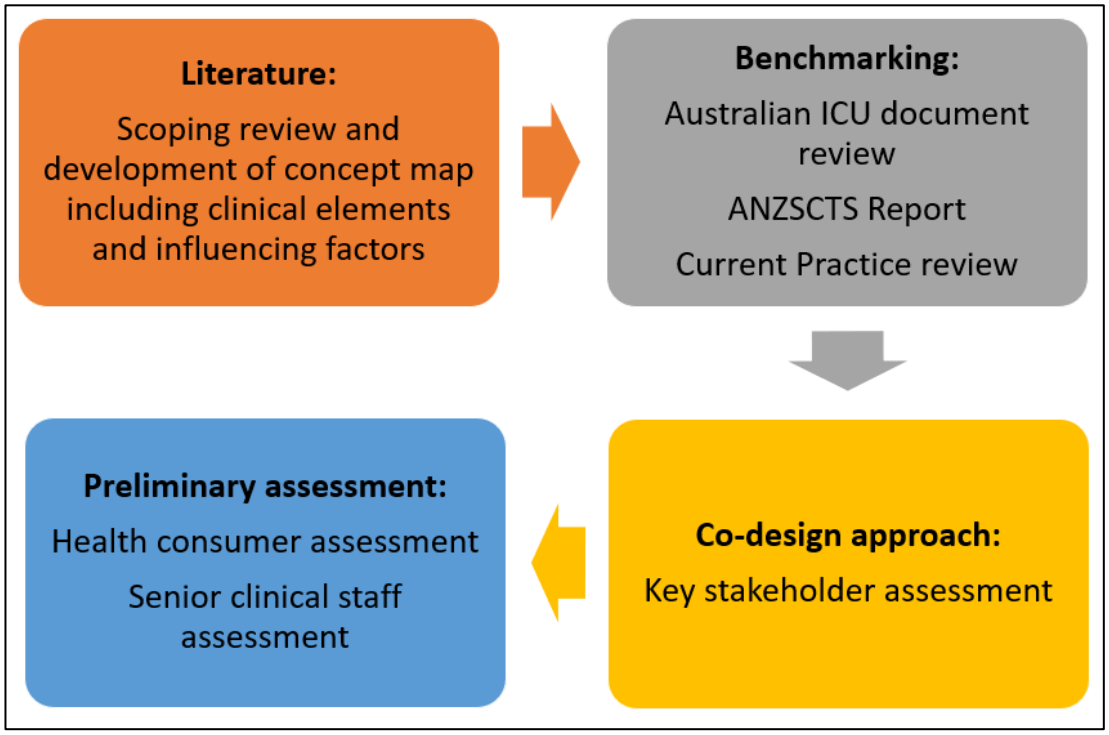
Methodology

Development of the draft care map involved the following: (Figure 4.1)

1) Completion of a scoping review with the development of a care map framework which outlined clinical elements and influencing factors in post operative care of the cardiac surgery patient (see Figure 2.7).
2) Benchmarking process (Australian ICU documents review, ANZSCTS report, Current practice review) based on the clinical elements and influencing factors identified in the care map framework.

3) A co-design approach which included achieving content consensus with key stakeholders
4) Preliminary assessment of acceptability and feasibility of the draft care map from two different perspectives; health consumers and senior ICU clinicians (nurses and doctors).

Figure 4.1 Care map assembly



Johnson et al[149] described a five-step approach to development of a clinical pathway program standardising the use of sedation and lung protective strategies for mechanical ventilated patients. The approach included a review of current literature, examining local hospital and national hospital and registry data, mapping clinical steps, achieving consensus statements and amalgamating these components.[149] Improving efficiency of care by reducing practice variations is a shared aim so adapting the same approach guided the development of this draft care map.

The scoping review and benchmarking process were reported in previous chapters. The assembly of the draft care map began with the identification or mapping of clinical steps or milestones in sequence from ICU patient admission until ward transfer. Recommendations from the scoping review and key findings from benchmarking were collated and grouped into each milestone. Content requiring key stakeholder consensus or clarification were identified.

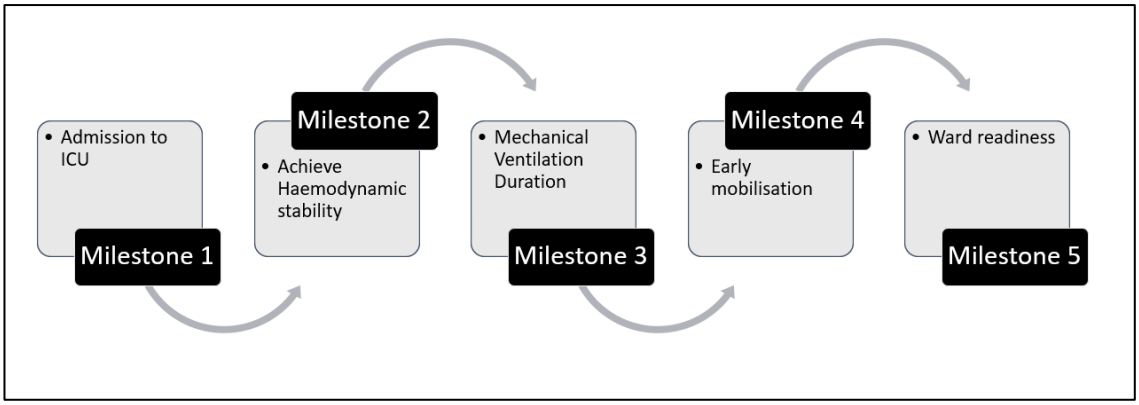
Draft care map design

The vision for the draft care map design was to create a simple, easy to follow visual representation of the ICU patient journey. Achieving this vision required adherence to usability principles such as consistency and structure of text, organisation, clarity of information, legibility, layout and aesthetics.[150,151] These principles have been utilised for digital application designs which were described to enhance visual communication potentially aiding understanding of the content.[151] The key features of care map design included contrasting colour to draw attention to the key information and clear succinct wording for readability. Microsoft Word© SmartArt graphics was utilised with a colourful alternating flow process design. Rectangular speech bubbles were added for the inclusion of additional information to support achievement of each milestone.

Results

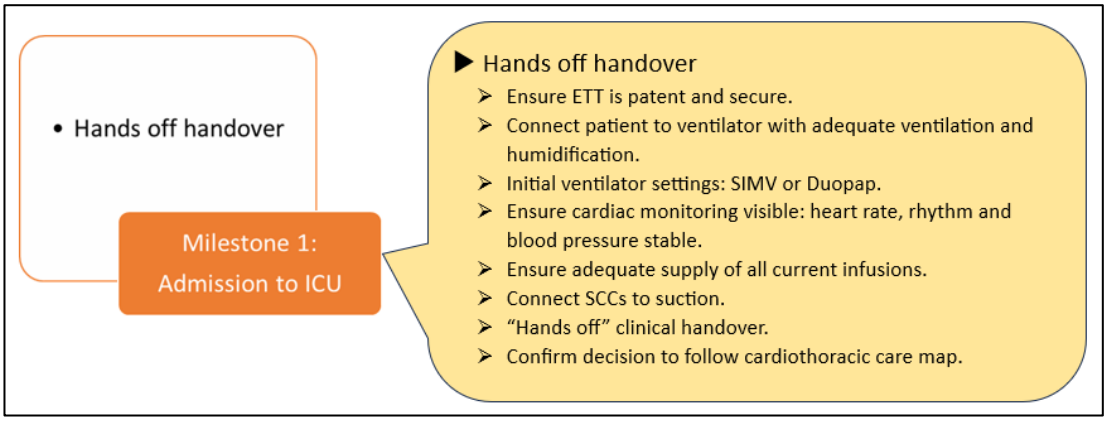
There were five post-operative milestones from admission to ICU until ward transfer, displayed in Figure 4.2.

Figure 4.2 Post operative milestones



Milestone 1: Admission to ICU. A hands off ISOBAR handover format is supported by the literature and Australian ICU documents and is current practice at the study site. Clinical handover was not addressed in the ANZ database report. Details from the current procedural document were transcribed into the draft care map. An initial mode of ventilation with standard settings were included. The choice of ventilation mode occurs on admission following anaesthetic handover with consideration to patient history and lung function. Standardising initial ventilation mode and written confirmation to follow care map were highlighted as requiring consensus from key stakeholders (see Figure 4.3).

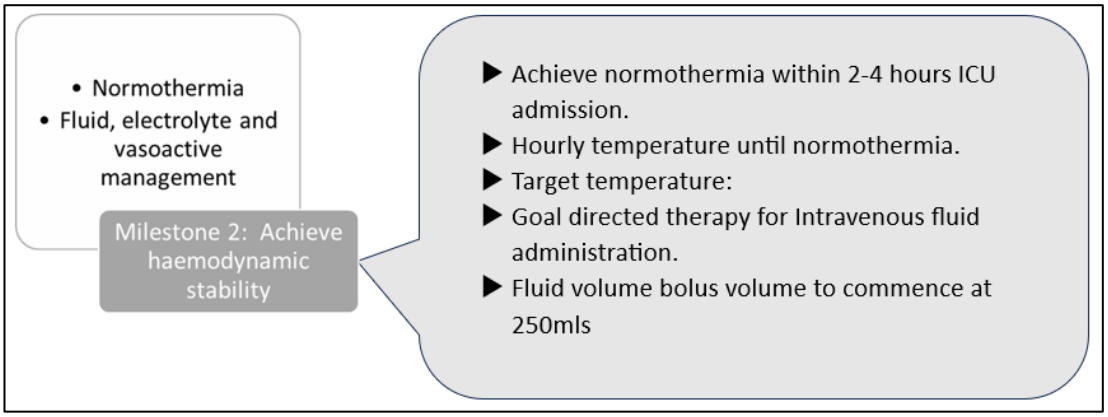
Figure 4.3 Milestone 1 outline



Milestone 2: Achieve haemodynamic stability. This milestone consisted of achieving normothermia, intravenous fluid management and vasoactive medication management. Recommendations from the literature were to achieve normothermia within 2-4 hours of ICU admission.[47,53,59,62,78,85,119] Specific techniques for rewarming were not detailed. The rewarming goal is to reduce complications such as increased bleeding and arrhythmia risks that may result from hypothermia. The Australian ICU document review showed a number of variations with target normothermia temperature definitions differing from 36°C, 35-37°C, >37°C to normothermia. Specific rewarming techniques were outlined in only three documents. Achieving normothermia, intravenous fluid and vasoactive medication management were not addressed in the ANZ database report. Hourly temperature monitoring was included to focus achieving normothermia within the desired time frame. The target normothermia temperature required consensus.

Intravenous fluid management was given no clear direction from the literature or benchmarking process with variations in both maintenance and bolus fluid recommendations. The literature addressed goal directed therapy using specific monitoring not currently available at the study site (oesophageal dopplers, flowtrac systems and Lidco monitors). Maintenance and bolus fluids for each of the Australian ICU documents differed in fluid types, additives and volumes or rates to be administered. Discussion and agreement with key stakeholders is required with consideration of standardising the initial fluid bolus choice (see Figure 4.4).

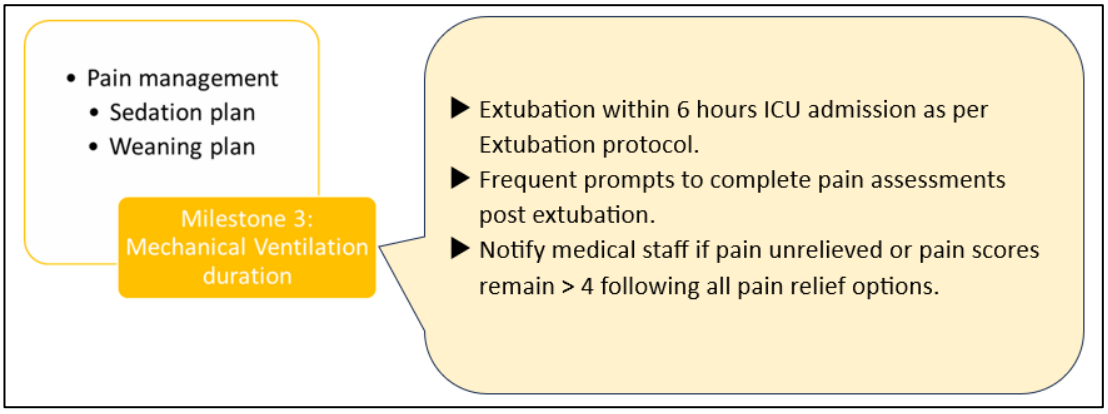
Figure 4.4 Milestone 2 outline



Milestone 3: Mechanical ventilation duration. Mechanical ventilation duration included extubation practices and pain management. Extubation within 6 hours of ICU admission was supported in the literature, the Australian ICU documents and the ANZ database report. Benchmarking against the ANZ database report showed the study site was achieving this milestone. Despite this, delays were evident with further improvement opportunities. There was also uncertainty about whether the extubation protocol at the study site was in use or redundant.

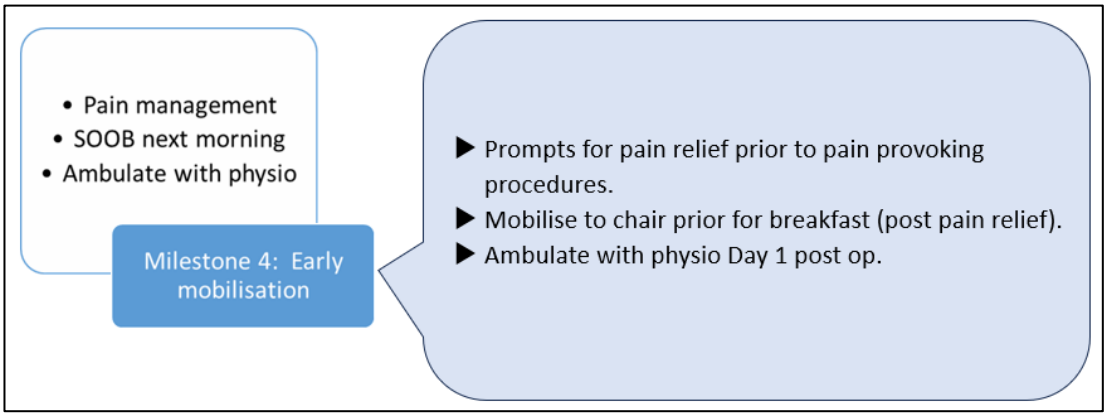
Pain management at the study site reflected the literature findings overall of poor pain management with inconsistent time intervals between pain assessments. Promoting best practice by bedside nurses includes specifying frequency of assessments to every two to three hours with follow up reassessments following administration of additional analgesia. Medical staff should be notified to review the pain management strategy if pain unrelieved or pain score consistently (i.e. 2 or more times) >4 (numerical pain scale 1-10) despite administration of additional analgesia (see Figure 4.5).

Figure 4.5 Milestone 3 outline



Milestone 4: Early mobilisation. Early mobilisation (within 6-12 hours post extubation or early Day 1) was supported by the literature and Australian ICU documents. Early mobilisation practices were not addressed in the ANZ database report. There was opportunity to improve practice at the study site. This was addressed by recommending prompts for nurses to administer additional analgesia prior to painful mobilising activities. The mobilisation staged approach included prompts to mobilise the patient to a chair prior to breakfast followed by full ambulation guided by the physiotherapist (see Figure 4.6).

Figure 4.6 Milestone 4 outline

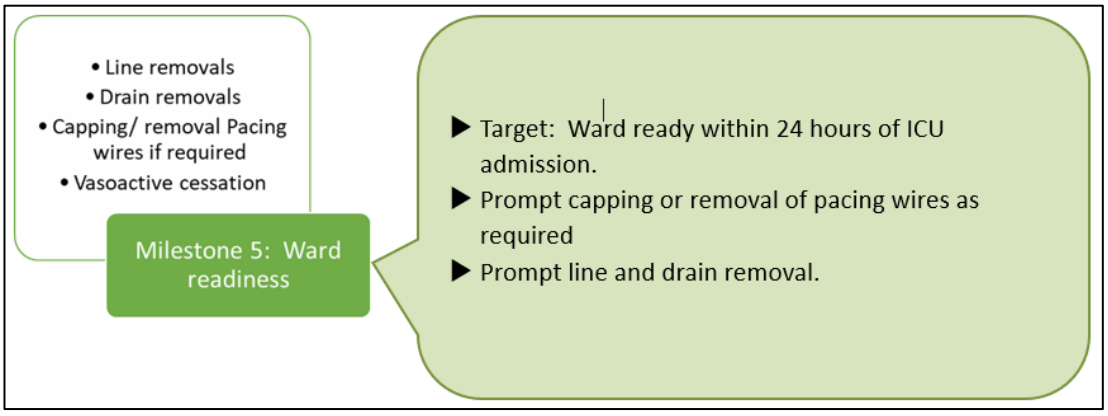


Milestone 5: Ward readiness. ICU length of stay corresponds to the total number of hours spent in ICU prior to ward transfer.[128] The literature indicated a significant reduction in ICU length of stay can be safely achieved following the introduction of a care map.[22,25,47-51,55,59,67,69,70,74,83,84] The ANZ database reported that 19% CABG patients were discharged within 24 hours. Australian ICU documents did not report on

ICU length of stay or ward readiness times. The study site current practice review reported 16% CABG patients were discharged within 24 hours.

Ward readiness was determined as the documented time of the medical decision made the patient was ready for discharge from ICU. The focus for this milestone is achieving ward readiness. Many external factors such as ward bed availability influence actual ICU discharge times. Achieving timely ward readiness ensures no additional stress is placed on patients or healthcare staff which occurs when transfers are delayed, rushed or do not occur during daylight hours.[2] The target is for the patient to be ward ready within 24 hours. Recommendations were to include prompt removal of lines and drains (see Figure 4.7).

Figure 4.7 Milestone 5 outline



Co-design approach

Three assessments shaped the co-design approach prior to the finalisation of the evidence-based care map. The key stakeholder assessment provided clarification and consensus on the draft care map content. Health consumers and senior clinical staff provided an assessment of the draft care maps acceptability and feasibility in the clinical setting. The strength of the co-design approach was that each assessment examined the draft care map from a different perspective. Each assessment is addressed in the order that the process was completed.

Applying a co-design approach with key stakeholders enables the inclusion of different perspectives.[152,153] An example in the use of a co-design approach include Borgstrom et al[152] whom describe the co-design core principles as the creation of

equity amongst health consumers, understanding personal experiences and improving services. Using experience based surveys, enabled a range of improvement ideas to be identified for breast disease referral process and clinical guidelines.[152] Rosgen et al[153] used a co-design approach in the development of the patients transition from ICU care bundle. Health consumers, researchers, decision makers and care providers combined their unique viewpoints in the development and implementation of care bundles. A co-design approach promotes active contribution and cooperation in creating a unified view of ownership and confidence in newly developed products.[153,154] The co-design approach for development of the draft care map has the potential key benefit of sustaining engagement and ownership by key stakeholders. This will be essential when the time comes for implementation and evaluation.

Key stakeholder assessment

Methodology

Key stakeholders and decision makers invited to participate in the co-design were the ICU head of service, ICU consultants, ICU nurse unit manager, associate nurse unit managers, ICU lead physiotherapist and the ICU nursing and midwifery educator. An ICU key stakeholder meeting was held in person and online (see Meeting Agenda Appendix 13). A PowerPoint© presentation was used to explain the project background, draft care map structure with each milestone expanded to include scoping review findings, benchmarking and current practice review results. To elicit expert opinion and agreement, content requiring consensus were embedded into the presentation and discussed.

Results

Sampling. Thirty-five key stakeholders were invited to meet to discuss the project findings and provide feedback on the creation of the draft care map: 25 ICU consultants, one nursing and midwifery educator, one ICU lead physiotherapist, six associate nurse unit managers, one acting nurse unit manager and one of the Master of Philosophy (MPhil) Student's supervisors. Nine people attended the meeting: one ICU consultant, one ICU lead physiotherapist, one acting nurse unit manager, four associate nurse unit managers, one nursing and midwifery educator and one MPhil supervisor.

Milestone discussion points and outcomes. The focus of discussion for **Milestone 1** was the mechanical ventilation settings which are important components of admission preparation and to ensuring optimal ventilation. It was agreed that patients initially require a mandatory mode of ventilation given they have received muscle relaxants, opioids and sedatives in theatre. It was agreed that the decision about mode of ventilation will be made by the ICU Consultant following anaesthetic handover.

Alterations to the draft care map included the removal of the standard initial ventilator settings which was replaced with mandatory mode with adequate ventilation and humidification. There were no recommendations for a change in practice related to hands off handover from the key stakeholder group.

For **Milestone 2** the consensus was to achieve 36.5°C target temperature. With the variety of rewarming times evident at the study site, and to assist with raising the core temperature faster, it was agreed to utilise the fluid warmer (which comes from theatre attached to the patient). However, the decision on whether to use the fluid warmer for each patient will remain discretionary. Use of convective air warming devices remains standard practice at the study site with close monitoring of haemodynamic and electrolyte status. There was no strong evidence to support any change in intravenous fluid management and it was agreed to make no changes. It was agreed that intravenous fluid bolus volumes to commence at 250mls as prescribed my medical staff.

The ICU Consultant reported their concern about an apparent lack of knowledge by ICU nurses about weaning and extubation requirements for different ICU patient cohorts. For example, the goal is for weaning of sedatives and mechanical ventilation for patients without lung problems to be brisk to aid in prompt extubation. The goal is different for patients who are ventilated due to respiratory compromise. The current extubation protocol at the study site was discussed and found to clearly detail the process with time frames. Further education to promote adherence to the protocol was recommended. Consensus was to further examine, revise and streamline the extubation protocol after the care map was implemented.

Alterations to the draft care map included the addition of target temperature 36.5ºC and consider use of fluid warmer.

Milestone 3 discussion involved timing and frequency of pain assessment and nuancing to the pharmacokinetics of medications. For example, analgesia delivered intravenously has a faster peak effect than oral medications and will require more

frequent pain assessments. It was agreed that hourly pain assessments for intravenous Fentanyl infusions were appropriate with additional assessments if bolus doses given. Once the patient had transitioned to oral pain medications the frequency of pain assessments will be decreased to two to three hourly intervals. There was an addition of another trigger for notifying medical staff for patients with little to no pain but unable to take a deep breath. This was identified as a concern which can lead to hypoventilation and further complications such as atelectasis.

Alterations to the draft care map included that pain assessments post extubation were aiming for a target score <4, two options were presented depending on whether oral (2-3 hourly) or IV medications (hourly). Additionally, if patients were unable to take a deep breathe was added as a trigger to notify medical staff.

The **Milestone 4** discussion centred around early mobilisation and related pain management strategies. There was consensus that an opportunity for improvements to early mobilisation practices existed. Barriers to achieving this were discussed including the patient receiving vasoactive medications, haemodynamic instability, timing of subcostal drain removal, pain, pulmonary artery catheter presence and current nursing culture. Barriers to ambulation had been identified by the physiotherapy department and will be shared to inform the care map implementation. Existing guidelines for no ambulation if noradrenaline requirements are single strength (Noradrenaline 8mg in 100mls 5% Dextrose) greater than 10mls/hr will be the only remaining barrier to examine at a later date.

There were further discussions on pharmacokinetic differences of medications comparing Oxycodone, Tramadol and Buprenorphine. Clarification was sought on commonly prescribed medications with consensus that Tramadol and Buprenorphine were preferred choices. There was consensus that initial mobilisation to chair by morning handover at 7am was realistic and desired. The assistant in nursing team provide support in turning and mobilisation of patients under the direction of nursing staff every three to four hours. To meet this goal the workflow entailed some changes in timing. It was agreed that this plan would relieve morning shift pressure to enable timely ward readiness.

Alterations to the draft care map to include pain relief options prior to pain provoking procedures such as Oxycodone or Buprenorphine (both have different peak effect). An additional time frame by 7am handover was included within the mobilising to chair details.

The **Milestone 5** discussion focused on various time-consuming procedures and tasks required to achieve ward readiness. Factors affecting timely subcostal drain removals included existing mobilisation practices and new nursing staff who were inexperienced. The clinical nurse education team are responsible for providing assistance, education and skill assessment for newly orientated cardiac surgery nurses. Consensus was that the clinical nurse education team will prioritise inexperienced nurses requiring assistance with cardiac surgery related tasks to improve timeliness. Arterial line removals created the largest discussion around medical staff preference for the device to be removed only once a ward bed was available despite the recommendation of removal within 1 hour of discharge decision time. The rationale was that ICU nurses may give less attention to patients with no arterial lines and there is ease of blood sampling whilst the device remains insitu. Without an arterial line medical staff may have additional tasks such as venepuncture. It was agreed alternatives such as central venous line access could be used, and prompt arterial line removal should occur following the medical decision time.

Alterations to the draft care map included the addition of prompt removal of arterial lines and drain removals post medical request or medical discharge decision time.

Additional discussion points raised included:

- Previous version of a clinical pathway: Highly detailed and often difficult to follow. It was agreed the care map Milestones will be easier to follow giving guidance and structure for patient progression. The care map also outlined desired KPI goals such as extubation within 6 hours, early mobilisation and ICU length of stay.
- Discussion about the name of the care map related to the focus on bedside nursing patient care.
- The planned health consumer assessment was well received and supported.
- The need for digital readiness was raised with discussion about a potential future digital care map.
- To include a clear timeframe, more robust visual milestone progression and the inclusion of symbols which assists staff to easily recognise and differentiate between each milestone[7].

Design changes to draft care map. Key stakeholder discussions included the care map design with the following alterations suggested. The name of the care map to be finalised as the ICU cardiac surgery nursing care map. The inclusion of Microsoft© SmartArt designs symbols as a visual representation for each milestone located by

searching Google© images with the key words intensive care symbol, temperature symbol, mechanical ventilation symbol, sitting in chair symbol and discharged symbol. Microsoft© SmartArt graphics also provided the additional timeline under the process category which is placed below the draft care map outlining key time points. Finally, to align with hospital requirements the poster contents were arranged on a Fiona Stanley Fremantle Hospital group Microsoft© PowerPoint slide template.

Draft care map acceptability and feasibility assessment

The purpose of an acceptability and feasibility assessment was to examine operational detail of the draft care map to assess if it would actually work in the clinical setting from perspective of users.[155] Reported acceptability characteristics include appropriateness, usefulness, potential discomfort and convenience of the intervention.[155] Acceptability relies on participant understanding incorporating adequate knowledge related to the components, goal and benefits of the intervention.[155] Personal beliefs and values of the health consumer are believed to influence perceptions which must be taken into consideration.

Barriers to feasibility may relate to comprehensiveness or transparency of the intervention or the ability of health consumers and nursing staff to participate in the health intervention.[155] Park et al[156] provided an example of feasibility and acceptability assessments related to the introduction of digital mental health intervention technology. An acceptability assessment focused on barriers to the technology use and why health consumers chose not to participate. The feasibility assessment focused on how the product became part of the care process therefore assessing its practicality. Refining content and early identification of operational barriers allowed for solution finding prior to implementation. Potential operational barriers included the intervention not meeting organisational needs or being inconvenient or uneasy to use.[155] The draft care map feasibility assessment was undertaken with two user groups: health consumers and senior clinical staff. Subsequent adjustments as a result of user feedback supported useability of the draft care map potentially promoting long term engagement and adherence.[155]

Health consumer assessment

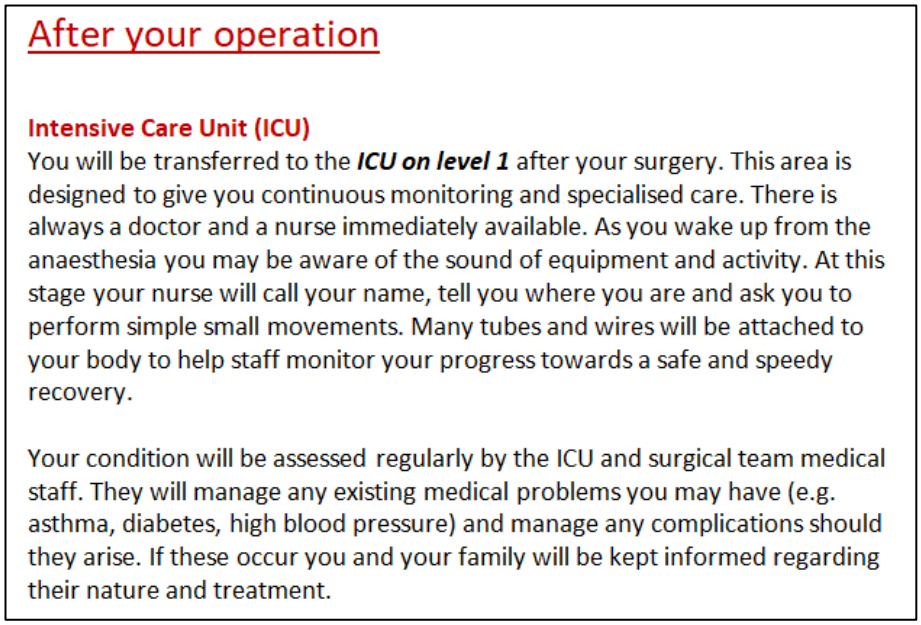
Health consumer assessment was essential to address the project aim to improve the patient experience.[157] The purpose was to elicit opinion and understand if the most important aspects of care appeared to be met, therefore addressing acceptability from

health consumers' perspective. Attention was focused on patient experience rather than operational process.

Methodology

Purposive selection of health consumers involved inviting three current inpatients who had experienced elective coronary artery bypass graft surgery to participate. Elective surgical cases were chosen because elective patients were routinely provided preoperative education and written information about their surgery. The Fiona Stanley Hospital Heart Surgery Patient Information booklet provides information on the patient's cardiac surgery journey from referral to a cardiac surgeon to follow up appointments post hospital discharge. The ICU related content provides a broad and limited overview of post operative care. The ICU content forms two paragraphs within the 37-page Heart Surgery Patient Information booklet, see Figure 4.8.

Figure 4.8 Post operative ICU information



After your operation

Intensive Care Unit (ICU)

You will be transferred to the ***ICU on level 1*** after your surgery. This area is designed to give you continuous monitoring and specialised care. There is always a doctor and a nurse immediately available. As you wake up from the anaesthesia you may be aware of the sound of equipment and activity. At this stage your nurse will call your name, tell you where you are and ask you to perform simple small movements. Many tubes and wires will be attached to your body to help staff monitor your progress towards a safe and speedy recovery.

Your condition will be assessed regularly by the ICU and surgical team medical staff. They will manage any existing medical problems you may have (e.g. asthma, diabetes, high blood pressure) and manage any complications should they arise. If these occur you and your family will be kept informed regarding their nature and treatment.

Note. From Fiona Stanely Hospital Heart Surgery Patient Information (p18), 2018[158]

The health consumer assessment involved presenting and discussing the draft care map with a sample of post-operative cardiac surgery patients and their families. To guide the discussion, an informal script was used with semi structured questions and project overview, purpose for health consumer assessment, an outline of the draft care map and specific feedback required (See Appendix 14). Deidentified meeting notes were taken by the student researcher, transcribed into electronic notes then saved in a password protected folder. The transcribed notes were examined and

content summarised inductively by the student researcher without any specific qualitative framework applied. [159]

Results

Sampling. Three consumers, two males and one female (labelled Consumer A, Consumer B and Consumer C) accepted the invitation to participate in semi structured interviews to provide feedback to understand if the draft care map addressed consumer needs. Family members (partner and son) were present and participated in one of the interviews.

Interview discussion points and outcomes. Background history of events which led to the launch of the project were first explained. A brief overview of each milestone from ICU admission to ward transfer, explained in layman's terms, was provided. The draft care map was displayed. All health consumers were previously unaware of these milestones with two consumers stating that a brief overview of the events and expectations during their ICU stay would be beneficial in the preoperative period. One consumer elaborated that a complete understanding of what to expect was important to relieve anxiety but also noted that not all patients' needs are the same. Family members verified that more information about the ICU journey would assist them in knowing what to expect. Development or revision of the ICU admission preoperative education will be followed up at the project conclusion as outside the scope of this project.

The most important aspects of the post operative journey identified included communication and adequate pain control. Professional and consistent communication was an important aspect for all. Consumer B was concerned about the pre-operative process for confirming scheduled surgery and had experienced difficulties that caused increased anxiety prior to surgery. All three consumers and families were satisfied with communication from ICU and surgical teams.

Consumer A expressed concern regarding perceived unprofessional behaviour by some nurses such as unfriendliness towards patients, relatives and colleagues. Similar reports in the literature influenced health consumer perception on whether nursing staff care and enjoy their job.[108] Feelings of depersonalisation and increased vulnerability have been reported when the patients' perception of whether nurses care have been altered.

Whilst all health consumers recalled no major issues with pain, they all agreed that adequate pain control was important. Consumer A was surprised at how quickly the

drains were removed which alleviated chest discomfort. Consumer A also commented on the benefit of quantifying pain, referring to pain assessments post extubation in the care map. Consumer B recalled the presence of the endotracheal tube but experienced no difficulties. Consumer C was unclear on memory of mobilisation in ICU but recalled sitting in chair by 7am each day on the cardiothoracic ward which was a positive experience. Consumer C supported the ICU plan for early mobilisation. The draft care map features were discussed and all consumers agreed that the needs of consumers and family were met.

Alterations to draft care map. No alterations were made to the draft care map.

Senior clinical staff assessment

Clinical feasibility of the draft care map was assessed through input by senior clinical staff.[152,153] Engaging potential end users early in the development process is recognised to improve adoption and adherence to the intervention which for this project is the care map.[154,157]

Methodology

There are eight senior registrars at the study site with an invitation to participate in the tabletop discussion extended to those with more than five years' experience in the care of cardiac surgery patients, two accepted the invitation. The same number of invitations were sent to senior clinical nurses with equivalent experience in care of the cardiac surgery patients. This approach allowed for debate amongst a smaller group while bringing different perspectives in a controlled and low stress environment.[160,161] A single session tabletop discussion was arranged and a meeting script was created which included background information, aim of the research project, purpose of clinical feasibility assessment, a structured overview to each milestone, discussion and feedback (see Appendix 15). Deidentified meeting notes were taken by the student researcher, transcribed into electronic notes then saved in a password protected folder. The transcribed notes were examined and content summarised inductively by the student researcher without any specific qualitative framework applied. This approach supported the preliminary assessment of acceptability of the care map through identifying obvious flow issues and examining workability in the clinical setting. Notes were taken and content summarised.

Results

Sampling. Senior medical and nursing staff with more than five years' experience caring for cardiac surgery patients were invited, two from each discipline accepted the invitation.

Meeting discussion points and outcomes. The background history of events leading to the project were outlined and the project aim and purpose of the working party assessment defined. A printed version of the thesis overview (Figure 1.1) and a verbal explanation were provided. The synthesis of data sources and creation of the evidence-based care map was outlined. The assembly and co-design with key stakeholders to reach consensus on content and design were summarised.

The discussion about **Milestone 1**'s handover process revealed a reported decline in adherence to the hands off handover. Due to recent staff shortages, it had been noticed that nursing staff were attempting task completion rather than exclusively listening to handover. The elements of Milestone 1 prior to hands off handover were highlighted. The revised ventilator instructions along with the inclusion of a written confirmation from medical staff to follow the care map was acceptable. It was agreed that the removal of specific ventilator settings was a positive change. The outcome from group consensus was that Milestone 1 had sufficient detail and was a concise reminder of key elements of the handover process.

Milestone 2 discussion disclosed a similarity between the perception of clinical practice and the findings of the scoping review and benchmark findings. Furthermore, participants were not surprised at the study site results and believed that the range for achieving normothermia may have been wider. Causes for prolongation of rewarming times were discussed with delayed commencement of rewarming techniques identified. It was agreed that the additional use of fluid warmers will be beneficial. Group consensus was that Milestone 2 was clear, concise and sufficient.

Benchmark findings from **Milestone 3**'s mechanical ventilation duration were explained. Causes for delays to extubation were discussed including some reluctance from both medical and nursing staff to progress weaning and follow the extubation protocol resulting in overnight extubations. Overnight extubations are not recommended best practice due to reduced staffing levels and expertise available to manage any potential complications.[162] Further, prolonged time to extubation post cardiac surgery results in increased risk of atelectasis, renal failure and deep sternal wound infections.[5,80] There was agreement that implementation of the care map may

potentially address the delays to extubation. The ICU extubation protocol was discussed and it was agreed that further education is warranted to increase awareness of weaning principles for cardiac surgery patients and to promote use of the protocol. There was a suggestion to include further education on the extubation protocol in the care map implementation plan.

The discussion on pain management disclosed a similarity of the current practice review and perception of clinical practice and agreed that time frames should be dependent on the type and delivery route of analgesia. Patients' inability to effectively cough and reposition in the bed was raised as another concern to notify medical staff to review pain management. Possible preoperative pain relief commencement using slow-release formulas were discussed. Group consensus was that Milestone 3 is sufficient with the above-mentioned alteration of patients being able to cough effectively.

The scoping review findings for **Milestone 4**'s staged progression for early mobilisation was defined. The study site findings reflected participant opinion that early mobilisation practices were poorly managed. Resistance to proactive mobilisation was expressed by nursing staff. Despite written medical request to mobilise patients it was noted that junior physiotherapists continued to question medical staff about whether to mobilise. This was attributed to a lack of familiarity with mobilisation goals for this patient cohort.

Pain relief prompts including time frame considerations were discussed and agreed to be acceptable in the clinical setting. It was agreed that mobilising patients to a chair by 7am was achievable and aligned with the cardiothoracic ward culture and practice. Altering the timing for the assistant in nursing turn round to allow early mobilisation to occur prior to 7am handover was agreed to be possible with the added suggestion that nursing staff in clinical leadership roles could assist with mobilisation if necessary. The multiple benefits of mobilising patients to a chair by 7am were discussed including early rehabilitation and possible earlier drain removals. Challenges with implementing this change were raised with the agreement that a uniform approach by the leadership team and clinical nurse education team would be required to support a practice change. The outcome from group consensus was that Milestone 4 was clear and concise. However, to ensure sufficiency it was suggested to add that if a patient was unable to cough effectively to the list of requirements to notify medical staff for pain management review.

Milestone 5: Literature and ANZ database report findings for ICU length of stay were presented and the difference between ICU length of stay and ward readiness explained. The study site results reflected the ANZ database report findings. The disparity in ICU length of stay and medical discharge decision times were discussed. The prompt removal of arterial lines were debated with reluctance from medical staff to remove unless a confirmed ward bed was available. With alternative options available for blood sampling there was not reasonable rationale for arterial lines to remain insitu. Subcostal drain removals attracted the same level of debate with some patients leaving ICU without drain removals due to bed pressures and nursing staff unable to complete timely transfer process. It was agreed that an improvement in early mobilisation practices could potentially improve achievement of prompt drain removal times. The prioritisation of drain removal support by the clinical nurse education team were communicated as a potential way to improve. Group consensus was that Milestone 5 was clear, concise and sufficient.

Final dialogue incorporated the design, size and location of the care map in preparation for implementation. The group agreed the design was clear, bright and easy to follow and agreed that an A3 size poster would be ideal. For ease of viewing ideal placement of the care map will be next to the Cardiac Advanced Life Support posters located on the wall in each bedspace. Group advice on implementation strategies were shared which included:

- Presentation of the care map to the ICU journal club to reach a large volume of medical staff.
- Inclusion of care map in the medical orientation guide.
- Inclusion of care map in the nursing cardiothoracic orientation package.
- Update the current study site post operative care in the ICU post cardiothoracic surgery procedure document.
- Priority will be for clinical nurses to receive education as they will be champions to role model and encourage care map use by all nursing staff.

Conclusion

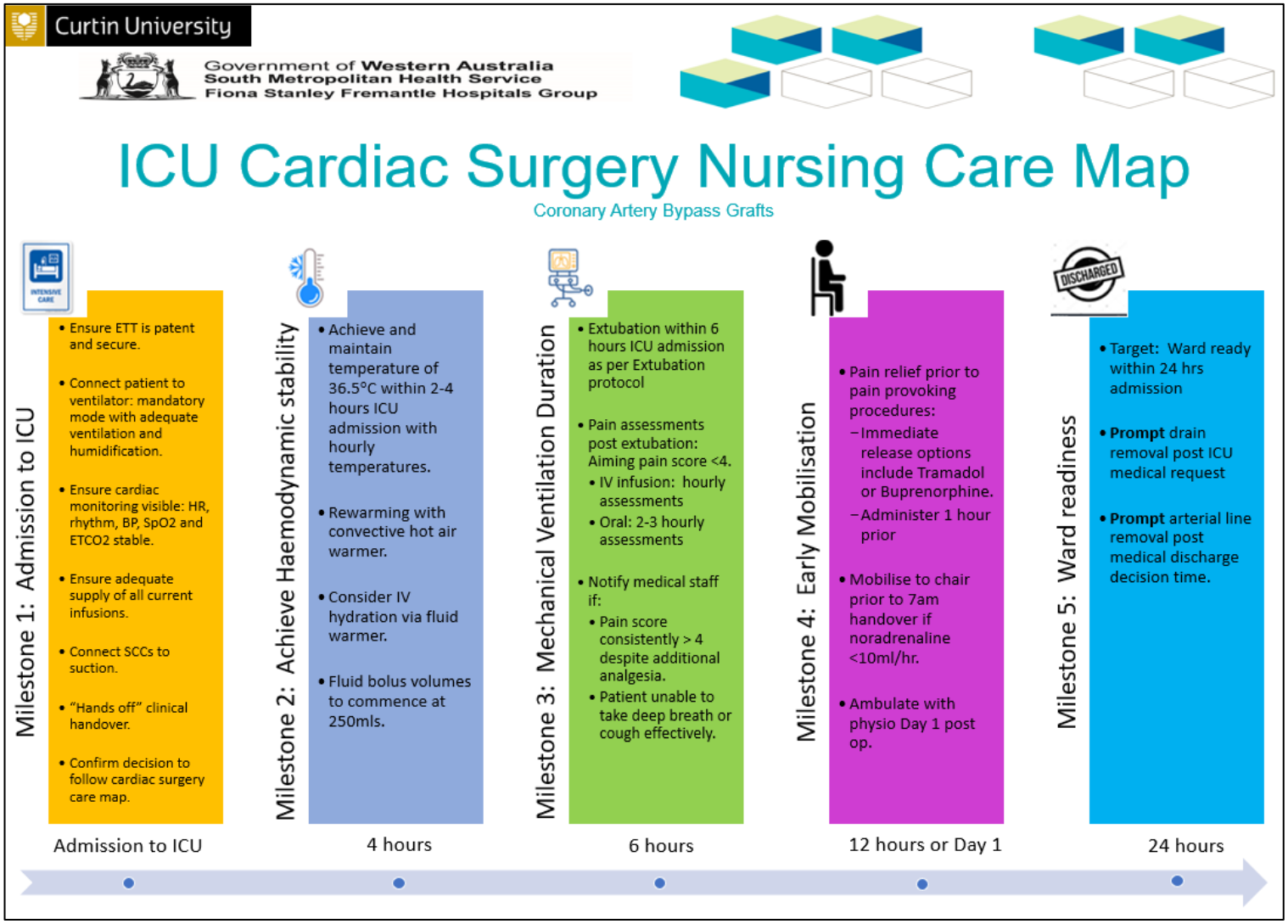
Assembly of the draft care map originated with the inclusion of recommendations from the scoping review and benchmarking process. Recommendations were grouped into milestones with content requiring key stakeholder clarification identified for discussion. Consensus of key stakeholders and senior clinical staff allowed for

various perspectives to be considered. Collaborative decision making on content, poster design and layout were elements that were contributed.

A preliminary assessment of feasibility and acceptability were conducted with health consumers and senior clinical staff. Important aspects and expectations in the post operative journey were the key focus for health consumers with the aim of improving the patient experience. Professional and consistent communication in conjunction with adequate pain control were revealed as the most important aspects for health consumers. The focus for senior clinical staff was to assess the workability in the clinical setting by identifying obvious flow issues. Group consensus that each milestone was clear, concise and sufficient was achieved.

The ICU cardiac surgery nursing care map was finalised (see Figure 4.9). Plans for implementation were discussed during key stakeholder and senior clinical staff meetings. The ICU Head of Service and Nurse Unit Manager accepted the final version of the care map and agreed for implementation to proceed.

Figure 4.9 Final ICU cardiac surgery nursing care map



Chapter 5 Discussion and Exploring the Significance

The purpose of this project was to research and build an evidence-based practice framework for the post operative management of cardiac surgery patients in the Intensive Care Unit. Developing a framework is predicted to guide and support a timely transition through the Intensive Care Unit recovery and enhance patient experience. Following an initial review of the literature, an evidence-based care map was selected as the standardised practice framework. Care maps encourage efficiency by outlining expected timelines and sequencing of tasks which aim to improve transparency of care, reduce practice variations and enable staff education.[22-24] Each thesis chapter described each phase of the project sequentially resulting in the assembly of a draft care map (see Figure 1.1). This chapter provides a synopsis of how the evidence-based care map was created, presents a discussion and implications for clinical practice and further research opportunities.

The introduction of practice frameworks originated in the United States of America in the 1980s with the purpose of improving patient outcomes, enhancing quality of care and ensuring efficient use of resources within an organisation.[49,145,163] Differing terminology used in the literature ranges from terms such as care maps, clinical pathways and integrated pathways, all of which are standardised practice frameworks in approaching post operative care.[145] Practice frameworks are now utilised worldwide in a variety of patient cohorts, providing guidance to reduce clinical practice variations which assists with optimising quality of patient care.[145-148]

The evidence-based movement was founded in the 1990s where exploration of the literature began informing healthcare decisions and practice.[28,34] It was at that time the volume of cardiac surgery cases soared and there were many advancements in surgical procedures, anaesthetic techniques and ICU post operative management. These improvements made the option of cardiac surgery more broadly available to older patients with various co-morbidities. The increased demand for cardiac surgery ignited research activities with the particular focus on improving efficiency of post operative care.[6-8] Subsequently, the number of research and other publications over the past thirty years presents a challenge for clinicians to remain informed of knowledge advancements and implications for clinical practice.[31]

Three phase approach to inform the care map

Phase 1 consisted of a scoping review which was undertaken to understand existing evidence related to post operative care of the adult cardiac surgery patient, including patient and family experiences and satisfaction. A systematic search across five selected databases identified 86 full text articles. The vast majority of research designs were cohort studies (35 articles) followed by analytical cross-sectional studies (19 articles) then qualitative studies (11 articles). The remaining research designs included randomised control trials, quasi-experimental studies, mixed method studies, quality improvement activities and a consensus survey. There was widespread international distribution of articles with most (32 articles) originating from the United States of America.

The scoping review included a critical appraisal process to assess the methodological quality of included articles to identify possible bias.[34] Poor quality articles were defined as meeting less than 50% of the critical appraisal tool criteria. The methodological quality ranged from 27% to 100% of the critical appraisal tool criteria with 67 articles meeting a minimum of 50%. Only two articles were excluded due to lack of clarity in their reporting structure which is attributed to the historical age of those articles.

The scoping review identified key concepts in the post operative journey and also highlighted gaps in current research.[28,33] Major topics were identified, categorised then organised as either clinical elements, influencing factors or process outcomes which shaped the construction of a care map framework (see Figure 2.7). This care map framework demonstrated the interrelationship between each component with clinical elements and influencing factors having a direct effect on process outcomes. Clinical elements focused on rewarming, haemodynamic stabilisation, pain management, duration of mechanical ventilation and early mobilisation. Influencing factors incorporated preoperative education, patient related factors such as patient age, preoperative medical history, use of practice frameworks with high risk versus low risk surgeries and intraoperative times as well as patient and family expectations/experience. Process outcomes were related to hospital and Intensive Care Unit length of stay. The evidence-based care map framework provided the foundation for data collection and reporting for the remainder of the project. An example of one clinical element and one influencing factor and how recommendations were formed is described below.

Mechanical ventilation duration was the dominant topic within the literature with 38 articles addressing early extubation practices dating from 1995 to 2022. Definitions of early extubation have shifted over time with earlier articles aiming for 10-12 hours and later articles aiming for 6 hours. The consensus found that early extubation practices guided by an extubation protocol were safe which shaped this recommendation. The influencing factor of preoperative education was limited to only three articles dating between 2020 to 2021. Articles surrounding preoperative education have emerged due to the increased interest in patient centred care. Albeit the number of articles were low the methodological quality of these articles was high with two randomised control trials (92% & 54%) and a quasi-experimental design meeting 77% of the critical appraisal tool criteria. Recommendations were based on the positive effects seen in these articles.

Phase 2 incorporated the benchmarking process which compared data from three sources: Australian ICU documents, the ANZ database KPIs as outlined by the Australia and New Zealand Society of Cardiothoracic Surgeons website report and a current practice review at the study site. Australian ICU policy and procedure documents were sourced through communications with Nurse Unit Managers across six states/territory. Data extracted from this source primarily related to the clinical elements of the care map framework with limited information on influencing factors. An additional component of clinical handover was identified during review of these documents. The ANZSCTS database KPI comparisons were limited to specific KPIs including ICU length of stay and mechanical ventilation duration. The remainder of the ANZSCTS database KPIs focused on key outcomes such as mortality, return to theatre rates and deep sternal wound infection rates. The current practice review aimed at understanding current ICU practice at the study site. A retrospective observational study incorporating a digital medical record audit was undertaken with the objective of determining site performance in relation to the clinical elements of the care map framework. Recommendations from the three data sources were collated and resulted in the formation of the draft ICU cardiac surgery nursing care map.

The process of benchmarking enabled identification of study site strengths such as clinical handover practice and mechanical ventilation duration. The study site clinical handover practice complied with the NSQHS standard, communicating for safety standard.[135] Study site mechanical ventilation duration of less than six hours was comparable with the ANZSCTS database KPIs reported average. However, a number of inefficiencies at the study site were identified, these were related to extended time

to achieve normothermia, suboptimal pain management and delays in early mobilisation practices. Synthesis of the data provided the platform for outlining improvement strategies. Early mobilisation is an example where five out of the six Australian ICU documents advocate for this practice. Mobilising to a chair early on the day post-surgery is the recommendation as an improvement strategy at the study site. Recommendations for achieving and maintaining normothermia were sourced from the literature and Australian ICU documents. The literature recommends return to normothermia within 2-4 hours of patient admission to ICU but the additional detail including temperature targets and monitoring requirements were gained from the Australian ICU documents.

Evidence-based practice combines the best available evidence from the literature with the best available practical evidence such as benchmarking.[164] This produces the highest quality and efficiency of healthcare improvements with potential for cost reductions.[164] However, without consideration of specific context, collating evidence from the literature to create a care map does not guarantee workability within clinical settings. Randomised controlled trials reported in the literature are an example as they are designed and conducted under controlled environments.[165] Knowledge gained from these studies fail to guide implementation into the real world.[165] Successful implementation of evidence into practice is dependent on broad stakeholder involvement to ensure the care map or guideline matches local contextual needs and culture.[147] Collaboration with key stakeholders and senior clinical staff to design and achieve consensus on the final content for the newly developed care map[147] enabled addressing proactively potential implementation barriers such as staff resistance and insufficient management support.

Phase 3 described the co-design approach shaped by three preliminary assessment strategies enabling the inclusion of different perspectives. The purpose was to review and refine the content and design of the draft care map and reach consensus on identified gap areas. Each preliminary assessment included a different perspective, each with a distinct purpose. Key stakeholders, health consumers and senior clinical staff contributed their views to important aspects of patient care designed to make the care map workable in the clinical setting.

The key stakeholder assessment contributed to content and design consensus creating a unified view of ownership and confidence in the newly developed care map. Refinements and design changes were generated from expert opinion and clarification. Improving the ICU experience was a project aim and gaining an

understanding of perspectives of health consumers was an essential project component. The health consumer assessment was to understand if patient comfort was adequately addressed in the care map. Finally, to determine the clinical feasibility and acceptability in the clinical setting, senior clinical staff perspectives were examined. Thus, the co-design approach with key stakeholders, health consumers and senior clinical staff served a dual purpose in securing agreement for implementation whilst tailoring the care map for local application.

During the care map development process a number of issues were identified. These were related to staff resistance to change and health consumer involvement which are expanded on below.

Resistance to change

Evidence-based practice and clinical practice preferences do not always align. Expert opinion and choice in conjunction with historical practice are the driving forces for this difference.[166,167]Identification of delays in timely removal of arterial lines at the study site is an example of resistance to change which was encountered in the development of the care map. The literature reports a tendency to overlook arterial lines as a source of infection and an inconsistency in adherence to recommended practice.[168] In the context of patients following cardiac surgery, exposure to cardiopulmonary bypass ignites an inflammatory response weakening the immune system increasing the vulnerability to infection for the cardiac surgery patient.[169] Prompt removal of arterial lines reduces any risk of complications including blood stream infections. The United States of America's centre for disease control and prevention published recommendations to reduce the incidence of blood stream infections.[166,168] These recommendations include categories such as site of insertion, dressings and duration of catheter placement. Radial rather than femoral arterial lines are the preferred site as there is a lower incidence of infection.[166,168] Removal of arterial lines should occur when they are no longer required although with no specific time frame is recommended. Timing of arterial line removal created the largest discussion with key stakeholders. There was preference for the device to be removed only once a ward bed was available and patient transfer/discharge time was known rather than when the device was no longer clinically indicated. This clinical practice preference is inconsistent with international guidelines and best practice. Justifications for leaving arterial lines insitu such as ease of blood sampling were debated as central venous access devices were an alternative. The other justification of requiring close blood pressure monitoring was also disregarded with the rationale that if concerned then

should not be ward listed. The final agreement for inclusion to the care map was prompt removal of arterial lines unless clinically contraindicated.

Health consumer involvement

A growing trend for health consumer involvement in research and quality improvement within the healthcare system[170] has shown to produce mutually valuable outcomes such as reduced length of hospital stay.[135] The Australian Commission on Safety and Quality in Healthcare includes partnering with consumers in the NSQHS standards with the aim of encouraging effective partnerships.[135] Increasingly health research funding requirements mandate health consumer engagement.[170] By encouraging clinicians and researchers to seek and utilise health consumer input a different perspective other than the traditional provider focused approach to healthcare is gained. Health consumer partnerships are desirable at three different levels including individual, service or departmental or health service. Health consumers offer a unique viewpoint of their healthcare adding to the value of research and clinical care.[170] Partnering with consumers is an essential component for ensuring a positive experience for both the patient and family. Optimising patient care that accounts for health consumer input is predicted to contribute to improving the patient experience and satisfaction levels.[20-22,135] Improvements in the efficiency of patient care will also assist in maintaining a sustainable healthcare system with the increasing demand for ICU beds and resources.[5]

As part of the co-design approach of Phase 3, the health consumers input reflected a priority on some of the scoping review findings, primarily adequate pain management and the importance of preoperative education. Health consumers agreed adequate pain control was important, reinforcing how pain management is a twofold issue, initially as a clinical element then as an influencing factor affecting patient satisfaction as identified in the scoping review.[41,42,45,52] Pain was reported as one of the major stressors related to cardiac surgery and nurses have a major role in effective management.[171] Uncontrolled pain for the post operative cardiac surgery patient impacts a number of key issues including limited physical activity, sleep disturbances and breathing difficulties.[103,171] The guidance provided in the care map now includes regular and more frequent pain assessment, targets for pain scoring and action prompts to notify medical staff for pain management strategy review, all predicted to improve post operative pain management.

Limitations

There were several limitations for the project. The scoping review of the literature was based on articles primarily sourced from overseas, relied on diverse quality in research methodologies and was restricted to English language. The care map focus remained on isolated coronary artery bypass graft surgery and may not be generalisable to other cardiac surgical procedures such as aortic root procedures and valve replacements. For the benchmarking phase the Australian ICU documents were limited to only six sites that only addressed parts of the clinical elements and influencing factors. The quality of the Australian ICU documents were also not assessed for methodological rigor and transparency. Similar limitations exist for the ANZSCTS database report KPIs where only mechanical ventilation duration and ICU length of stay were able to be compared. The site-specific patient digital medical record review was undertaken retrospectively, albeit from a recent patient cohort and limited to a representative, but still only a sample of cases.

The co-design steps of key stakeholder and senior clinical staff assessments enabled a preliminary assessment based on clinical experience and remains untested in actual practice. Successful implementation into clinical practice will rely on broad stakeholder support and collaboration being an effective strategy in overcoming barriers. The involvement of health consumers had a positive influence on the project outcomes by highlighting important aspects of care and addressing acceptability from the health consumers' perspective. However, the input was limited to three health consumers and those who participated did not fully recall all events of their ICU stay.

Some logistical issues were experienced that included practical challenges of coordinating a consensus meeting with a potentially large number of key stakeholders. An online option was offered in addition to an in person meeting, yet only one quarter of invitees attended. Busy schedules, roster patterns and competing demands were amongst the barriers identified. The main reason for this methodology choice was to proceed with the project in a timely way, however, low attendance limited the representative consensus from the meeting. The Delphi technique method is another research methodology with the similar purpose of compiling expert opinion.[172] In this process several rounds of semi structured or open ended surveys are distributed to compile expert opinion and attain consensus on defined topics.[172] The Delphi functionality is flexible and with technology, communications between the researcher and experts have been enhanced.[172] Despite the potential advantages of using the Delphi technique method, it is more time consuming, does not guarantee

participation across all stages of the method and was not suitable for this time-limited project. Regardless of the challenges experienced, the co-design approach was informative for obtaining multidisciplinary and multi-stakeholder support for the project.

Implications for clinical practice

The creation of a care map has provided a useful tool predicted to improve the efficiency of the ICU post operative care of cardiac surgery patients in the context of the study site. Implementation of the care map into clinical practice will require careful planning to address anticipated barriers. Consideration of facilitators and barriers to implementation are required to improve the likelihood of success.[173,174] Facilitators such as stakeholder and senior clinical staff buy-in and support have already been achieved through Phase 3 of the project. Clinical care components of prompt patient rewarming, optimal pain management strategies and nurse-initiated patient mobilisation to a chair are the main issues requiring practice improvement. Ongoing nursing staff shortages and nurse low skill mix mean that continued education and training are required for evidence-based cardiac surgery nursing care. Shifting the focus to patient centred care rather than nurse centred care may be a difficult attitude to change. An approach highlighting perceived direct benefits to clinical staff with repeated reminders and encouragement will be selected.[173] A targeted strategy engaging senior clinical staff as influencers and champions may improve the likelihood for success.[165,174]

Successful achievement in early mobilisation for patients will require a change in routine for night shift staff. At the study site the assistant in nursing team provides a pressure injury prevention patient turn round every 3-4 hours. The final assistant in nursing patient turn round historically commences at 5am for the cardiac surgery patients. Gaining the support of the assistant in nursing team through education will enable early mobilisation by 7am nursing handover. Education including the rationale for changing the morning routine with the aim of mobilising cardiac surgery patients to chairs just prior to 7am will be able to promote a positive staff (nursing and assistant in nursing) attitude toward achieving this milestone.

The process undertaken in developing this care map has potential value for future projects. The creation of a process template can be utilised for other potential care maps for high volume and resource intensive procedures within the Intensive Care Unit.

Implications to further research

As a result of the project further research opportunities have been identified. From the feedback received from health consumers, an update of preoperative patient and family education and information resources should be considered. An update can include a modified version of the care map which was requested by the participating health consumers. Developing a preoperative preparation program with health consumer involvement provides an opportunity to research how this might further enhance their experience and satisfaction levels.

An implementation evaluation will give further clinical relevance to the ICU cardiac surgery nursing care map. Determining whether efficiency of care and health consumer satisfaction levels are increased will be valuable. Understanding and systematically addressing factors impacting on fidelity of the care map intervention will be important.

The study population for the current practice review were elective and urgent isolated coronary artery bypass surgery patients which represented the single largest procedural group in intensive care. Further research into additional cardiac surgical procedures could potentially expand the utility of the care map.

The use of pain assessment tools for the diverse population of post operative patients appeared to be suboptimal. High numerical pain scores were documented for patients with limited to no English-speaking abilities and only 16% of all patients received regular pain assessments with good pain control. The numerical pain scale has historically been utilised but is limited to English speaking patients. Exploring alternative options to assessing pain in the post operative period for diverse populations including non-verbal or non-English speaking patients may improve assessment.

Finally, this project has brought attention to the significant practical difference between patient ward readiness and actual ICU length of stay. Exploration could identify opportunities for efficiencies in either patient related or process factors and identify potential solutions to promote earlier transfer to ward, post operative recovery and improved patient and family experiences.

Conclusion

The multiphase project involved a comprehensive examination of the ICU post operative journey for cardiac surgery patients. A scoping review revealed the key

components of the post operative care of the cardiac surgery patient. In order to develop a framework for clinical care, a care map framework was created (see Figure 2.7) to show the interrelationships between the clinical elements, influencing factors and process outcomes identified in the literature, which became the foundation for data collection and reporting for the remainder of the thesis. Benchmarking between selected Australian ICUs, KPIs from the ANZSCTS database report and current practice at the study site revealed both strengths and inefficiencies that required attention. Synthesising all data sources, a draft evidence-based care map was developed. A co-design approach involved three preliminary assessments prior to finalisation of the evidence-based care map. The key stakeholder assessment allowed for content clarification and consensus. Health consumer and senior clinical staff perspectives were incorporated whilst assessing feasibility and acceptability of the draft care map. Refinements and design changes were confirmed prior to the finalisation of the evidence-based ICU cardiac surgery nursing care map (see Figure 4.9).

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Appendix 1 Data Management Plan

Curtin University

Research Data Management Plan

Developing an evidence based practice framework for post operative cardiac surgery patients in the intensive care unit.

Supervisor	Fenella Gill
Data Management Plan Edited by	Melissa Bedford
Modified Date	17/03/2021
Data Management Plan ID	GILL0F-HS09068
Faculty	Health Sciences

1 Research Project Details

1.1 Research project title

Developing an evidence based practice framework for post operative cardiac surgery patients in the intensive care unit.

1.2 Research project summary

Compare current practice, best practice and bench marking policies for post operative Coronary Artery Bypass Graft Surgery patients in the Intensive care unit. Bench marking policies will be obtained from major teaching hospitals with cardiac surgery specialty throughout Australia. This project has 4 phases with phase one consisting of a scoping literature review. Phase two involves investigating and outlining current practice using a retrospective observational study design with data being sourced from hospital records and entered into Recap secure data management tool. Phase three will assemble all gathered information to design a draft practice framework for use in the study site. Stakeholder consensus will be elicited using the nominal group technique. Phase four will involve a pilot test of the draft practice framework. Feedback from working party (clinicians using framework) will be elicited using structured interview questions prior to any recommendations on refinements or revisions being made to key stakeholder group and full implementation occurring.

1.3 Keywords

Cardiac surgery, Heart surgery, Intensive care unit, practice framework,

2 Research Project Data Details

2.1 Research project data summary

1) Scoping review: Peer reviewed and published articles with collation of data to provide a summary and overview of materials found. Will also include bench marking policy and procedure documents from major teaching hospitals with cardiothoracic specialty across Australia.

2) Retrospective observational study: Patient characteristics and clinical data sourced from medical records and entered directly into Redcap (secure data management program). Statistical analysis of both patient characteristics and clinical data will be completed.

3) Feedback: Interview data from participating clinical staff will be collected then collated and summarised.

2.2 Will the data be identifiable

- Re-identifiable — identifiers have been removed and replaced by a code, but it is possible to re-identify an individual

2.3 Will biospecimens or human participant information be sent overseas?

No

2.4 Will novel information about controlled goods or technologies on the Defence and Strategic Goods List (DSGL) be sent overseas?

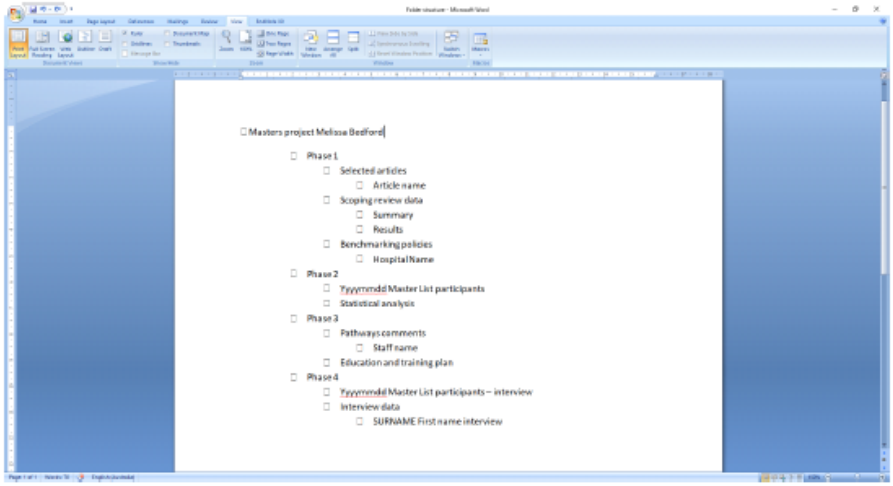
No

2.5 Data organisation and structure

Version control will be used and saved regularly and will include both numbering and date created.

All files will be text files

2.6 Data organisation and structure image



3 Research Project Data Storage, Retention and Dissemination Details

3.1 Storage arrangements

Health records will be entered directly into Redcap (secure data management system).

All health record data will be extracted for analysis and stored on Curtin R: drive folders, WA health computer personal drive (password protected).

Scoping review data will be kept on home computer (password protected) and WA health computer personal drive (password protected)

Staff interview data will be stored on Curtin R: drive folders and WA health computer personal drive.

3.2 Estimated data storage volume

Health record data and statistical analysis Staff interview data

Estimated storage space <2TB

3.3 Safeguarding measures

Computer drives are password protected.

Duplicate copies will be kept in WA health computer personal drive and home computer (password protected)

Data stored on Curtin networked drive ensures a variety of different data protection mechanisms, automatically provided by CTIS, are in place.

3.4 Retention requirements

7 years (All other research with outcomes that are classed as Minor)

3.5 Collaboration

Melissa Bedford - Master of philosophy student Fenella Gill is the approved research supervisor for this project.

3.6 Data dissemination

Non identifiable participant data and all data summaries will be reported as data in a peer reviewed publication of findings in this research project.

3.7 Embargo period

The data will be embargoed from open sharing until the final publication of the journal article associated with this research project, or one year after concluding the research project, whichever comes first.

Appendix 2 Additional Search Strategies

Name:	Proquest final search Edit name
Searched for:	noft("cardiac surgery" OR "heart surgery" OR "coronary artery bypass" OR "cardiovascular surgery" OR "cardiovascular surgical procedures" OR "valve surgery" OR "valve replacement") AND noft("intensive care unit" OR ICU OR "critical care" OR "post an*" OR PACU OR "Intensive therapy unit") AND noft("practice framework" OR "care map" OR "clinical pathway" OR "care pathway" OR "integrated pathway" OR "clinical protocols" OR "fast track protocol" OR "patient care plan*" OR "advance care planning" OR "case management" OR "critical pathways" OR "patient experience" OR "patient satisfaction" OR "family satisfaction" OR "patient reported outcome measures") AND PEER(yes) AND pd(>19900101)
Limited by:	Date: After 01 January 1990
Databases:	All databases searched View list ▾
	These databases are searched for part of your query.
Notes:	Add notes
Saved:	01 July 2021

Cinahl

Search ID#	Search Terms	Search Options
S7	S5 OR S6	**Limiters** - Published Date: 20201201-2022053
		Expanders - Apply equivalent subjects
		Search modes - Boolean/Phrase
S6	S1 AND S3 AND S4	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase
S5	S1 AND S2 AND S4	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase
S4	intensive care unit or ICU or critical care or critical care unit or post an* unit or PACU or intensive therapy unit	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase
S3	patient experience or patient satisfaction or family satisfaction or patient reported outcome measures	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase
S2	practice framework or care map or clinical pathway or care pathway or integrated pathway or clinical protocols or fast track protocol or patient care planning or advance care planning or case management or critical pathways	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase
S1	cardiac surgery or heart surgery or coronary artery bypass or valve surgery or valve replacement or post operative or post surgical or cardiovascular surgical procedures	**Expanders** - Apply equivalent subjects
		Search modes - Boolean/Phrase

JBI EBP

Edit Search

Search Name: JBI 1st July

Comment:

Save Cancel

Set	Search Statement
1.	cardiac surgery or heart surgery or coronary artery bypass or cardiovascular surgery or valve surgery or valve replacement or post operative or post surgical
2.	practice framework or care map or clinical pathway or care pathway or integrated pathway or clinical protocols or fast track protocol or patient care planning or advanced care planning or case management or critical pathway
3.	patient experience or patient satisfaction or family satisfaction or patient reported outcome measures
4.	intensive care unit or ICU or critical care or critical care unit or post anesthetic care unit or intensive therapy unit or PACU
5.	1 and 2 and 4
6.	1 and 3 and 4

Appendix 3 Data Extraction Tool

Rewarming							
Author	**Year**	**Title**	**Journal**	**Aim**	**Study design**	**Population/ sample size**	**Country**
Stevens et al[78]	1995	Effect of a standardized rewarming protocol and acetaminophen on core temperature after coronary artery bypass	American Journal of Critical Care	Describe the effect of a standardized rewarming protocol and acetaminophen on the following outcomes variables; core temperature, peak core temperature, rewarming time, and hyperthermia.	Prospective cohort study	CABG surgery, n=60	USA

Haemodynamic stability							
Author	**Year**	**Title**	**Journal**	**Aim**	**Study design**	**Population/ sample size**	**Country**
McKendry et al[43]	2004	Enhanced recovery after surgery pathway for patients undergoing cardiac surgery: a randomized clinical trial	BMJ	To assess whether a nurse led, flow monitored protocol for optimising circulatory status in patients after cardiac surgery reduces complications and shortens stay in intensive care and hospital.	RCT	On pump cardiac surgery, n=174	United Kingdom
Smith et al[77]	2010	Fluid therapy using a balanced crystalloid solution and acid-base stability after cardiac surgery	Critical Care & Resuscitation	To evaluate the effect of fluid therapy using Accusol (Baxter Healthcare, McGaw Park, Ill, USA), a crystalloid solution containing sodium bicarbonate and other electrolytes and having a strong ion	Retrospective pre-protocol comparison. Randomised	Elective on pump CABG surgery, n=91	Australia

				difference of 35 mEq/L, on acid–base stability after cardiac surgery.			
Thomson et al[79]	2014	Goal-directed therapy after cardiac surgery and the incidence of acute kidney injury	Journal of Critical Care	The purpose of this study was to assess the effect of goal-directed therapy (GDT), after cardiac surgery, on the incidence of acute kidney injury (AKI).	Prospective observational study	On & off pump CABG and/or aortic valve surgery, AVR. N=264	United Kingdom
Li et al[120]	2018	Enhanced recovery after surgery pathway for patients undergoing cardiac surgery: a randomized clinical trial	European Journal of Cardio-Thoracic Surgery	Evaluate the clinical effectiveness and safety profile of ERAS pathways compared with routine care for patients undergoing cardiac valvular surgery.	Single centre RCT	Elective heart valve surgery, n=226	China
Parke et al[44]	2021	A multicenter, open-label, randomized controlled trial of a conservative fluid management strategy compared with usual care in participants after cardiac surgery: the fluids after bypass study	Critical Care Medicine	Determine if a protocolized strategy known to reduce fluid administration when compared with usual care reduced ICU length of stay following cardiac surgery.	Prospective, multicentre, parallel group, randomized clinical trial	Cardiac surgery, n=715	New Zealand

Pain Management

Author	Year	Title	Journal	Aim	Study design	Population/ sample size	Country
Meehan et al[71]	1995	Analgesic administration, pain intensity, and patient satisfaction in cardiac surgical patients	American Journal of Critical Care	To examine nursing practice regarding analgesia admin and measure pain intensity and patient satisfaction with pain management practices.	Retrospective observational and prospective observational	On pump cardiac surgery, n=101	USA

Valdix et al[99]	1995	Pain, pain relief and accuracy of their recall after cardiac surgery	Progress in Cardiovascular Nursing	Investigate relationships between levels of pain and pain relief post cardiac surgery and accuracy of their recall later, during hospital recovery.	Descriptive, correlational & longitudinal study	Cardiac surgery patients, n=39	USA
Kuperberg et al[117]	1997	Coronary artery bypass patients' perceptions of acute postoperative pain	Clinical Nurse Specialist: The Journal for Advanced Nursing Practice	Explore patients' expectation and perceptions of their acute postoperative pain to improve understanding and management.	Descriptive study	CABG surgery, n=20	USA
Yorke et al[101]	2004	Patients' perceptions of pain management after cardiac surgery in an Australian critical care unit	Heart & Lung	Explore patients' perceptions of the effectiveness of a pain management regimen, which consisted of intermittent prn bolus doses of morphine, in a critical care unit after cardiac surgery.	Descriptive and correlational study.	Cardiac surgical patients, n=102	Australia
Carey et al[89]	2019	Patients' perception of stressful events in the Intensive Care Unit after cardiac surgery	American Journal of Critical Care	To identify stress generating experiences that occur in an ICU for patients after cardiac surgery.	Prospective designed project	Cardiac surgery patients, n=16	USA
Markham et al[50]	2019	Assessment of a multimodal analgesia protocol to allow the implementation of enhanced recovery after cardiac surgery: retrospective analysis of patient outcomes	Journal of Clinical Anesthesia	Investigate the impact of utilizing a multimodal analgesia protocol to allow the implementation of Enhanced recovery after cardiac surgery in patient requiring cardiopulmonary bypass.	Retrospective case review	Elective cardiac surgery patients excluding thoracic procedures and combined CABG and valve, n=50	USA

Williams et al[83]	2019	One-year results from the first US-based enhanced recovery after cardiac surgery (ERAS Cardiac) program	Journal of Thoracic & Cardiovascular Surgery	The study reports on systematic application of enhanced recovery principals to a US cardiac surgery program with reduced opioid use and LOS, and improved patient and staff satisfaction.	Retrospective data review and Prospective implementation data collection	Nonemergency adult cardiac surgery patients, n=932	USA

Mechanical Ventilation

Author	Year	Title	Journal	Aim	Study design	Population/ sample size	Country
Marquez et al[70]	1995	Cardiac surgery "fast tracking" in an academic hospital	Journal of Cardiothoracic and Vascular Anesthesia	Establish a protocol attempting to extubate cardiac surgical pts within 12 hours of ICU arrival and discharge from hospital in 6 days without compromising the quality of care.	Cohort	CABG surgery, n=1391	USA
Engelman[60]	1996	Mechanisms to reduce hospital stays	The Annals of Thoracic Surgery	Compare Cardiac surgery patients from two hospitals before and after the intro of a fast track protocol.	Retrospective analysis before FT, after FT and 2 years on	Cardiac surgery patients, n=562	USA
London et al[68]	1997	Fast-track cardiac surgery in a Department of Veterans Affairs patient population	The Annals of Thoracic Surgery	Examine safety and efficacy of fast track cardiac surgery in elderly veterans with multiple comorbid risk factors, decreased social functioning and impaired social support systems.	Retrospective cohort	All Cardiac surgery requiring CPB, N=559	USA

Quigley et al[74]	1997	A coronary artery bypass "fast-track" protocol is practical and realistic in a rural environment	The Annals of Thoracic Surgery	We determine retrospectively whether assignment of all patients undergoing coronary artery bypass grafting to a “fast-track” protocol (FT) is practical and realistic in our rural institution.	Retrospective cohort study	All CABG patients, n=266	USA
London et al[67]	1998	Early extubation following cardiac surgery in a veterans population	Anesthesiology	Determine associations of preoperative risk and intraoperative clinical process variables with time to extubation in this population.	Retrospective cohort study	FT cardiac surgery patients; n=304	USA
Miller[72]	1998	Factors influencing selected lengths of ICU stay for coronary artery bypass patients	The Journal of Cardiovascular Nursing	This study examines factors influencing the length of Intensive Care Unit stay for patients after coronary artery bypass grafts.	Retrospective chart review	Isolated CABG surgery, n=175	USA
Capdeville et al[56]	2001	Effect of gender on fast-track recovery after coronary artery bypass graft surgery	Journal of Cardiothoracic and Vascular Anesthesia	To examine the effects of gender on time to extubation after coronary artery bypass graft surgery and ICU and Hospital LOS.	Retrospective study	Isolated CABG surgery, n=561	USA
Alhan et al[53]	2003	Fast track recovery of high risk coronary bypass surgery patients	European Journal of Cardio-thoracic Surgery	Define the safety and efficacy of fast track recovery among high risk patients (Euroscore ≥ 6).	Cohort study	All patients undergoing cardiac surgery (on pump CABG) n=1162	Turkey

Toraman et al[98]	2005	Fast-track recovery in noncoronary cardiac surgery patients	Heart Surgery Forum	Evaluate the safety and efficacy of fast track recovery for patients undergoing open cardiac surgery other than isolated CABG.	Prospective	All scheduled cardiac surgery other than isolated CABG, n=299	Turkey
Hancock et al[107]	2006	The decision-making processes of nurses when extubating patients following cardiac surgery: an ethnographic study	International Journal of Nursing Studies	Explore the realities of research and EBP through an exam of the decision making of nurses when extubating patient following cardiac surgery.	Naturalistic research, participant observation & semi structured interviews	CICU Nurses, n=61	United Kingdom
Gooi et al[47]	2007	Fast-track cardiac surgery: application in an Australian setting	Asian Cardiovascular & Thoracic Annals	Study was designed to examine the safety and efficacy of a fast track policy for low risk cardiac surgery patients.	Prospective cohort	Cardiac surgery patients excluding VADs & transplants, n=342	Australia
Ender et al[59]	2008	Cardiac surgery fast-track treatment in a postanesthetic care unit: six-month results of the Leipzig fast-track concept	Anesthesiology	Compare safety and efficacy of newly developed FT concept including implementation of a direct admission PACU to standard perioperative management.	Cohort study	Elective Cardiac surgery patients, n=842	Germany
Schou et al[112]	2008	A qualitative study into the lived experience of post-CABG patients during mechanical ventilator weaning	Intensive & Critical Care Nursing	Provide a contemporary description of the patient experience of weaning, in order to update this aspect of knowledge in the context of newer	Descriptive, in depth interviews with semi-structured focused approach. Hermeneutic phenomenological approach	CABG surgery patients, n=10	Denmark

				modalities of mechanical ventilation and sedation.			
Starks et al[115]	2011	Aspiration prevention protocol: decreasing postoperative pneumonia in heart surgery patients	Critical Care Nurse	Determine if measures to reduce aspiration in patients after CT surgery would decrease occurrence of postoperative pneumonia.	Prospective study. Performance improvement study	All cardiac surgery patients, n=144	USA
Lisboa Gois et al[109]	2012	Stress factors for patients undergoing cardiac surgery	Investigacion & Educacion en Enfermeria	Describe the stress factors related to cardiac surgery and the environment in an ICU.	Exploratory, descriptive and qualitative study. Semi structured interviews	Cardiac surgery patients, n=8	Brazil
Paarman et al[95]	2012	Low preoperative cerebral oxygen saturation is associated with longer time to extubation during fast-track cardiac anaesthesia	Interactive Cardiovascular & Thoracic Surgery	Study designed to determine factors influencing the time to extubation in pts included in FT protocol for on pump CABG.	Demographic & clinical data (prospectively gathered for quality improvement). Retrospective observational pilot study	Elective on pump CABG patients, n=80	Germany
Hansen et al[64]	2015	Comparison of positive end-expiratory pressure of 8 versus 5 cm H2O on outcome after cardiac operations	Journal of Intensive Care Medicine	Compare the 2 most common postop initial PEEP settings, 8 and 5 cmH2O, on postop initial tracheal intubation time, CICU and hospital LOS, occurrence of pneumonia and hospital mortality.	Cohort study	CABG or combined CABG + valve, n=18257.	USA
Wang et al[100]	2015	Analysis of complaints from patients during mechanical ventilation	Journal of Cardiothoracic & Vascular Anesthesia	Summarise physiologic and psychologic needs of patients during	Retrospective	Cardiac surgery patients, n=800	China

		after cardiac surgery: a retrospective study		mechanical ventilation.			
Akhtar et al[86]	2016	Fast track extubation in adult patients on pump open heart surgery at a tertiary care hospital	Journal of Ayub Medical College	Determine the success and failure profile of fast track extubation practice in adult open heart surgical patients.	Observational study, Cross sectional study	All ON pump elective adult cardiac surgery patients, n=290	Pakistan
Cove et al[58]	2016	Multidisciplinary extubation protocol in cardiac surgical patients reduces ventilation time and length of stay in the Intensive Care Unit.	Annals of Thoracic Surgery	Assess how a team based extubation protocol would affect ventilation time and ICU LOS.	Retrospective, before and after observational study	Elective open heart surgery patients, n=201	Singapore
Van Der Kolk et al[24]	2017	Development and implementation of a clinical pathway for cardiac surgery in the intensive care unit: effects on protocol adherence	Journal of Evaluation in Clinical Practice	Cardiac surgery is facilitated by multiple perioperative guidelines and protocols. Use of a clinical pathway may facilitate the care of these patients.	Pre-post design	Cardiac surgery patients, n=575	Netherlands
Hartjes et al[25]	2018	Improving cardiac surgery outcomes by using an interdisciplinary clinical pathway: the official voice of perioperative nursing	AORN Journal	To streamline and improve care in the CTICU by implementing a new clinical pathway for patients undergoing CABG or valve replacement procedures.	QI project: pre implementation & postimplementation groups.	Cardiac surgery (CABG, valve & other) n=802	United Kingdom
Kebapci et al[49]	2018	Effects of nurse-led clinical pathway in coronary artery bypass graft surgery: A quasi-experimental study	Journal of Clinical Nursing	Develop and evaluate the effects of a nurse led clinical pathway for patients undergoing CABG surgery.	Prospective quasi-experimental	CABG +/- valve, n=82	Turkey

Li et al[120]	2018	Enhanced recovery after surgery pathway for patients undergoing cardiac surgery: a randomized clinical trial	European Journal of Cardio-Thoracic Surgery	Evaluate clinical effectiveness and safety profile of ERAS pathways compared with routine care for patients undergoing valvular surgery.	Single centre RCT	Elective heart valve surgery, n=226	China
Richey et al[75]	2018	Implementation of an early extubation protocol in cardiac surgical patients decreased ventilator time but not intensive care unit or hospital length of stay.	Journal of Cardiothoracic & Vascular Anesthesia	Compare pre and post rapid ventilator weaning in relation to outcomes.	Prospective clinical trial - 2 cohorts	Adult cardiac surgery patients, n=459	USA
Carey et al[89]	2019	Patients' perception of stressful events in the Intensive Care Unit after cardiac surgery	American Journal of Critical Care	Identify stress generating experiences that occur in an ICU for patients after cardiac surgery.	Prospective designed project	Cardiac surgery patients, n=16	USA
Van Der Kolk et al[22]	2019	Sustainability of clinical pathway guided care in cardiac surgery ICU patients; 9-years' experience in over 7500 patients	International Journal for Quality in Health Care	Determine trends over time regarding inclusion of postop cardiac surgery ICU patients in a clinical pathway and associated outcomes.	Retrospective cohort study	All consecutive cardiac surgery patients, n=7553	Netherlands
Markham et al[50]	2019	Assessment of a multimodal analgesia protocol to allow the implementation of enhanced recovery after cardiac surgery: Retrospective analysis of patient outcomes	Journal of Clinical Anesthesia	Investigate the impact of utilizing a multimodal analgesia protocol to allow the implementation of Enhanced recovery after cardiac surgery in patient requiring CPB.	Retrospective case review	Elective CT surgery excluding thoracic procedures and combined CABG and valve, n=50	USA

Tierney et al[80]	2019	Implementing a weaning protocol for cardiac surgery patients using simulation: a quality improvement project	DCCN	The objectives of this project were to decrease cardiac surgery patients' ventilation hours and intensive care unit length of stay using a ventilator weaning protocol.	Pre-post design, retrospective chart review for pre implementation group.	Cardiac surgery patients, n=150	USA
Edeer et al[116]	2020	Thoracic and cardiovascular surgery patients: Intensive Care Unit experiences	Nursing in Critical Care	Determine the intensive care experiences of thoracic and cardiovascular surgery patients and the factors that affect them.	Descriptive and cross sectional. Face to face Interviews. Content analysis using inductive method	Post thoracic or cardiovascular surgery, n=100	Turkey
Ford et al[61]	2020	Safety and effectiveness of early oral hydration in patients after cardiothoracic surgery	American Journal of Critical Care	Determine the effect of early oral hydration after extubation on adverse events and thirst in patients after cardiothoracic surgery.	Prospective 2 group design, random assignment to a group (computer generated number sequencer)	Cardiac surgery (CABG, valve & Bentall's), n=149	USA
Gilder et al[175]	2020	Avoidance of routine endotracheal suction in subjects ventilated for <= 12 hours following elective cardiac surgery	Respiratory Care	Assess the safety of avoiding endotracheal suction, including at extubation, in cardiac surgical patients who were mechanically ventilated for ≤ 12 hours.	Noninferiority RCT	Elective on pump cardiac surgery patients, n=249	New Zealand
Ellis et al[113]	2021	Reducing intubation time in adult cardiothoracic surgery patients with a fast-track extubation protocol	Critical Care Nurse	Engage interprofessional stakeholders to reduce intubation times after cardiac surgery as there was	Staged implementation study	Cardiac surgery patients, n=101	USA

				a lack of consistency and coordination across the team.			
Grutzner et al[62]	2021	A comparison of patients undergoing on- vs. off-pump coronary artery bypass surgery managed with a fast-track protocol	Journal of Clinical Medicine	Compare on vs off pump CABG managed with fast track protocol.	Retrospective observational	Fast track CABG patients, n=3505	Germany
Yazdchi et al[84]	2021	Enhanced recovery after cardiac surgery: a propensity-matched analysis	Seminars in Thoracic & Cardiovascular Surgery	Since the adaptation of ERAS in cardiac surgery is rapidly increasing yet still evolving, herein, we demonstrate early results of our implementation of ERAS cardiac guidelines.	Retrospective cohort study	Isolated CABG, AVR, MVR/repair, noncomplex AVR + aorta, CABG + AVR, CABG + MV, n=102	USA
Gilder et al[40]	2022	Patient's experiences of endotracheal tubes and suction following cardiac surgery	Nursing in Critical Care	Describe the patient experience of ETT and suction.	Semi structured interviews	Cardiac surgery patients, n=10	New Zealand
MacLeod et al[69]	2022	Fast tracking in cardiac surgery: is it safe?	Journal of Cardiothoracic Surgery	Determine the impact of fast tracking on post operative outcomes following cardiac surgery.	Retrospective	1st time on pump, nonemergent CABG, valve surgery, n=3252	Canada

Early Mobilisation							
Author	**Year**	**Title**	**Journal**	**Aim**	**Study design**	**Population/ sample size**	**Country**
Anderson et al[54]	1999	Critical pathways: application to selected patient outcomes following coronary artery bypass graft	Applied Nursing Research	Examine ICU LOS after CABG surgery relative to postop hrs when ambulation occurred and	Descriptive, comparative study, retrospective chart review	CABG 1-5 only, n=152	USA

				examine the overall postop hospital LOS.			
Jacavone et al[26]	1999	CNS facilitation of a cardiac surgery clinical pathway program	Clinical Nurse Specialist: The Journal for Advanced Nursing Practice	Reporting an interdisciplinary team approach to meeting standards and recommendations of literature and best practice models whilst decreasing unnecessary patient charges.	Clinical project, QI. Cohort	CABG, mitral and aortic valve replacements, n=1200	USA
Van Der Kolk et al[24]	2017	Development and implementation of a clinical pathway for cardiac surgery in the intensive care unit: effects on protocol adherence	Journal of Evaluation in Clinical Practice	Cardiac surgery is facilitated by multiple periop guidelines and protocols. Use of a CP may facilitate the care of these patients.	Pre-post design	Cardiac surgery (CABG, valve or combo), n=659	Netherlands
Hartjes et al[25]	2018	Improving cardiac surgery outcomes by using an interdisciplinary clinical pathway: the official voice of perioperative nursing	AORN Journal	Streamline & improve care in the CTICU by implementing a new CP for patients undergoing CABG or valve replacements.	QI project: preimplementation & postimplementation groups. cohort, retrospective	Cardiac surgery (CABG, valve & other), n=802	United Kingdom
Kebapci et al[49]	2018	Effects of nurse-led clinical pathway in coronary artery bypass graft surgery: a quasi-experimental study	Journal of Clinical Nursing	Develop and evaluate the effects of a nurse led clinical pathway for patients undergoing CABG surgery.	prospective quasi-experimental	CABG +/- valve, n=82	Turkey
Jacob et al[114]	2021	Multidisciplinary, early mobility approach to enhance functional independence in patients admitted to a cardiothoracic intensive care unit: a quality	BMJ Open Quality	Attain out of bed mobilisation within 12 hours of extubation.	QI activity	CT patients, n=1320	Qatar

		improvement programme.					
Damstra et al[119]	2022	Perioperative care standards in cardiac surgery patients aiming at enhancing recovery: a nationwide survey in the Netherlands and Belgium	Journal of Cardiothoracic & Vascular Anesthesia	Assess existing perioperative standards in cardiac surgery in Netherlands and Belgium regarding ERAS concepts.	Online survey with follow-up in-depth personal interview	Specialists including cardiac surgeons, cardiac anaethetist & intensivists, n=84	Netherlands and Belgium

Preoperative education

Author	Year	Title	Journal	Aim	Study design	Population/ sample size	Country
Pazar et al[45]	2020	The effects of preoperative education of cardiac patients on haemodynamic parameters, comfort, anxiety and patient-ventilator synchrony: a randomised, controlled trial	Intensive & Critical Care Nursing	Evaluate the effects of preoperative education regarding haemodynamic parameters, patient comfort and anxiety, and patient-ventilator synchrony provided to patients before they undergo cardiac surgery.	Prospective RCT, randomised controlled clinical study. Semi structured interview form to gather info on themes of what patient want to know about mech ventilation.	Cardiac surgery patients, n=200	Turkey
Lai et al[41]	2021	Effect of preoperative education and ICU tour on patient and family satisfaction and anxiety in the intensive care unit after elective cardiac surgery: a randomised controlled trial	BMJ Qual Saf	Assess the effect of a preoperative multifaceted education intervention on patient and family satisfaction levels in the ICU and measures of perioperative patients' anxiety and depression.	Single centre, two-armed, parallel, superiority, RCT	Adult patients with 1st CABG +/- valve replacement, family members >18yrs, n=100	China

Yoo et al[52]	2021	The effect of a multifaceted family participation program in an adult cardiovascular surgery ICU	Critical Care Medicine	Develop and implement a patient and family-centered care program for patients in a cardiovascular surgery ICU.	Quasi experimental	CTICU family members >3days post elective surgery, aged >19yrs, n=60	Korea

Patient related factors

Author	Year	Title	Journal	Aim	Study design	Population/ sample size	Country
Johnson et al[65]	1997	Postoperative factors contributing to prolonged length of stay in cardiac surgery patients	Dimensions of Critical Care Nursing: DCCN	Identify postop factors contributing to prolonged LOS and recommend collaborative management strategies to address these factors.	Retrospective chart review	CABG, valve repair or replacement +/- CABG, n=477	USA
London et al[67]	1998	Early extubation following cardiac surgery in a veteran's population	Anesthesiology	Determine associations of preoperative risk and intraoperative clinical process variables with time to extubation in this population.	Retrospective cohort study	FT cardiac surgery patients; primary or redo CABG, valve surgery or both, n=304.	USA
Miller[72]	1998	Factors influencing selected lengths of ICU stay for coronary artery bypass patients	The Journal of Cardiovascular Nursing	This study examines factors influencing the length of Intensive Care unit stay for patients after coronary artery bypass grafts.	Retrospective chart review, 2 cohorts	Isolated CABG surgery, n=175	USA

Nickerson et al[94]	1999	Obstacles to early discharge after cardiac surgery	American Journal of Managed Care	To identify obstacles to and the effects of early discharge on outcome after cardiac surgery.	Prospective observational	Non emergent, Iso CABG, iso valve & combined CABG & valve, n=422.	USA
Toraman et al[98]	2005	Fast-track recovery in noncoronary cardiac surgery patients	Heart Surgery Forum	Evaluate the safety and efficacy of fast track recovery for patients undergoing open cardiac surgery other than isolated CABG.	Prospective	All scheduled cardiac surgery other than isolated CABG, n=299	Turkey
Constantinides et al[57]	2006	Fast-track failure after cardiac surgery: development of a prediction model	Critical Care Medicine	Determine risk factors for fast track failure and incorporate them into a predictive fast track failure score.	Prospective observational study	Cardiac surgery patients undergoing FT protocol, n=1084	United Kingdom
Trussell et al[81]	2008	Impact of a patient care pathway protocol on surgical site infection rates in cardiothoracic surgery patients	The American Journal of Surgery	Determine if peri-incisional antibiotic administration, TGC and hair removal with clippers would reduce surgical site infection (SSI) rates in patients undergoing CABG +/- valve replacement.	Retrospective chart review pre and post implementation patient care pathway protocol	CABG +/- valve replacement, n=1482.	USA
Haanschoten et al[7]	2012	Fast-track practice in cardiac surgery: results and predictors of outcome	Interactive Cardiovascular & Thoracic Surgery	Evaluate their 7 year experience with the fast track protocol and investigated the preoperative predictors of successful outcome.	Retrospective observational single centre study	CABG, OPCABG, isolated AVR or combined AVR with 1 x CABG n=5367.	Netherlands

Kiessling et al[91]	2013	Risk factor analysis for fast track protocol failure	Journal of Cardiothoracic Surgery	Statistically analyse risk factors and predictors for re-admission to the ICU after a fast track patient management program.	Retrospective chart review	Cardiac surgery patients with CPB, n=299	Germany
Lee et al[8]	2013	Fast-track failure after cardiac surgery: external model validation and implications to ICU bed utilization	Critical Care Medicine	Facilitate the planning of perioperative care pathways, a fast track failure prediction model has been developed in patients undergoing cardiac surgery.	Prospective cohort study	Adult cardiac surgery, n=1597	China
Zakhary et al[102]	2015	Independent Risk Factors for Fast-Track Failure Using a Predefined Fast-Track Protocol in Preselected Cardiac Surgery Patients	Journal of Cardiothoracic & Vascular Anesthesia	The purpose of this study was to identify the independent risk factors for fast-track failure (FTF) in cardiac surgery patients.	A retrospective observational	Cardiac surgery + FT protocol, n=1704.	Germany
Guo et al[63]	2020	Perioperative and long-term morbidity and mortality for elderly patients undergoing thoracic aortic surgery	Seminars in Thoracic & Cardiovascular Surgery	Evaluate age related differences in short and long term outcomes in elderly patients undergoing elective thoracic aortic surgery.	Retrospective cohort	Elective thoracic aortic surgery, n=786	Canada
Jacob et al[114]	2021	Multidisciplinary, early mobility approach to enhance functional independence in	BMJ Open Quality	Attain out of bed mobilisation within 12 hours of extubation.	QI activity	CT patients, n=1320	Qatar

		patients admitted to a cardiothoracic intensive care unit: a quality improvement programme					

Expectations/ experiences and satisfaction							
Author	**Year**	**Title**	**Journal**	**Aim**	**Study design**	**Population/ sample size**	**Country**
Simpson et al[97]	1996	Patients' perceptions of environmental factors that disturb sleep after cardiac surgery	American Journal of Critical Care	Describe patients' perceptions of environmental factors that disturb sleep after cardiac surgery including frequency and differences in disturbance ratings after transfer from ICU.	Correlational descriptive design, survey	Elective or emergent cardiac surgery, n=102.	USA
Hunt[108]	1999	The cardiac surgical patient's expectations and experiences of nursing care in the intensive care unit	Australian Critical Care	Explore both cardiac surgical patients' expectations of ICU nursing care and actual experience of nursing care. To determine which caring behaviours are important and why.	Semi structured interviews, Interpretive & descriptive qualitative	CABG surgery, n=12	Australia
Nickerson et al[94]	1999	Obstacles to early discharge after cardiac surgery	American Journal of Managed Care	To identify obstacles to and the effects of early discharge on outcome after cardiac surgery.	A prospective approach using a protocol consisting of modified anesthesia, limiting use of postoperative narcotics, early	Non emergent, Iso CABG, iso valve & combined CABG & valve, n=422.	USA

					extubation, early mobilisation with a goal of discharge at <5days		
Doering et al[104]	2002	Recovering from cardiac surgery: what patients want you to know	American Journal of Critical Care	Examine patients' perceptions of the quality of the nursing and medical care they receive during their hospital stay after cardiac surgery, expand to include generate meanings to the comments.	2 x structured telephone interviews, Qualitative, descriptive	Cardiac surgery patients, n=109	USA
Gardner et al[106]	2005	Patient experiences following cardiothoracic surgery: an interview study	European Journal of Cardiovascular Nursing	Presents a thematic analysis of interviews conducted with patients recovering from cardiothoracic surgery, about their memories and experiences of hospital and recovery post hospital discharge.	Exploratory qualitative study using semi structured interviews	Cardiac surgery patients, n=8	Australia
Dunckley et al[105]	2007	Recovery after coronary artery bypass grafting: patients' and health professionals' views of the hospital experience	European Journal of Cardiovascular Nursing	To describe the recovery trajectory after CABG and identify facilitators and barriers to recovery	Semi structured interviews- interview guides available in appendix	CABG patients and healthcare professionals, n=21	United Kingdom
Lisboa Gois et al[109]	2012	Stress factors for patients undergoing cardiac surgery	Investigacion & Educacion en Enfermeria	Describe the stress factors related to cardiac surgery and the environment in an ICU.	Exploratory, descriptive and qualitative study. Semi structured interviews	Cardiac surgery patients, n=8	Brazil

Aslan et al[88]	2015	Cardiovascular surgery patients: intensive care experiences and associated factors	Asian Nursing Research	Determine ICU experiences of cardiovascular surgery patients and define associations between their ICU experiences and related factors.	Quantitative Descriptive study Interviews	CT surgical patients, n=106.	Turkey
Shadvar et al[96]	2015	Assessment of patient and relatives satisfaction in a cardiac surgery ICU model	Advances in Bioscience & Clinical Medicine	Evaluate the satisfaction of patients and their families from the quantity and quality of services provided in the cardiac surgical ICU of Madani hospital, Tabriz, Iran.	Prospective descriptive study	Cardiac surgery patients, n=200.	Iran
Wang et al[100]	2015	Analysis of complaints from patients during mechanical ventilation after cardiac surgery: a retrospective study	Journal of Cardiothoracic & Vascular Anesthesia	Summarise physiologic and psychologic needs of patients during mechanical ventilation.	Retrospective	Cardiac surgery patients, n=800	China
Al-Daakak et al[87]	2016	Symptom management strategies of Jordanian patients following coronary artery bypass grafting surgery	International Journal of Nursing Practice	Explore the symptom management strategies utilized by post coronary artery bypass graft patients and its associations with demographic variables.	Cross sectional descriptive study	Post CABG surgery, n=100	Jordan
Göktas et al[90]	2016	A comparison of the intensive care experiences of emergency and elective cardiac surgery patients	Nigerian Journal of Clinical Practice	Review the experiences of patients in the ICUs and determine their states of awareness following an emergency or	Multicentre prospective descriptive study	Emergency or elective CT surgery, n=300.	Turkey

				elective cardiac surgery.			
Lupieri et al[110]	2016	Cardio-thoracic surgical patients' experience on bedside nursing handovers: findings from a qualitative study	Intensive & Critical Care Nursing	Describe the experiences of postoperative cardiothoracic surgical patients experiencing nursing bedside handover.	Descriptive, semi structured interviews	Cardiac surgery patients, n=14	Italy
Marosti Dessotte et al[92]	2016	Stressors perceived by patients in the immediate postoperative of cardiac surgery	Revista Brasileira de Enfermagem	Investigate stressors perceived by pts in immediate postop of cardiac surgery and their association with sociodemographic and clinical characteristics.	Prospective correlational study	Cardiac surgery patients, n=105	Brazil
Milani et al[111]	2018	Caregivers' perception when facing the care humanization in the immediate postoperative period from a cardiac surgery procedure	Revista de Pesquisa: Cuidado e Fundamental	Analyze the caregivers' perceptions of patients submitted to cardiac surgery when facing the care humanization in an Intensive Care Unit.	Exploratory descriptive study, semi structured interviews	Anchor caregivers, n=5	Brazil
Carey et al[89]	2019	Patients' perception of stressful events in the Intensive Care Unit after cardiac surgery	American Journal of Critical Care	To identify stress generating experiences that occur in an ICU for patients after cardiac surgery.	Prospective designed project	Cardiac surgery patients, n=16	USA
Williams et al[83]	2019	One-year results from the first US-based enhanced recovery after cardiac surgery (ERAS Cardiac) program	Journal of Thoracic & Cardiovascular Surgery	The study reports on systematic application of enhanced recovery principals to a US cardiac surgery program with reduced opioid use	Retrospective data review and Prospective implementation data collection	Nonemergency adult cardiac surgery patients, n=932	USA

				and LOS, and improved patient and staff satisfaction.			
Edeer et al[116]	2020	Thoracic and cardiovascular surgery patients: Intensive care unit experiences	Nursing in Critical Care	Determine the intensive care experiences of thoracic and cardiovascular surgery patients and the factors that affect them.	Descriptive and cross sectional. Face to face Interviews. Content analysis using inductive method	Post thoracic or cardiovascular surgery, n=100	Turkey
Lai et al[41]	2021	Effect of preoperative education and ICU tour on patient and family satisfaction and anxiety in the intensive care unit after elective cardiac surgery: a randomised controlled trial	BMJ Qual Saf	To assess the effect of a preoperative multifaceted education intervention on patient and family satisfaction levels in the ICU and measures of perioperative patients' anxiety and depression.	Single centre, two-armed, parallel, superiority, RCT	Adult patients with 1st CABG +/- valve replacement, family members >18yrs, n=100	China
Vitomskyi et al[82]	2021	The effect of incentive spirometry on pulmonary function recovery and satisfaction with physical therapy of cardiac surgery patients	Advances in Rehabilitation	Investigate the effect of incentive spirometry on pulmonary function recovery and the level of satisfaction with PT in patients undergoing cardiac surgery.	Mixed methods	Cardiac surgery patients, n=70	Ukraine
Yoo et al[52]	2021	The effect of a multifaceted family participation program in an adult cardiovascular surgery ICU	Critical Care Medicine	Develop and implement a patient and family-centered care program for patients in a cardiovascular surgery ICU.	Quasi experimental	Family members for patients admitted to CTICU >3days, visited at least once post	Korea

						elective surgery, aged >19yrs, communicate in Korean, n=60	
Albanesi et al[103]	2022	Lived experience of patients in ICU after cardiac surgery: a phenomenological study	Nursing in Critical Care	Describe the lived experiences for cardiothoracic surgical patients.	Qualitative phenomenological study using an interpretative analysis approach	Cardiac surgery patients, n=11	Italy
Gilder et al[40]	2022	Patient's experiences of endotracheal tubes and suction following cardiac surgery	Nursing in Critical Care	Describe the patient experience of ETT and suction.	Semi structured interviews	Cardiac surgery patients, n=10	New Zealand

Process Outcomes

Author	Year	Title	Journal	Aim	Study design	Population/ sample size	Country
Mazer et al[93]	1993	Postoperative utilization of critical care services by cardiac surgery: a multicenter study in the Canadian healthcare system	Critical Care Medicine	To describe patterns of critical care services used after cardiac surgery and to evaluate whether variations in the process of care influence outcome.	Multicentre, prospective observational study	Cardiac surgery, n=335	Canada
Marquez et al[70]	1995	Cardiac surgery "fast tracking" in an academic hospital	Journal of Cardiothoracic and Vascular Anesthesia	Establish a protocol that attempts to extubate cardiac surgical patients within 12 hours of ICU arrival and discharge from hospital in 6 days without compromising the quality of care.	Cohort	CABG surgery, n=1391	USA

Engelman[60]	1996	Mechanisms to reduce hospital stays	The Annals of Thoracic Surgery	Compare Cardiac surgery patients from two hospitals before and after the introduction of a fast track protocol.	Retrospective analysis before FT, after FT and 2 years on	Cardiac surgery patients, n=562	USA
Velasco et al[51]	1996	Cost containment in cardiac surgery: results with a critical pathway for coronary bypass surgery at the New York hospital-Cornell Medical Center	Best Practices & Benchmarking in Healthcare: a Practical Journal for Clinical & Management Applications	To develop critical pathways for open-heart surgery to help reduce cost, shorten hospital length of stay (LOS), and streamline patient care.	Cohort	Elective CABG, n=114	USA
Johnson et al[65]	1997	Postoperative factors contributing to prolonged length of stay in cardiac surgery patients	Dimensions of Critical Care Nursing: DCCN	Identify postop factors contributing to prolonged LOS in cardiac surgery pts and recommend collaborative management strategies to address factors.	Retrospective chart review	CABG, valve repair or replacement +/- CABG, n=477	USA
London et al[68]	1997	Fast-track cardiac surgery in a Department of Veterans Affairs patient population	The Annals of Thoracic Surgery	Examine the safety and efficacy of fast track cardiac surgery in elderly veterans with multiple comorbid risk factors, decreased social functioning and impaired social support systems.	Retrospective cohort	All Cardiac surgery requiring CPB, N=559	USA
Quigley et al[74]	1997	A coronary artery bypass "fast-track" protocol is practical and realistic in a rural environment	The Annals of Thoracic Surgery	We determine retrospectively whether assignment of all patients undergoing coronary artery bypass	Retrospective cohort study	All CABG patients, n=266	USA

				grafting to a “fast-track” protocol (FT) is practical and realistic in our rural institution.			
Anderson et al[54]	1999	Critical pathways: application to selected patient outcomes following coronary artery bypass graft	Applied Nursing Research	Examine ICU LOS after CABG surgery relative to when ambulation occurred postop and examine the overall postop hospital LOS.	Descriptive, comparative study, retrospective chart review	CABG 1-5 only, n=152	USA
Jacavone et al[26]	1999	CNS facilitation of a cardiac surgery clinical pathway program	Clinical Nurse Specialist: The Journal for Advanced Nursing Practice	Reporting of an interdisciplinary team approach to meeting the standards and recommendations of the literature and best practice models whilst decreasing unnecessary patient charges.	Clinical project, QI. Cohort	CABG, mitral and aortic valve replacements, n=1200	USA
London et al[66]	2000	Association of fast-track cardiac management and low-dose to moderate-dose glucocorticoid administration with perioperative hyperglycemia	Journal of Cardiothoracic and Vascular Anesthesia	To delineate associations between preoperative risk factors and clinical processes of care and perioperative glucose tolerance in patients managed on a fast track cardiac surgery clinical pathway with prebypass methylprednisolone administration.	Retrospective sequential cohort study	Cardiac surgery requiring CPB, n=671	USA

Alhan et al[53]	2003	Fast track recovery of high risk coronary bypass surgery patients	European Journal of Cardio-thoracic Surgery	Define the safety and efficacy of fast track recovery among high risk patients (Euroscore ≥ 6).	Cohort study	All patients undergoing cardiac surgery (on pump CABG) n=1162	Turkey
Naughton et al[73]	2005	Rapid recovery following cardiac surgery: a nursing perspective	British Journal of Nursing	Identify which patients were selected for rapid recovery and to evaluate safety (Hosp LOS and postop complications) compared to a conventional recovery pathway. Gain insight into patients views on rapid recovery.	Retrospective data collection, Structured questionnaire	Cardiac surgery, n=100	United Kingdom
Toraman et al[98]	2005	Fast-track recovery in noncoronary cardiac surgery patients	Heart Surgery Forum	Evaluate the safety and efficacy of fast track recovery for patients undergoing open cardiac surgery other than isolated CABG.	Prospective	All scheduled cardiac surgery other than isolated CABG, n=299	Turkey
Halpin et al[48]	2006	Gender differences for rapid after bypass back into telemetry tract following cardiac surgery	Journal of Nursing Care Quality	Document the results of their successful fast track program for patients following cardiac surgery.	Retrospective cohort study	CABG, valve, CABG + valve, n=1016	USA
Gooi et al[47]	2007	Fast-track cardiac surgery: application in an Australian setting	Asian Cardiovascular & Thoracic Annals	Study was designed to examine the safety and efficacy of a fast track policy for low risk cardiac surgery patients.	Prospective cohort	Cardiac surgery patients excluding VADs & transplants, n=342	Australia

Ender et al[59]	2008	Cardiac surgery fast-track treatment in a postanesthetic care unit: six-month results of the Leipzig fast-track concept	Anesthesiology	Compare safety and efficacy of newly developed fast-track concept including implementation of a direct admission PACU to standard perioperative management.	Cohort study	Elective Cardiac surgery patients, n=842	Germany
Thomson et al[79]	2014	Goal-directed therapy after cardiac surgery and the incidence of acute kidney injury	Journal of Critical Care	Assess effect of GDT, after cardiac surgery, on the incidence of acute kidney injury (AKI).	Prospective observational study	on & off pump CABG, CABG and/or aortic valve surgery, AVR. N=264	United Kingdom
Cove et al[58]	2016	Multidisciplinary extubation protocol in cardiac surgical patients reduces ventilation time and length of stay in the Intensive Care Unit	Annals of Thoracic Surgery	Assess how a team based extubation protocol would affect ventilation time and ICU LOS.	Retrospective, before and after observational study	Elective open heart surgery patients, n=201	Singapore
Van Der Kolk et al[24]	2017	Development and implementation of a clinical pathway for cardiac surgery in the intensive care unit: effects on protocol adherence	Journal of Evaluation in Clinical Practice	Cardiac surgery is facilitated by multiple perioperative guidelines and protocols. Use of a clinical pathway may facilitate the care of these patients.	Pre-post design	Cardiac surgery (CABG, valve or combo), n=659	Netherlands
Hartjes et al[25]	2018	Improving cardiac surgery outcomes by using an interdisciplinary clinical pathway: the official voice of perioperative nursing	AORN Journal	To streamline and improve care in the CTICU by implementing a new clinical pathway for patients undergoing CABG or valve replacement procedures.	QI project: preimplementation & postimplementation groups. cohort, retrospective	Cardiac surgery (CABG, valve & other), n=802	United Kingdom
Kebapci et al[49]	2018	Effects of nurse-led clinical pathway in	Journal of Clinical Nursing	Develop and evaluate the effects	Prospective quasi-experimental	CABG +/- valve, n=82	Turkey

		coronary artery bypass graft surgery: A quasi-experimental study		of a nurse led clinical pathway for patients undergoing CABG surgery.			
Li et al[120]	2018	Enhanced recovery after surgery pathway for patients undergoing cardiac surgery: a randomized clinical trial	European Journal of Cardio-Thoracic Surgery	Evaluate the clinical effectiveness and safety profile of ERAS pathways compared with routine care for patients undergoing cardiac valvular surgery.	Single centre RCT	Elective heart valve surgery, n=226	China
Richey et al[75]	2018	Implementation of an early extubation protocol in cardiac surgical patients decreased ventilator time but not Intensive Care Unit or hospital length of stay	Journal of Cardiothoracic & Vascular Anesthesia	Compare pre and post rapid ventilator weaning in relation to outcomes.	Prospective clinical trial - 2 cohorts	Adult cardiac surgery patients, n=459	USA
Van Der Kolk et al[22]	2019	Sustainability of clinical pathway guided care in cardiac surgery ICU patients; 9-years experience in over 7500 patients	International Journal for Quality in Health Care	Determine trends over time regarding inclusion of postop cardiac surgery ICU patients in a clinical pathway, and the association with clinical outcome.	Retrospective cohort study	All consecutive cardiac surgery patients, n=7553	Netherlands
Markham et al[50]	2019	Assessment of a multimodal analgesia protocol to allow the implementation of enhanced recovery after cardiac surgery: retrospective analysis of patient outcomes	Journal of Clinical Anesthesia	Investigate impact of utilizing a multimodal analgesia protocol and allow the implementation of Enhanced recovery after cardiac surgery in patient requiring CPB.	Retrospective case review	Elective cardiac surgery patients excluding thoracic procedures and combined CABG and valve, n=50	USA
Tierney et al[80]	2019	Implementing a weaning protocol for cardiac	DCCN	The objectives of this project were to	Pre-post design, retrospective chart	Cardiac surgery patients, n=150	USA

		surgery patients using simulation: a quality improvement project		decrease cardiac surgery patients' ventilation hours and intensive care unit length of stay using a ventilator weaning protocol.	review for pre implementation group.		
Williams et al[83]	2019	One-year results from the first US-based enhanced recovery after cardiac surgery (ERAS Cardiac) program	Journal of Thoracic & Cardiovascular Surgery	The study reports on systematic application of enhanced recovery principals to a US cardiac surgery program with reduced opioid use and LOS, and improved patient and staff satisfaction.	Retrospective data review and Prospective implementation data collection	Nonemergency adult cardiac surgery patients, n=932	USA
Borys et al[55]	2020	Implementation of Enhanced Recovery After Surgery (ERAS) protocol in off-pump coronary artery bypass graft surgery. A prospective cohort feasibility study	Anestezjologia Intensywna Terapia	Assess impact of recovery after ERAS protocol in patients undergoing off pump CABG. Investigate whether pre-emptively performed bilateral ESP block combined with intraoperative remifentanil infusion could be safe in OPCABG patients.	Prospective cohort study	OPCABG patients with same surgeon, n=57	Poland
Chen et al[46]	2020	Effect of enhanced recovery after surgery protocol on patients who underwent off-pump coronary artery bypass graft	Asian Nursing Research	Explore the effect of Enhanced recovery after surgery (ERAS) protocol in patient undergoing OPCABG surgery	Quasi-experimental	OPCABG , n = 94	China

Guo et al[63]	2020	Perioperative and long-term morbidity and mortality for elderly patients undergoing thoracic aortic surgery	Seminars in Thoracic & Cardiovascular Surgery	Evaluate age related differences in short and long term outcomes in elderly patients undergoing elective thoracic aortic surgery.	Retrospective cohort	Elective thoracic aortic surgery, n=786	Canada
Grutzner et al[62]	2021	A comparison of patients undergoing on- vs. off-pump coronary artery bypass surgery managed with a fast-track protocol	Journal of Clinical Medicine	Compare on vs off pump CABG managed with fast track protocol	Retrospective observational	Fast track CABG patients, n=3505	Germany
Yazdchi et al[84]	2021	Enhanced recovery after cardiac surgery: a propensity-matched analysis	Seminars in Thoracic & Cardiovascular Surgery	Since the adaptation of ERAS in cardiac surgery is rapidly increasing yet still evolving, herein, we demonstrate early results of our implementation of ERAS cardiac guidelines.	Retrospective cohort study	Isolated CABG, AVR, MVR/repair, noncomplex AVR + aorta, CABG + AVR, CABG + MV, n=102	USA
Damstra et al[119]	2022	Perioperative care standards in cardiac surgery patients aiming at enhancing recovery: a nationwide survey in the Netherlands and Belgium	Journal of Cardiothoracic & Vascular Anesthesia	Assess existing perioperative standards in cardiac surgery in Netherlands and Belgium regarding ERAS concepts.	Online survey with follow-up in-depth personal interview	Specialists including cardiac surgeons, cardiac anaethetist & intensivists, n=84	Netherlands and Belgium
MacLeod et al[69]	2022	Fast tracking in cardiac surgery: is it safe?	Journal of Cardiothoracic Surgery	Determine the impact of fast tracking on post operative outcomes following cardiac surgery.	Retrospective	1st time on pump, nonemergent CABG, valve surgery, n=3252	Canada

Appendix 4 Critical Appraisal Tool Checklist Questions

JBI Critical appraisal checklist for Randomised control trials[36]	
Q1.	Was true randomisation used for assignment of participants to treatment groups?
Q2.	Was allocation to treatment groups concealed?
Q3.	Were treatment groups similar at baseline?
Q4.	Were participants blind to treatment assignment?
Q5.	Were those delivering treatment blind to treatment assignment?
Q6.	Were outcome assessors blind to treatment assignment?
Q7.	Were treatment groups treated identically other than the intervention of interest?
Q8.	Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?
Q9.	Were participants analysed in the groups to which they were randomized?
Q10.	Were outcomes measured in the same way for treatment groups?
Q11.	Were outcomes measured in a reliable way?
Q12.	Was appropriate statistical analysis used?
Q13.	Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?

JBI Critical Appraisal Checklist for Quasi-experimental studies[36]	
Q1.	Is it clear in the study what is the 'cause' and what is the 'effect'?
Q2.	Were the participants included in any comparisons similar?
Q3.	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
Q4.	Was there a control group?
Q5.	Were there multiple measurements of the outcome both pre and post the intervention/exposure?
Q6.	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?
Q7.	Were the outcomes of participants included in any comparisons measured in the same way?
Q8.	Were outcomes measured in a reliable way?
Q9.	Was appropriate statistical analysis used?

JBI Critical Appraisal Checklist for Cohort studies[36]	
Q1.	Were the two groups similar and recruited from the same population?
Q2.	Were the exposures measured similarly to assign people to both exposed and unexposed groups?
Q3.	Was the exposure measured in a valid and reliable way?
Q4.	Were confounding factors identified?
Q5.	Were strategies to deal with confounding factors stated?
Q6.	Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?
Q7.	Were the outcomes measured in a valid and reliable way?
Q8.	Was the follow up time reported and sufficient to be long enough for outcomes to occur?
Q9.	Was follow up complete, and if not, were the reasons to loss to follow up described and explored?
Q10.	Were strategies to address incomplete follow up utilised?
Q11.	Was appropriate statistical analysis used?

JBI Critical appraisal Checklist for Analytical cross sectional studies[36]	
Q1.	Were the criteria for inclusion in the sample clearly defined?
Q2.	Were the study subjects and the setting described in detail?
Q3.	Was the exposure measured in a valid and reliable way?
Q4.	Were objective, standard criteria used for measurement of the condition?
Q5.	Were confounding factors identified?
Q6.	Were strategies to deal with confounding factors stated?
Q7.	Were the outcomes measured in a valid and reliable way?
Q8.	Was appropriate statistical analysis used?

JBI Critical appraisal checklist for Qualitative research[36]	
Q1.	Is there congruity between the stated philosophical perspective and the research methodology?
Q2.	Is there congruity between the research methodology and the research question or objectives?
Q3.	Is there congruity between the research methodology and the methods used to collect data?
Q4.	Is there congruity between the research methodology and the representation and analysis of data?
Q5.	Is there congruity between the research methodology and the interpretation of results?
Q6.	Is there a statement locating the researcher culturally or theoretically?
Q7.	Is the influence of the researcher on the research, and vice-versa, addressed?
Q8.	Are participants, and their voices, adequately represented?
Q9.	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?
Q10.	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

Quality Improvement Minimum Quality Criteria Set (QI-MQCS)[38]		
Domain		**Minimum Standard**
1.	Organisational motivation	Names or describes at least one motivation for the organisation's participation in the intervention
2.	Intervention rationale	Names or describes a rationale linking at least one central intervention component to intended effects
3.	Intervention description	Describes at least one specific change in detail including the personnel executing the intervention
4.	Organisational characteristics	Reports at least two organisational characteristics
5.	Implementation	Names at least one approach used to introduce the intervention
6.	Study design	Names the study design
7.	Comparator	Describes at least one key care process
8.	Data source	Describes the data source and defines the outcome of interest
9.	Timing	Describes the timing of the intervention and evaluation to determine the presence of baseline data and the follow-up period after all intervention components were fully implemented
10.	Adherence/Fidelity	Reports fidelity information for at least one intervention component, or describes evidence of adherence or a mechanism ensuring compliance to the intervention
11.	Health outcomes	Reports data on at least one health-related outcome
12.	Organisational readiness	Reports at least one organisational-level barrier or facilitator
13.	Penetration/ Reach	Describes the proportion of all eligible units who actually participated

14. Sustainability	Describes the sustainability or the potential for sustainability
15. Spread	Describes the potential for spread, existing tools for spread, or spread attempts / largescale rollout
16. Limitations	Reports at least one limitation of the design / evaluation

Mixed Methods appraisal tool[39]		
Screening	S1.	Are there clear research questions?
	S2.	Do the collected data allow to address the research question?
Qualitative questions	1.1.	Is the qualitative approach appropriate to answer the research question?
	1.2.	Are the qualitative data collection methods adequate to address the research question?
	1.3.	Are the findings adequately derived from the data?
	1.4.	Is the interpretation of results sufficiently substantiated by data?
	1.5.	Is there coherence between qualitative data sources, collection, analysis and interpretation?
Quantitative questions	3.1.	Are the participants representative of the target population?
	3.2.	Are measurements appropriate regarding both the outcome and intervention (or exposure)?
	3.3.	Are there complete outcome data?
	3.4.	Are the confounders accounted for in the design and analysis?
	3.5.	During the study period, is the intervention administered (or exposure occurred) as intended?
	5.1.	Is there an adequate rationale for using a mixed methods design to address the research question?
	5.2.	Are the different components of the study effectively integrated to answer the research question?
	5.3.	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
	5.4.	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
	5.5.	Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

Appendix 5 Email to Nurse Unit Managers

Curtin University

My name is Melissa Bedford, and I am currently enrolled in the Master of Philosophy (Nursing and Midwifery) course at Curtin University, Western Australia, and work in a staff education role in the ICU at Fiona Stanley Hospital. This Masters Course features a research thesis as the major component of assessment. I have chosen to study the care of the cardiothoracic surgical patient in the Intensive Care unit (ICU). The aim is to gain an understanding of current practice related to the care of the post operative cardiac surgery patient which will assist in the development of a practice framework facilitating a timely transition through the ICU recovery phase and enhance the patient experience.

A component of my project includes conducting a focused search exploring current practice from various cardiothoracic centres from around Australia. I am hoping to engage your assistance by providing your latest policy and/or procedure documents for the care of the cardiothoracic surgical patient in the Intensive Care Unit. These documents will only be seen by my research team whilst we review and extract concepts only. Each document will be deidentified in my thesis with a general acknowledgement for all contributing sites. There will not be any reproduction of any policy or procedure document that have been entrusted to myself and the research team and we are happy to share my findings at the conclusion of my project.

If you have any questions or queries, then please don't hesitate to contact either myself or one of my supervisors, details are below. I thank you in advance for any assistance that you can provide.

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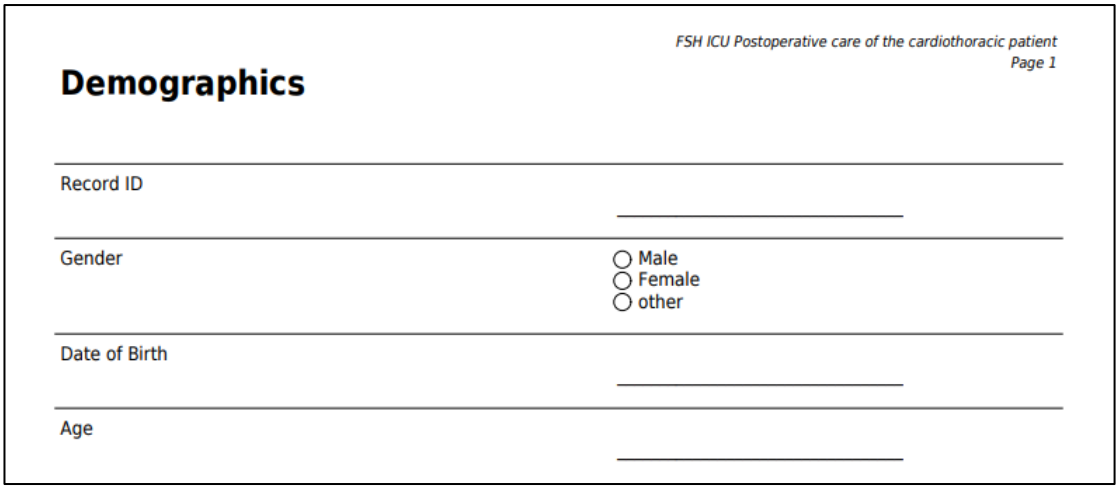
Appendix 6 Demographics Data Extraction Tool



FSH ICU Postoperative care of the cardiothoracic patient
Page 1

Demographics

Record ID	_____
Gender	◯ Male ◯ Female ◯ other
Date of Birth	_____
Age	_____

Appendix 7 Preoperative Data Extraction Tool

Preoperative Data

Record ID	_____
Ejection Fraction	_____
NYHA classification	◯ Class 1 ◯ Class 2 ◯ Class 3 ◯ Class 4 ◯ Not documented
Renal Impairment	◯ Yes ◯ No (Cr>200)
Was antiplatelets or anticoagulants given within 24hrs of surgery.	◯ Yes ◯ No

Appendix 8 Operative Data Extraction Tool

Operative Data

Record ID	_____
Surgery Type	☐ CABG ☐ OPCABG
Operation urgency	○ elective ○ urgent
CPB time	_____
Cross clamp time	_____
Intraoperative complications	○ Yes ○ No
Complications	☐ Cardiac arrest ☐ Failure to come off bypass ☐ Bleeding requiring blood products ☐ Other

Appendix 9 ICU Admission Data Extraction Tool

ICU Admission Data

Record ID	_____
ICU Admission	_____
Temperature on adm	_____
Normothermia reached	_____ (temp >36.5)
Rewarming Time	_____ (mins)
SCC Blood loss at 6 hr	_____
SCC Blood loss 12 hr	_____
SCC Blood loss at 24hr	_____
Transfusion requirement	◯ Yes ◯ No
Was Transfusion required in 1st 6 hours	◯ Yes ◯ No
Number and type of Transfusion	_____
PaO2/FiO2 ratio at 6hrs	_____
PaO2/FiO2 12 hours	_____
PaO2/FiO2 ratio at 24hrs	_____ (or prior to discharge)
Sedation Cessation	_____
Sedation length	_____ (mins)

Extubation Time	_____
Mechanical ventilation duration	_____ (mins)
Delayed extubation?	◯ Yes ◯ No (Extubation > 6hrs)
Delayed extubation rationale	☐ oversedation ☐ prolonged hypothermia ☐ agitation ☐ haemodynamic instability ☐ unclear
extubation comments	_____
Urine Output 6 hrs	_____
Urine Output 12 hours	_____
Urine Output at 24hrs	_____
Vasoactive drugs	☐ Noradrenaline ☐ Dobutamine ☐ Other ☐ None
Max Noradrenaline dosage in first 6 hrs (mcg/kg/min)	_____ (dose(mcg)/wt/60/vol x rate)
Max Noradrenaline dosage in first 12 hours (mcg/kg/min)	_____ (dose(mcg)/wt/60/vol x rate)
Max Noradrenaline dosage in first 24 hrs (mcg/kg/min)	_____ (dose(mcg)/wt/60/vol x rate)
Max Dobutamine dosage in first 6 hrs (ml/hr)	_____
Max Dobutamine dosage in first 12 hours (ml/hr)	_____
Max Dobutamine dosage in first 24 hours (ml/hr)	_____

Return to Theatre in first 24 hours.	◯ Yes ◯ No

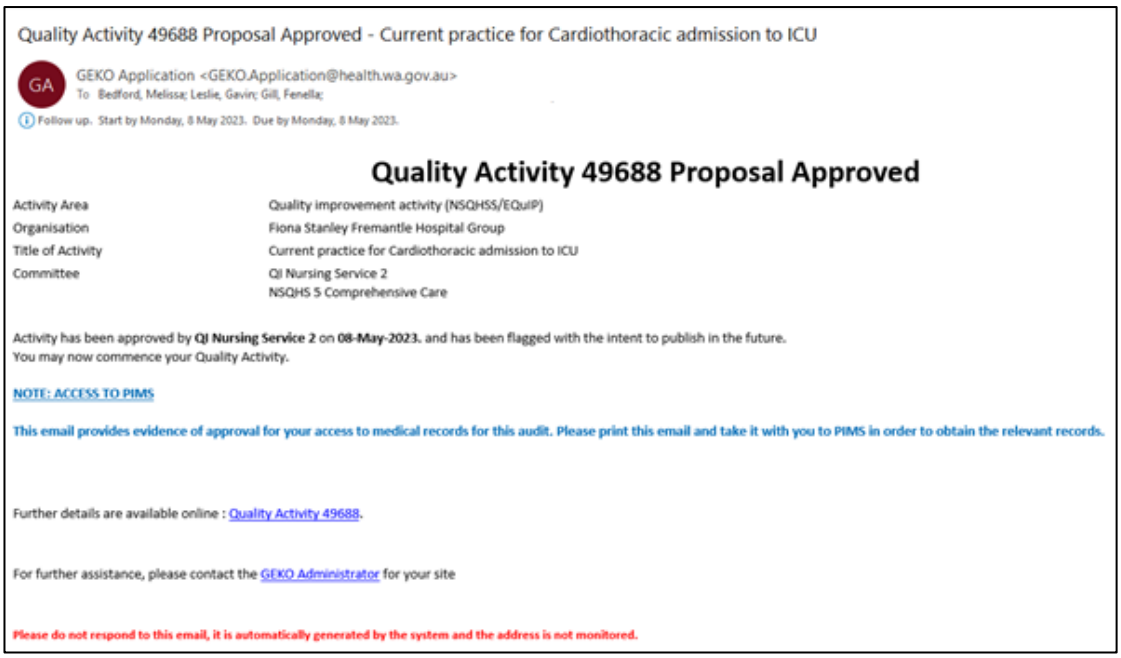
Appendix 10 Ward Readiness Data Extraction Tool

Ward readiness data

Record ID	_____
All Vasoactives cessation	_____
# pain scores first 12hrs post extubation	_____
Lowest Pain score	◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10
High Pain score	◯ 0 ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10
Pain comment	_____
Was patient mobilised to chair?	◯ Yes ◯ No
First mobilisation	_____
Mobilisation time	_____ (hrs)
Mobilisation comment	_____
Was the patient ambulated with physio?	◯ Yes ◯ No

First ambulation	_____
Were SCCs removed?	◯ Yes ◯ No
SCCs Surgeon Request	_____
SCCs ICU Request	_____
SCCs removal	_____
SCC Removal request vs removing	_____ (mins)
ICU vs Surgeon	_____
Arterial line removal	_____
Line removal timeline	_____
removal post ward ready	_____
Is there a discharge decision date/Time?	◯ Yes ◯ No
Discharge decision Time	_____
ICU Discharge	_____
ICU LOS	_____ (hrs)
Discharge decision difference	_____
Comments	_____

Appendix 11 Quality Activity Approval 1



Quality Activity 49688 Proposal Approved - Current practice for Cardiothoracic admission to ICU

GA GEKO Application <GEKO.Application@health.wa.gov.au>
To Bedford, Melissa; Leslie, Gavin; Gill, Fenella;

Follow up. Start by Monday, 8 May 2023. Due by Monday, 8 May 2023.

Quality Activity 49688 Proposal Approved

Activity Area	Quality improvement activity (NSQHSS/EQuIP)
Organisation	Fiona Stanley Fremantle Hospital Group
Title of Activity	Current practice for Cardiothoracic admission to ICU
Committee	QI Nursing Service 2 NSQHS 5 Comprehensive Care

Activity has been approved by **QI Nursing Service 2** on **08-May-2023.** and has been flagged with the intent to publish in the future.
You may now commence your Quality Activity.

NOTE: ACCESS TO PIMS

This email provides evidence of approval for your access to medical records for this audit. Please print this email and take it with you to PIMS in order to obtain the relevant records.

Further details are available online : Quality Activity 49688.

For further assistance, please contact the GEKO Administrator for your site

Please do not respond to this email, it is automatically generated by the system and the address is not monitored.

Appendix 12 Curtin University Human Research Ethics Committee Approval

Curtin University

Research Office at Curtin

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7863
Facsimile +61 8 9266 3793
Web research.curtin.edu.au

26-May-2023

Name: Fenella Gill
Department/School: Curtin School of Nursing
Email: F.Gill@curtin.edu.au

Dear Fenella Gill

RE: Reciprocal ethics approval
Approval number: HRE2023-0263

Thank you for your application submitted to the Human Research Ethics Office for the project RECIPROCAL - Current Practice for cardiothoracic admission to ICU.

Your application has been approved by the Curtin University Human Research Ethics Committee (HREC) through a reciprocal approval process with the lead HREC.

The lead HREC for this project has been identified as Fiona Stanley Fremantle Hospital Group.

Approval number from the lead HREC is noted as Quality Activity 49688.

The Curtin University Human Research Ethics Office approval number for this project is **HRE2023-0263**. Please use this number in all correspondence with the Curtin University Ethics Office regarding this project.

Approval is granted for the period **26-May-2023** to **08-May-2024**. Continuation of approval will be granted on an annual basis following submission of an annual report.

Personnel authorised to work on this project:

Name	Role
Gill, Fenella	CI
Bosco, Anna	Supervisor
Bedford, Melissa	Student
Leslie, Gavin	Supervisor

You must comply with the lead HREC's reporting requirements and conditions of approval. You must also:

- Keep the Curtin University Ethics Office informed of submissions to the lead HREC, and of the review outcomes for those submissions
- Conduct your research according to the approved proposal
- Report to the lead HREC anything that might warrant review of the ethics approval for the project
- Submit an annual progress report to the Curtin University Ethics Office on or before the anniversary of approval, and a completion report on completion of the project. These can be the same reports submitted to the lead HREC.
- Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
- Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this project
- Data and primary materials must be managed in accordance with the Western Australian University Sector Disposal Authority

(WAUSDA) and the Curtin University Research Data and Primary Materials policy
- Where practicable, results of the research should be made available to the research participants in a timely and clear manner
- The Curtin University Ethics Office may conduct audits on a portion of approved projects.

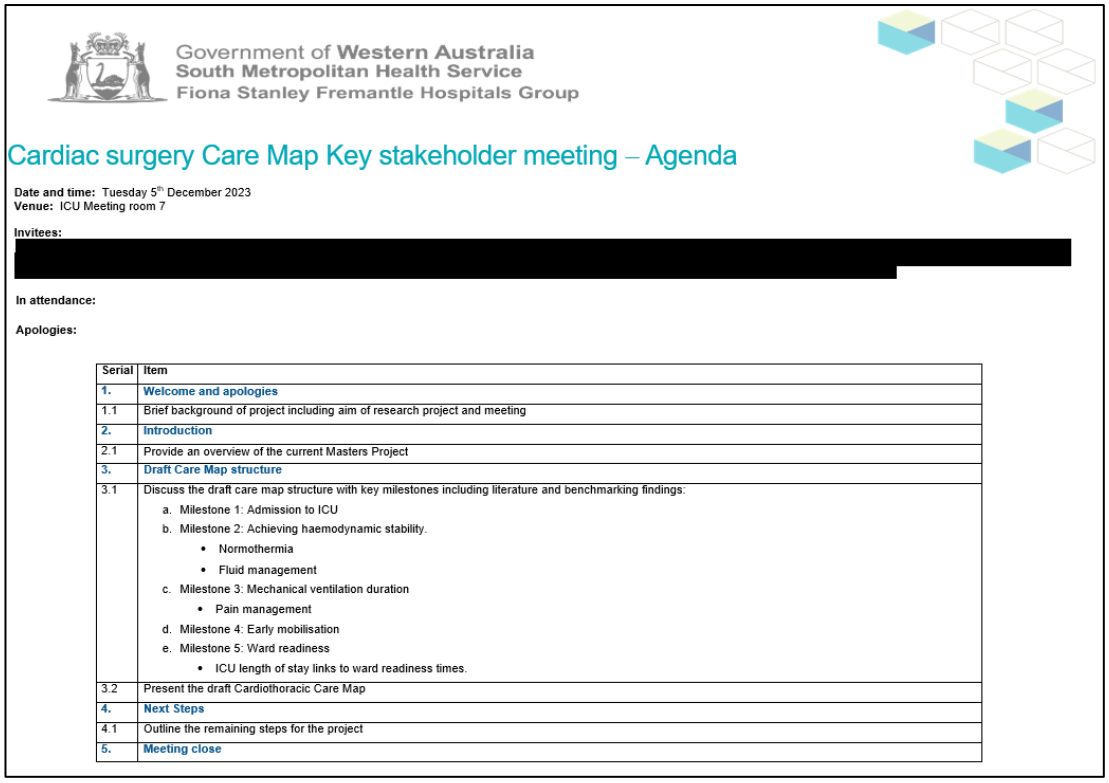
This letter constitutes ethical approval only. This project may not proceed until you have met all of the Curtin University research governance requirements.

Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

Yours sincerely

Amy Bowater
Ethics, Team Lead

Appendix 13 Key Stakeholder Meeting Agenda



Government of Western Australia
South Metropolitan Health Service
Fiona Stanley Fremantle Hospitals Group

Cardiac surgery Care Map Key stakeholder meeting – Agenda

Date and time: Tuesday 5th December 2023
Venue: ICU Meeting room 7

Invitees:
[redacted]

In attendance:

Apologies:

Serial	Item
1.	**Welcome and apologies**
1.1	Brief background of project including aim of research project and meeting
2.	**Introduction**
2.1	Provide an overview of the current Masters Project
3.	**Draft Care Map structure**
3.1	Discuss the draft care map structure with key milestones including literature and benchmarking findings: a. Milestone 1: Admission to ICU b. Milestone 2: Achieving haemodynamic stability. • Normothermia • Fluid management c. Milestone 3: Mechanical ventilation duration • Pain management d. Milestone 4: Early mobilisation e. Milestone 5: Ward readiness • ICU length of stay links to ward readiness times.
3.2	Present the draft Cardiothoracic Care Map
4.	**Next Steps**
4.1	Outline the remaining steps for the project
5.	**Meeting close**

Appendix 14 Health Consumer Assessment Script

Consumer engagement meeting

Topic introduction:

- Introduce self.
- Thank for participation.
- Reason for this quality activity is due to my ongoing passion for ensuring the highest level of care is delivering to patients undergoing cardiac surgery.
- I have been an ICU nurse for ~20 years and decided to go back to Uni to formally look at the process for ensuring we deliver the highest possible care.
- Enrolled in master's program with the project aim of understanding current practice whilst identifying areas for improvement.
- Project included:
    - Reading through lots of research from around the world on the topic to see what they recommend.
    - Contacted several other cardiothoracic centres across the country to compare our practices against them.
    - Acquired summary information about all heart surgeries from the national database.
- Used all the information above to develop what we call a cardiac surgery care map which identifies important achievements for patients so we can improve your experience.

Cardiac surgery care map:

- Show map but will need to explain in layman's terms, see below.
- Important achievements are what we call milestones.
- These achievements are specifically related to your ICU admission only.
- Milestone 1:
    - About admitting you to ICU, you will be asleep at this time.
- Milestone 2:
    - We are making sure that you are warm, your blood pressure is good, and we are making sure there are no complications from the surgery. You are still asleep at this stage.
- Milestone 3:
    - This is the point where we are waking you up as we stop the medications that keep you asleep.
    - The general idea is to get that breathing tube out ASAP.
    - We just need to make sure you are awake and able to breathe normally.
- Pain management:
    - This is a very important aspect of your recovery and occurs throughout your ICU stay.
    - Without good pain management your recovery can be lengthy and unsatisfying.
    - We need to ensure that communication between the patients and nursing staff is adequate.
    - We recommend frequent pain assessments which includes rating a pain score out of 10 on how bad their pain is. Additional pain relief should be offered if pain score is high. Pain relief should also be offered prior to certain procedures such as taking the drains out and walking with the physiotherapist or moving to the chair. This will allow you to move more freely.
- Milestone 4:
    - This is where your rehabilitation commences as we start to get you moving.
    - This helps improve your physical and mental recovery by slowly returning to normal activity.
    - The first step is getting out of bed and sitting in a chair. This should occur as early as possible following the removal of the breathing tube.
    - The second step is walking with the physiotherapist.

- Milestone 5:
    - This is where we are preparing you to be moved to the ward and removing as many tubes and drains as possible.
    - Very important that you feel confident and as stress free during this period.
    - Ward 4C has specialist nurses just like ICU but there is a difference in the level of monitoring you need.
    - The nurses on 4C will also be caring for other patients so will not be as readily available.

Questions for consumers:

Q1. Were you aware of these steps or milestones in ICU?
Q2. What were the most important parts of the post operative recovery for you?
Q3. Does the cardiac surgery care map meet the needs of patients and their families?
Q4. Is there anything in the cardiac surgery care map that you disagree with?
Q5. Would this information about your ICU stay be beneficial prior to your surgery?

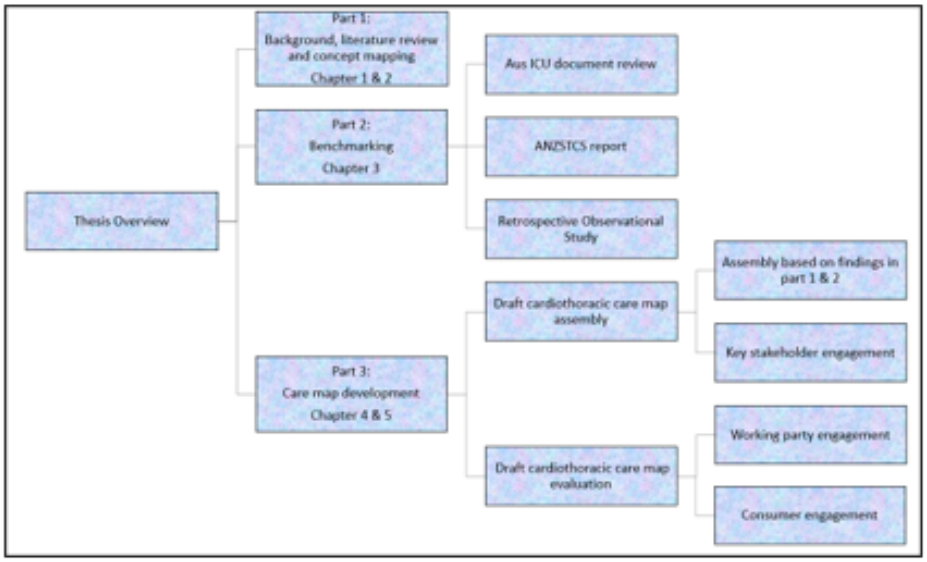
Appendix 15 Senior Clinical Staff Assessment Script

Working party discussion plan

Welcome to my Masters update and thank you for attending.
I will be writing notes throughout so I can capture your feedback.

Background:
Over the years I have been involved in many QI projects, so thought it be beneficial to do further studies with a focus on change management.
With research findings being the driving force for change this was a perfect fit for my purpose.
I enrolled in the Master of philosophy course in July 2020 which features a research thesis as the major component of assessment.
My topic of choice was cardiac surgery which is an area that I continue to have a keen interest in.

Aim of research project:
The main aim of this project was to develop a practice framework that would facilitate a timely transition through the ICU recovery phase and enhance the patient experience.
The choice of a practice framework was to provide visual prompts as guidance for staff outlining key achievements during the patient journey with predicted progressions for patients.
The main expectation for today's meeting is to discuss the draft ICU cardiac surgery care map to receive your valuable feedback on its clinical workability.



This is an overview of my journey which as you can see has involved many components.

Part 1: Explored current literature with completion of a scoping review which looks at the extent, volume and scale of literature on the topic.

- The Scoping review research question was: What evidence exists relating to the post operative care of the adult cardiac surgery patient, including patient and family experiences and satisfaction levels, in the ICU?
- The focus was on generating a comprehensive overview of published articles including the use of practice frameworks.
- Articles were then summarised, and major topics were identified then categorised as either clinical elements or influencing factors with the formation of a concept map illustrating their interrelationships.

Part 2: Benchmarking

Provided a comparison between literature, current practice, Australian database statistics and various Australian ICU documents with each of these components were carried out separately prior to bringing all the information together.

Australian ICU document review:

- A selection of ANZSCTS database participating sites with high case volumes, centres of excellence and contributing >5years specialising in cardiothoracic care were contacted requesting policy and procedure documents.
- Six responses were received: 2 x Queensland, 2 x NSW, 2 x Victoria, 1 x Canberra, 1 x SA and 1 x WA which included the original clinical pathway.
- These documents were compared and summarised.

ANZSCTS report: I will refer to as the national database report. Just to note: FSH has been a contributing hospital since opening in 2015.

- I downloaded the 2021 annual report and extracted the clinically specific Key performance indicator data, then summarised alongside the identified elements from literature review concept map.

The Retrospective observational study: Refer to as FSH Current practice.

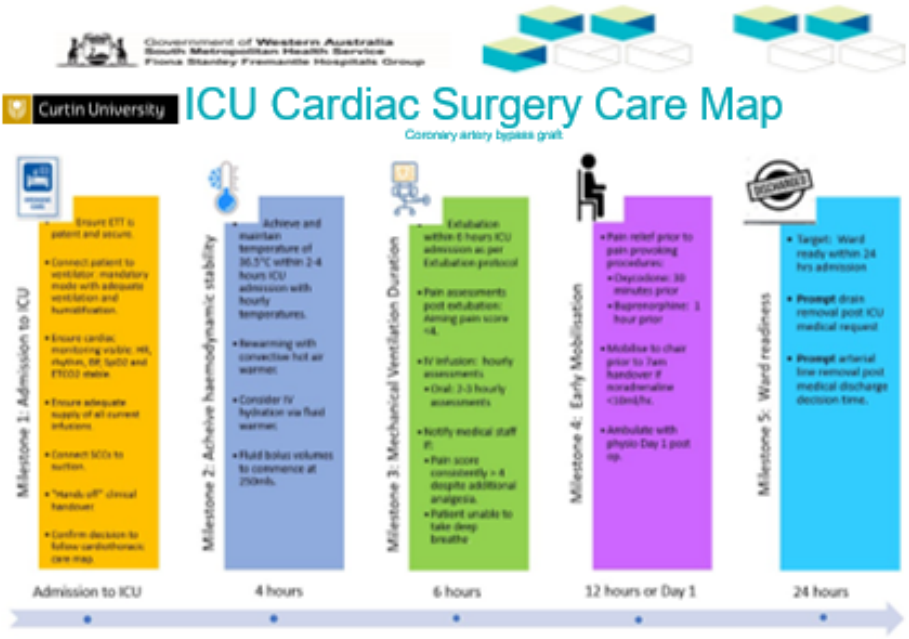
- Inclusion criteria: elective or urgent CABG surgery only
- Exclusion criteria: MCS, RTT, preop dialysis dependent, LVEF <35%
- In 2022; 253 patients underwent CABG surgery, 43 were ineligible based off exclusion criteria, leaving 210 patients with 50 patients randomly selected.
- Type of data extracted included:
    - Patient demographics, Preoperative data, Operative data, ICU admission data and Ward readiness data.

The assembly of the Draft cardiac care map was based off the findings from the first 2 parts of this project:

Clinical steps or Milestones were outlined with relevant recommendations from the literature review and benchmarking process. I will include some of these results throughout our discussion.

The Purpose of the ICU cardiac surgery care map is to create a visual reminder about each milestone in the post operative journey with key principles to improve patient satisfaction and enhance their journey.

I have already met with key stakeholders which included ICU consultants, NUM, ANUMs, NME to attain their input for clinical details.



Milestone 1:

Admission to ICU is a standardised process which has already been engrained into our practice and is well supported in the literature.

These details were initially pulled from our current procedure document with some alterations.

- Standard ventilator settings have been removed and substituted with mandatory mode of ventilation as the initial settings will change depending on the patient.
- Confirm decision to follow the care map from medical staff has been included.

Question: Is this information sufficient and clear?

Milestone 2:

Common theme amongst the literature and benchmarking documents is that normothermia should be achieved and maintained within 2-4 hours of ICU admission.

FSH current practice:

- Achieving of Normothermia ranged between 0-12.65hrs with a mean of 3.5hrs.
- Normothermia within 4 hours as per literature recommendations = 68%.

Read through milestone steps.

May need to keep Theatre pumps at bedside until 4-hour mark or normothermia reached, whichever comes first.

Question: Is this information sufficient and clear?

Milestone 3:

FSH Current Extubation practice: CABG only

- Extubation within 6 hours = 46%, not bad compared with national database average of 30.2%
- Some extubations were felt to be delayed for reasons such as prolonged hypothermia, slow propofol weaning and remaining on mandatory mode ventilation.

- There were also overnight extubations (between midnight and 6am) which potentially may improve with the milestone introduction.
- Further education on the extubation protocol is required and will assist in improving this along with the other milestone achievements.

FSH current pain management:

- Pain score frequency in 1st 12 hours post extubation:
  - Regular pain assessments between 2-4 hourly (3-5 assessments in the first 12 hours) = 22%.
  - Regular pain assessment + good pain control (NPS < 4 as per FSH policy) = 16%,
  - Regular pain assessment + poor pain control = 6%
- Current practice reflects literature findings – poor pain management with inconsistent time frames.

Read through milestone steps.

Pain assessment timeframes have been based on the type of analgesia given with IV infusion having much shorter half-life.
Important to ensure nursing staff are aware of when to escalate so pain management strategies can be reviewed.

Question: Is this information sufficient and clear?

Milestone 4:

Literature:

Early mobilisation plays an integral role in improving the physical and psychological recovery of patients post cardiac surgery.
Literature talks about mobilisation as a staged progression: Sitting edge of bed, sitting in chair, ambulation.
Early mobilisation in the literature is defined as:

- Within 6-12 hours or early day1 post-surgery to sit out of bed in a chair.
- Ambulation with physio/ nursing staff within 24 hours.

FSH Current practice:

Early mobilisation was defined as sitting in a chair by 9am.

- 86% patient were mobilised to chair but only 24% within the recommended time frame.
- Of the 86% only 4% were initiated by nursing, the remaining 82% were following ambulation with physio which is possibly why this stage of progression is not achieved within 12 hours.
- Huge difference in timings for sitting out of bed from 6am to 4pm
- Ambulation with physio well achieved (96%), limitations due to issues with pain.

Need to focus on improving early mobilisation practices.

Read through milestone steps.

Consistency in this practice may improve pain management strategies as it will be easier to plan analgesia.
Early mobilisation is also linked to tasks such as SCC drain removal times with general practice being to SOOB prior to drain removal.
We may need to adjust the timing of the AIN round for Pod 1 to coincide with this.

Question: Is this information sufficient and clear?

Milestone 5:

Milestone 5 is about achieving ward readiness rather than ICU discharge due to the many factors that affect actual discharge times.

Literature:

Facilitating a smooth and timely ward transfer relies on patient readiness with additional stress being placed on both healthcare staff, patients and their families when transfers are delayed, rushed or don't occur during daylight hours especially with the significant difference in level of care between the two areas.

FSH Current practice:

Ward ready times were based off the documented medical discharge decision time with 55% of patients ready in less than 24hours.
Big difference between ward readiness and actual discharge times with only 16% discharged within 24 hours, the national average was 19%.

I then looked at task completions post medical decision times.

- Arterial line removal vs medical discharge decision time: 0.2 to 68 hours, mean 8.4 hours.
- SCC drain removal vs ICU medical request to remove time: 0.25 to 6.91 hours, mean 2.73 hours.

Reasons for the huge variability in response time for both tasks were not explored during this project. However, thought to be a result of delayed mobilisation practices so improving this practice may impact on drain removal times as well.

Read through milestone steps.

Question: Is this information sufficient and clear?

Summary:

Just a reminder: This is a visual guide for staff to keep on track with patient progression only.
Following our discussion today I will be taking your comments and suggestions and review against the draft map.

I will also be engaging with consumers for their feedback.

Further questions for working party:

Have we captured all relevant and necessary info to guide nursing staff?

- If no, what is missing?

Is the information clear and easy to follow?

- If no, what would you change?

Does the flow of the cardiac care map mimic real life?

What size poster do you suggest?

Appendix 16 Quality Activity Approval 2

Quality Activity 52272 Proposal Approved

Activity Area	Quality improvement activity (NSQHSS/EQuIP)
Organisation	Fiona Stanley Fremantle Hospital Group
Title of Activity	ICU cardiac surgery care map co-design
Committee	QI Nursing Service 2 NSQHS 2. Partnering with Consumers (Secondary committee only)

Activity has been approved by **QI Nursing Service 2** on **02-Feb-2024.**.
You may now commence your Quality Activity.

Further details are available online : Quality Activity 52272.

For further assistance, please contact the GEKO Administrator for your site

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