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A mixed method study of the incidence, peri-operative risk factors and patient experiences of post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery

Daisy Ezakadan Sandeman

Thesis presented in fulfillment of the requirements of the degree of

Doctor of Philosophy in Nursing Studies

THE UNIVERSITY OF EDINBURGH

2023
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<tr>
<td>AWI</td>
<td>Adult with Incapacity</td>
<td></td>
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<tr>
<td>CABG</td>
<td>Coronary Artery Bypass Graft</td>
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<tr>
<td>CAM-ICU</td>
<td>Confusion Assessment Method – Intensive Care Unit</td>
<td></td>
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<td>CASP</td>
<td>Critical Appraisal Skills Programme</td>
<td></td>
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<td>CHF</td>
<td>Congestive Heart failure</td>
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<tr>
<td>CPB</td>
<td>Cardio Pulmonary Bypass</td>
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<tr>
<td>DTS</td>
<td>Davidson Trauma Scale</td>
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<td>DS14</td>
<td>Distress Score 14</td>
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<td>ERAS</td>
<td>Enhanced Recovery after Surgery</td>
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<td>Hospital Anxiety and Depression Scale</td>
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<td>High Dependency Unit</td>
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<td>HRQoL</td>
<td>Health Related Quality of Life</td>
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<td>ICU</td>
<td>Intensive Care Unit</td>
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<td>IES-R</td>
<td>Impact Event Scale – Revised</td>
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<tr>
<td>MeSH</td>
<td>Medical Subject Headings</td>
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<tr>
<td>MMR</td>
<td>Mixed Method Research</td>
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<td>MRC</td>
<td>Medical Research Council</td>
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<tr>
<td>MDT</td>
<td>Multi-Disciplinary Team</td>
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<tr>
<td>NYHA</td>
<td>New York Heart Association</td>
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<td>POD</td>
<td>Post-operative Delirium</td>
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<tr>
<td>PRISMA</td>
<td>Preferred Reporting Items for Systematic Reviews and Meta-Analyses</td>
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<td>PDS</td>
<td>Post-traumatic Diagnostic Scale</td>
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<td>PTSD</td>
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<td>RCT</td>
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<tr>
<td>SIGN</td>
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<td>SCID</td>
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<td>STROBE</td>
<td>Strengthening the Reporting of Observational Studies in Epidemiology</td>
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<td>TSQ</td>
<td>Trauma Stress Questionnaire</td>
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<td>TIPI</td>
<td>Ten Item Personality Inventory</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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<tr>
<td>4AT</td>
<td>4 ‘A’s Test</td>
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Declaration

Title of Work: A mixed method study of the incidence, peri-operative risk factors and patient experiences of post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery

I confirm that this work is my own except where indicated, and that I have:

- Read and understood the Plagiarism Rules and Regulations.
- Composed and undertaken the work myself.
- Clearly referenced/ listed all sources as appropriate.
- Referenced and put in inverted commas and quoted text of more than three words (from books, web, etc.).
- Given the sources of all pictures, data etc. that are not my own.
- Not made undue use of essay(s) of any other student(s), either past or present or where used, this has been referenced appropriately).
- Not submitted the work for any other degree or professional qualification except as specified.
- Acknowledged in appropriate places any help that I have received from others (for example: fellow students, statisticians, external sources).
- Compiled with other plagiarism criteria specified in the Programme Handbook.
- I understand that any false claim for this work will be penalised in accordance with the University regulations.
- Received ethical approval from the School of Health in Social Science, University of Edinburgh OR deceived ethical approval from an external body and registered this application and confirmation of approval with the School of Health in Social Science's Ethical Committee.

Signature: Daisy Ezakadan Sandeman

Date: 24th November 2022
Acknowledgements

I write this page with a lot of pride and gratitude as I come to the end of this very long journey. This would have been an impossible task without numerous people's support and contribution and in some instance just their profound presence (my dad).

I would like to start extending my gratitude to the patients who agreed to participate in this study despite the knowledge that it might bring back some distressing memories. Also the relatives and friends of the participants for supporting them through some perceived dark times of physical, mental and emotional recovery.

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I have to acknowledge the COVID-19 Pandemic and reflect on my life, my work, this PhD and everything else that got affected with it. And as I come to the end of the PhD journey, the seasons changing and this year coming to an end, I remain optimistic about a brighter and healthier 2023.
Abstract

Introduction: Delirium, an acute fluctuation of cognitive function, is a common complication after cardiac surgery. There are multiple pre, post and intra-operative factors attributed to the development of delirium. Whatever the precipitating factors, delirium not only causes psychological distress to the patient but also their family members. In some cases, this psychological upset continues to affect the patient after discharge from hospital, referred to as post-traumatic stress syndrome (PTSS). Despite this, there is little known about the aftermath of delirium and the associated patient experience, especially following cardiac surgery.

Aim: The aim of the study was to identify the incidence, peri-operative risk factors and explore patient experiences of post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery.

Methods: In order to address the aim, the study adopted a mixed methods approach. Data collection took place in a large teaching hospital in Scotland.
- Phase I: Quantitative phase (Pre Admission Clinic/ Ward assessment for in-patients)
  Data collection included identifying peri-operative risk factors, assessment of personality and mood using validated tools, and screening for delirium.
- Phase II-a: Quantitative phase (6-8 weeks following discharge)
  Following phase I, 'Purposive Criterion' sampling was used with the criterion being the phenomenon of delirium to enroll patients into phase IIa of the study. Data collection included validated tools for re-assessing mood, re-screening for delirium and PTSS diagnoses using SCID - Structural Clinical Interview for DSM (Diagnostic and Statistical Manual for Psychiatric Disorders).
- Phase II-b: Qualitative phase (Telephone follow up at three months)
  Sixteen participants from phase IIa were selected and enrolled in phase IIb. Data collection included two validated tools - SCID and delirium screening and an additional semi-structured interview to gain an understanding of the patient experience.

Findings: The study recruited 406 participants (72% male, mean age 67 years, SD=10.50). The EuroSCORE (European System for Cardiac Operative Risk Evaluation) which provides a simple, additive risk model in European adult cardiac surgery patients, was calculated to be 4.77 (SD=2.62). This suggests a moderate level predicted risk of 30-day mortality across the
study population following cardiac surgery. The incidence of post-operative delirium was 18.3%.

Univariate analysis of the data showed that ‘Age’ (p<0.001) and ‘pre-operative renal impairment’ (p<0.008) were associated with post-operative delirium. However, in a fully adjusted model, only ‘Age’ remained a significant predictor of post-operative delirium. Of the 406 participants, 73 were positive for delirium during their post-operative hospital stay. Only two out of the 73 patients were positive for PTSS with heightened levels of anxiety requiring post-operative psychological support. Additionally, there was no correlation noted between participants’ personalities and delirium. Notably, patient anxiety levels were lower after surgery at the follow up clinics.

Qualitative analysis included examining the transcribed interviews using a 'thematic approach'. This uncovered five main themes: These were 'what I remember or not' (failure to recall details during period of delirium); 'Not right in my head' (recall information juxtaposed with relative's accounts); 'My body' (focus on physical recovery after surgery); 'No regrets' (decision to undergo surgery despite complications); 'Reassurance' (relief and comfort gained with follow up).

**Conclusion:** In summary, from the quantitative data, age at time of surgery was the only attributable risk factor for post-operative delirium. The qualitative data informs the after-effects of in–hospital delirium and clearly distinguishes between post-delirium anxiety states and PTSS.

Recommendations for appropriate patient selection should focus on biological age and frailty along with pre-operative optimisation. Clinicians should explain about delirium as a serious complication prior to obtaining consent for cardiac surgery. Also, ensure that patients and families are more prepared and have a better understanding when psychological issues emerge after elective cardiac surgery.
Lay Summary

Cardiac surgery is a branch of cardio-vascular surgery, which encompasses operations on the heart and/or the associated large blood vessels. The types of adult cardiac surgery operations include Coronary Artery Bypass Grafts (CABG) performed to replace narrowed or blocked arteries and improve the blood flow to the heart, and repair or replacement of heart valves for patients with heart valve disease. The Cardio Pulmonary bypass (CPB) pump is used in 67% of cardiac surgery procedures in the centre where the research was undertaken. The bypass machine transiently takes over the patient's heart and lung function of maintaining the flow of blood, while ensuring optimum circulation and oxygen demands of the body. This temporary heart pump provides the surgeon a blood free and clear space to undertake the operation effectively on the heart.

Special teams of practitioners called Perfusionists operate the CPB pump. They manage the optimum circulating volume of blood by gradually cooling down the patient's body temperature, which in turn reduces the oxygen demands of the body. However, because of the brief change in the normal body function, in some patients, there may be short-term adverse effects. These include the potential for systemic inflammatory responses and brain injury.

CPB circuit- Adapted from Indian Journal of Anaesthesiology 2017 Sep: 61 (9) 760-767
'Post-perfusion syndrome' or 'pump head' are terms historically associated with cardiac surgery due to the transient deficits in thinking and concentration attributed to the process of cardio-pulmonary bypass. The official terminology for this neurological disturbance is 'post-operative delirium'. Common characteristics of delirium are difficulties with attention such as inability to direct, focus, sustain, or shift attention, and cognitive disturbances including impaired memory, confusion and hallucinations.

People with delirium can sometimes be very frightened and distressed, and may think they are being threatened or imprisoned, sometimes leading to a natural response of resisting care from health care staff. Occasionally, in the acute phase, post-operative delirium may be so concerning that it can potentially lead to a patient becoming a danger to themselves or others around them. In some cases, in order to manage these patient safety issues carefully, the healthcare team may have to administer medications or even physical restraint on rare occasions. These measures are sometimes unavoidable and are undertaken in the best interests of the patient. Studies show that patients with these kinds of emotional disturbances during delirium may have longer-term consequences such as increased anxiety and even post-traumatic stress symptoms.

Delirium may also manifest in the form of increased drowsiness and an unusual lack of engagement with the surroundings and day-to-day activities. This form of delirium can lead to reduced oral intake and dehydration with consequences such as low blood pressure and electrolyte disturbances. Although these physical complications are often short-lived without any permanent physical or neurological impairment, patients with this kind of ‘quiet’ delirium can still experience psychological trauma with long-term effects. This may be long after their discharge from the hospital. Little is known in this particular area and it stirred the researcher's interest, to understand the journey and longer-term experience of patients who had post-operative delirium. Though some studies have explored the effects of delirium on future psychological health, none have focused specifically on patients undergoing cardiac surgery.

This study has two main aims. The first one is to measure the risk factors causing delirium before, during and after cardiac surgery. The second aim is to determine the psychological impact of delirium in the weeks following hospital discharge. In order to achieve this, the researcher studied the participant’s entire hospital journey and experiences.
It started from the point of admission, through the course of their stay after surgery, until the follow-up appointments around six weeks and three months after discharge from the hospital. Several methods were used to achieve the objectives of the study including delirium assessments, questionnaires looking at psychological health, and extended interviews with detailed analysis.

The study included 406 patients, of which 73 tested positive for delirium following cardiac surgery. Several risk factors were reviewed in this study and on analysis the most notable one was age at the time of cardiac surgery. Of the 73 patients with delirium, two experienced post-traumatic stress symptoms. This was a lower than expected figure compared with other studies looking at the effects of delirium in other patient groups. On exploring the actual experience of the participants, their realities were varied ranging from an inability to remember the episode/s of delirium to bewilderment and embarrassment when informed about it by their family and friends. There were also expressions of need to move on and focus on the aspects of physical recovery, which was seemingly more tangible than and not as abstract as delirium. Most participants felt reassured with the follow-up appointments arranged by the researcher. Moreover, despite the experiences during this time, none of the participants’ conveyed any regret at undergoing the operation.

In conclusion, this study confirmed the importance of age as a risk factor for delirium. Though 18% of patients experienced delirium, only two developed post-traumatic stress symptoms. This low figure contrasts with several other studies, however, this is an interesting finding that requires further enquiry. Comparison and analysis of delirium associated with cardiac surgery versus other surgery requiring intensive care unit care, and also the process of care in the researcher’s institution is an important area for consideration. It is possible that this process of care is beneficial in terms of overall delirium risk and also the psychological care of patients throughout their hospital stay. The researcher will use these findings to explore further how best to understand and disseminate best practice.
1 Chapter 1: Introduction

1.1 Thesis overview

The aims of the study were to identify the incidence, peri-operative risk factors and explore patient experiences with post-operative delirium and potential associated post-traumatic stress syndrome following cardiac surgery. The study population was patients undergoing either elective and/or urgent cardiac surgery in a large tertiary hospital in Scotland.

The first chapter introduces the reader to the background and context of post-operative delirium within the area of cardiac surgery and associated post-traumatic stress syndrome. Chapter 2 comprises a literature review specifically focusing on the pre-existing risk factors associated with post-operative delirium in the first section, and then cognitive and other mental health consequences of post-operative delirium in the next section. The following two chapters cover the research design and methods employed to undertake the study including ethical considerations. The next two chapters present the quantitative and qualitative findings elaborated with discussions about each. The final chapter draws the findings together acknowledging the strengths and limitations of the study, highlighting the clinical implications of the discovery, and recommending directions for future research.

1.1.1 Background

This chapter sets the stage for the thesis and explains the context of the study. It is divided into sections related to the origin of the study, incidence of the issue under study, audit data, qualitative associations and post-traumatic stress syndrome (PTSS).

1.1.2 Provenance

In Scotland, there are three centres, which provide adult cardiac surgery. These are regional centres, which administer services to a wide geographical area covering the North, West and South East regions of the country, performing an average of 1000 cardiac operations every year (NHS TOMCAT Data, 2019). Seventy percent of these patients are elective with patients attending a pre-admission clinic 2-3 weeks before their scheduled operation. It is a one-stop clinic, where patients are assessed for anaesthetic fitness including clinical investigations undertaken on the same day.
A further 25% of patients are admitted to the cardiology wards either in the same centre or in affiliated district general hospital following an acute cardiac event. These cohorts of patients are then referred and transferred to the relevant regional centre if appropriate as inpatients for urgent surgery. The remaining five percent of patients undergo an emergency procedure with limited time available for any kind of pre-operative preparation and/or optimisation before surgery. Additionally, due to the emergency nature of the need for surgery in this small subgroup of patients, the pre-operative team usually do not get the opportunity to meet with these patients before their operation. Therefore, this group of patients don’t get the same level of support and education in comparison to those undergoing elective or urgent cardiac surgery.

All patients following cardiac surgery, irrespective of the kind of operation or the nature of admission to hospital, stay in the (ICU) Intensive Care Unit after their surgery for at least 24 hours. During this period, these patients are under sedation, requiring ventilator support and are closely monitored until they are haemodynamically stable. The following day, if the patient is suitably recovered, they are transferred to the high dependency unit (HDU) or the post-operative surgical ward. The patient’s clinical progress on the ward is closely monitored by the ward Nurse Practitioner team until they are deemed fit for discharge home from the hospital. If required, some patients may be transferred to their local district general hospital for further in-patient non-surgical care. Generally, the patients are prepared with the expectation of an average seven-day post-operative hospital stay. During this period, the Nurse Practitioners are the thread of continuity for the patients and their families. They are closely involved in this patient journey from the initial surgical referral until discharge from the hospital and subsequent follow up. The Nurse Practitioners aim to make this patient experience as smooth as possible.

1.1.3 Incidence and context of post-operative delirium in cardiac surgery

Studies report that between 20-50% of patients undergoing cardiac surgery experience delirium in the days following the operation (NHS TOMCAT data, 2013; Kazmierski et al, 2006; Chang et al, 2008; Price, 2017). Delirium is a clinical syndrome of acute onset and fluctuating course (NICE guidelines, 2010). It is characterised by inattention and other cognitive deficits, with many patients also experiencing altered level of arousal, psychotic features (hallucinations and delusions), and mood changes (Table 1).
Delirium has historically been described using many terms including acute confusional state, acute confusion, acute-on-chronic confusion, acute encephalopathy, and post-operative psychosis. Recent recommendations state that the term delirium should be used to describe the ‘clinical state characterised by a combination of features defined by diagnostic systems such as the DSM-5. The term acute encephalopathy is to be used for ‘refers to a rapidly developing (for less than four weeks, but usually within hours to a few days) patho-biological process in the brain’. Acute encephalopathy refers to the brain processes that underlie delirium, however the term describes the clinical state. Acute encephalopathy can also lead to coma or sub-syndromal delirium, where there are some features of delirium but the full DSM-5 criteria are not fulfilled (Slooter et al, 2020).

Delirium can be classified as having three different subtypes based on the level of motor activity. In the 'hyperactive' form, patients can appear agitated, restless, confused and disorientated and often have psychotic features like delusions and hallucinations. In the 'hypoactive' form, patients may be drowsy and/or acutely withdrawn from their surroundings. Hypoactive patients can also have psychotic symptoms but they are more difficult to detect because the patient often produces little or no speech and may not respond to questions. In the third ‘mixed’ form, patients display a combination of both hypoactive and hyperactive delirium alongside each other, which, is referred to as 'mixed delirium'. The presence of delirium puts excessive, undesired strain on the patients, their families, health care providers and hospital resources (Seitz and Van 2006). Delirium is associated with considerable distress in patients and carers (Boehm et al, 2021).
### Table 1-I: Adapted from the Diagnostic and Statistical Manual of Mental Disorders, Fifth edition (DSM-5)

<table>
<thead>
<tr>
<th></th>
<th>Definition</th>
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<tbody>
<tr>
<td>A</td>
<td>A disturbance in attention (ie. reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).</td>
</tr>
<tr>
<td>B</td>
<td>The disturbance develops over a short period of time (usually hours to a few days), represents a change from baseline attention and awareness, and tends to fluctuate in severity during the course of the day.</td>
</tr>
<tr>
<td>C</td>
<td>An additional disturbance in cognition (eg., memory deficit, disorientation, language, visuospatial ability, or perception).</td>
</tr>
<tr>
<td>D</td>
<td>The disturbances in Criteria A and C are not explained by another pre-existing, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level of arousal, such as coma.</td>
</tr>
<tr>
<td>E</td>
<td>There is evidence from the history, physical examination, or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal (ie., due to a drug of abuse or to a medication), or exposure to a toxin, or is due to multiple etiologies.</td>
</tr>
<tr>
<td>F</td>
<td>A disturbance in attention (ie. reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).</td>
</tr>
<tr>
<td>G</td>
<td>The disturbance develops over a short period of time (usually hours to a few days), represents a change from baseline attention and awareness, and tends to fluctuate in severity during the course of the day.</td>
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<tr>
<td>H</td>
<td>An additional disturbance in cognition (eg., memory deficit, disorientation, language, visuospatial ability, or perception).</td>
</tr>
<tr>
<td>I</td>
<td>The disturbances in Criteria A and C are not explained by another pre-existing, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level of arousal, such as coma.</td>
</tr>
<tr>
<td>J</td>
<td>There is evidence from the history, physical examination, or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal (ie., due to a drug of abuse or to a medication), or exposure to a toxin, or is due to multiple etiologies.</td>
</tr>
</tbody>
</table>
1.1.4 Audit

A small scale audit was carried out in the researcher’s unit in order to measure the incidence of post-operative delirium. In the Cardiothoracic Intensive Care Unit in October 2012, over a three-week period, 42 patients were surveyed in an audit cycle. The review evaluated the appropriate diagnoses of delirium in the unit following surgery. Thirty three percent of the patients were found to be delirium positive (hypoactive/hyperactive). Unfortunately, none of these patients were recognised by the health care team to have delirium (data not published but presented at the cardiothoracic unit Mortality and Morbidity meeting in December 2012). This finding echoes many others which show that delirium is commonly under-detected in surgical and other settings (Wilson et al, 2020; Panitchote et al, 2015; Traynor et al, 2016).

An education programme was introduced in 2013, which included raising awareness of the high incidence of post-operative delirium and the use of delirium diagnostic and screening tools. Three months later, a second audit was carried out, and 40 ICU patients were included in this cycle. The results, following the education programme, showed a 90% increase in the recognition of delirium using CAM-ICU screening tool (Appendix 16), prompting early, appropriate clinical management. The audit and their findings stimulated the researcher’s interest in delirium and thus started the journey to understand and improve the scope in this particular area.

1.1.5 Supporting qualitative data

In the centre, where the researcher works as an Advanced Nurse Practitioner, traditionally patients are reviewed in the outpatient clinic six to eight weeks following cardiac surgery. Prior to commencing the present study, the focus of these clinics clearly was evaluating the patient’s physical recovery rather than any kind of psychological review. Anecdotally, the researcher and other practitioner colleagues had noted that on general enquiry some patients and relatives reported varied and unusual psychological problems after having cardiac surgery. Some of these anecdotal remarks are documented below in Section 1.1.6. These comments suggested that patients who have undergone cardiac surgery sometimes appear to have distressing memories, mood changes, some form of cognitive impairment or even a reflection of post-traumatic stress symptoms that continued to affect the patients after discharge. At least in some cases, these longer-term complications appeared to be linked with post-operative delirium. The researcher wanted to understand more about this aspect of the recovery process.
1.1.6 Post-Traumatic Stress Disorder and Post-Traumatic Stress Syndrome

Post-Traumatic Stress Disorder (PTSD) is an anxiety disorder caused by very stressful, frightening or distressing events. PTSD is known to either develop immediately after the disturbing event or weeks and months later. According to the American Psychiatric Association: DSM- 5 (2013), the actual symptoms of PTSD may be varied and are categorised in three sections: re-experiencing, avoidance/ emotional numbing and/or hyper arousal (feeling 'on edge’). For decades, there has been a link shown between violent or life-threatening events and related psycho-physiological debilitation including malingering, weakness, or genuine dysfunction (Lamprecht and Sack, 2002). The inclusion of the PTSD category in the DSM-III in 1980, led to an exponential increase in research and theory about clinically significant trauma reactions.

Wonder when my dad will get back to normal in his head

Wonder when my dad will get back to normal in his head

My husband has never been the same since the operation. I can hardly get him to come out of the house

Looks like along with a new heart, my mum has had a personality transplant.
Post-traumatic stress disorder (PTSD) is the term usually preferred once a clinician makes a diagnosis regarding a fully activated condition (Kilpatrick et al, 2013; American Psychiatric Association DSM IV). However, there is still sparse understanding in the clear-cut differences between the subgroups within the broad category of individuals not showing full PTSD. Some prospective studies have focused on individual differences in reactions following trauma (Bonanno and Kaltman, 2001). Although the DSM (Diagnostic and Statistical Manual of Mental Disorders) has not specified a unique category for acute or complicated reactions, the available research generally shows that chronic depression and distress occurs in 10% to 15% of traumatised individuals. (Zisook, et al, 1997: Bonanno and Field, 2001). Significant numbers of traumatised individuals display more time-limited disruptions in functioning (for example, cognitive disorganisation, dysphoria, health deficits, disrupted social and occupational functioning) lasting at least several months up to one or two years (Tucker et al, 2002).

‘Post-traumatic stress syndrome (PTSS) refers to symptoms that are experienced after a traumatic event, which may appear from up to three months after the event to some forty years or more after the trauma’


PTSS symptoms may also include the feeling of being numb and/or detached, having a flat affect, as well as a self-report of cognitive disconnection in the form of failure in optimum concentration and memory (Vance et al, 2018).

An interesting, population-based survey conducted one month after the 2001 terrorist attacks in New York City estimated that 7.5% of local residents would meet criteria for PTSD and that another 17.4% would meet the criteria for PTSS, manifested in high symptom levels that do not meet full diagnostic criteria (Galea, et al, 2002). However, the study discovered another significant finding that most participants showed a rapid decline in symptoms over time. PTSD prevalence related to 9/11 dropped to only 1.7% at four months and 0.6% at six months, whereas PTSS dropped to 4.0% and 4.7%, respectively, at these times (Galea et al, 2003).
It has been recognised that being a critically ill patient in the ICU can by itself be traumatic for both patients and their families (Cypress, 2013). However, symptoms may resolve or become transient before an official diagnosis of PTSD is made (Jackson et al, 2014). This may be because symptoms associated with PTSS usually do not persist for more than one month following the initial trauma (Sparks, 2018). Another reason could be due to the under-representation of PTSS as it does not fully meet the criteria for PTSD, which is diagnosed when symptoms persist for at least one month and causes distress or dysfunction (Warlan, Howland and Connelly, 2016).

During the process of literature search, the researcher recognised that there was far less focus on the condition of “PTSS,” in general compared to “PTSD”. The most common explanation for this in trauma literature is that most patients with PTSS exhibit the symptoms of PTSD but do not meet the full criteria for the diagnosis of PTSD (Sparks, 2018). However, due to the difference in the diagnostic criteria, that is, the full diagnosis of PTSD cannot be made until 30 days after exposure to the trauma-causing event; patients who exhibit signs of PTSS may not be recognised as being at risk for developing PTSD. This can be perceived as a major challenge in managing these patients if there is a delay in recognising and appropriately diagnosing merely due to the technicalities in use of terminology. People with PTSS may progress to PTSD, however both PTSS and PTSD associated conditions may be prevented if the symptoms are identified early (Warlan, Howland and Connelly, 2016). Therefore, it is imperative, especially if early recognition of PTSS can improve the long-term psychological outcomes of patients who have known to be exposed to traumatic events, to begin interventions as early as possible.

An issue that has such an impact on any patient and their loved ones was worth investigating and understanding to improve the care provided. Being in such an unique professional position, as a Nurse Practitioner the researcher was ideally placed to conduct this study where the focus is on the pre-operative risk factors contributing to delirium, actual incidence of delirium and post-operatively following the patients to evaluate the potential after effects of delirium in the form of post-traumatic stress syndrome.
1.2 Summary

This chapter has introduced the reader to the wider context of post-operative delirium, including its incidence and risk factors in cardiac surgery cohort. The section also gives a flavour of the qualitative view associated to the data and an overview of the lesser known psychiatric after effects of delirium such as PTSS. This chapter then concluded with a brief discussion around the professional role of the researcher and the need for this research to increase awareness in this area and ultimately supporting the need to provide holistic care to the patients in their care.
2 CHAPTER 2: LITERATURE REVIEW

In this chapter, the researcher aims to review literature related to delirium, its association to cardiac surgery and specifically the cognitive and other mental health consequences following surgery including post-traumatic stress syndrome (PTSS). The researcher explains the process of the literature search including the databases and search terms used for this study. Additionally, the researcher details the course of action in evaluating the quality of the studies, and the criteria used for inclusion and exclusion of the shortlisted studies.

The literature review began in 2013-14 and has been updated with new sources added throughout subsequent years, as the subject of delirium became more topical, and an increased awareness of the topic area led to an expansion of the literature. Around the same time, the researcher was also invited to join the SIGN (Scottish Intercollegiate Guideline Network) committee contributing to the development of "SIGN157 - Risk reduction and management of delirium" (SIGN 2019). This commitment increased the researcher's engagement with delirium related literature and critical analysis of the data. This PhD was undertaken on a part–time basis over a period of eight years (2+ due to the Covid-19 pandemic). During the writing-up of the thesis, the researcher recognises the age of some of the literature reviewed and included in the study. To counteract it, the final discussion chapter includes more up- to- date literature to reasonably and relevantly argue the debate.

2.1 Introduction

Delirium is an acute neuropsychiatric syndrome characterised by rapid onset (typically hours to days) and fluctuating course of deterioration in mental functioning (DSM 5, 2013; Wilson et al, 2020). The hallmark of delirium is inattention, however other abnormalities are commonly observed including altered level of arousal, delusions, hallucinations, anxiety and depressed mood.

Delirium is common and poses major diagnostic and management challenges in clinical practice. The recorded incidence of delirium following cardiac surgery ranged from 13.5% to 41.7% in one study (Koster et al, 2011). Delirium is triggered by multiple precipitating factors including acute illness and surgery, and is frequently present in hospitalised patients (Wilson et al, 2020; Leslie and Inouye, 2011; Partridge et al, 2013).
The predisposing and precipitating risk factors are found to be variable especially in different settings (Neufeld and Thomas, 2013), suggesting that there are multiple potential mechanisms underlying delirium.

Pre-operative risk factors for delirium in cardiac surgery patients include increasing age and chronic predisposing causes such as vascular disease. These factors may interact with accumulative peri-operative precipitating surgical risk factors. There have been several review papers confirming the variability of factors triggering delirium in hospitalised patients (Table 2-2). For the purposes of the present study, the researcher aspired to cover the whole spectrum and the entire patient journey affected by delirium. To support this, the researcher has attempted to explain this through the literature review process.

Post-operative delirium (POD) has been studied at acute and sub-acute time courses ranging from post-operative day 0 –1 to as many as 5–30 days after surgery (Hernandez et al, 2017). Peri-operative risk factor studies have also been undertaken in cardiac surgery patients (Kazmierski et al, 2006; Rudolph et al, 2009; Koster et al, 2011; Bakker et al, 2012; Guenther et al, 2013). Yet most of the studies have focused on physiological factors and not psychological factors in the context of cardiac surgery. For any research to be fully justified, including literature reviews, the research questions must address what is important to patients (Pollock and Berge, 2018). There is also a relative lack of data on the cognitive outcomes of post-operative delirium and the actual patient experience.

This literature review addresses the following research questions:
- What are the peri-operative risk factors contributing to delirium following cardiac surgery?
- Is there an association between post-operative delirium, and other mental health outcomes such as PTSS?
- What is the experience of cardiac surgery patients affected by post-operative delirium?
2.2 Methods

2.2.1. Eligibility Criteria

Peer reviewed studies were considered eligible for the present review if published between years 1965-2015 and meeting the criteria set out in Box 1. The researcher continued these search criteria throughout the thesis to add literature that is more recent.

Box 1: Scope of Literature Review

<table>
<thead>
<tr>
<th>Eligibility Criteria for study selection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion for consideration:</td>
</tr>
<tr>
<td>- The sample population was over 18 years of age</td>
</tr>
<tr>
<td>- Written in English</td>
</tr>
<tr>
<td>- Included post-operative cognitive changes following cardiac surgery</td>
</tr>
<tr>
<td>- Assessed short and long term neuropsychological changes affected by delirium</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exclusion for study selection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Case reports</td>
</tr>
<tr>
<td>- Articles with no primary data that is.: reviews, editorials, abstracts etc.</td>
</tr>
</tbody>
</table>

Search strategy

The researcher identified sources for this literature review through electronic databases including CINAHL, Medline, PsychINFO and the online search engines PubMed, DiscoverEd and Google Scholar. There was date restriction from 1965-2015 initially applied when searching the literature and only sources written in English language were selected. Search terms used were Delirium, Confusion, Cardiac, Operation, Intensive Care Unit, Cognition, Post-traumatic Stress, Anxiety, Depression, and Mental Health (Box 2). These terms were used in various combinations in the MeSH format including ‘Or’ and additional sources were identified through reference lists of retrieved articles. Articles were mainly inputted through the links provided on the electronic databases and search engines. Some papers were downloaded from Wiley Online Library and Science Direct. Some were requested from the Edinburgh Interlibrary Loan Service.
Box 2: Search terms

- ‘adult’, ‘aged’
- ‘cardiac surgery’, ‘cardiotomy’, ‘cardio pulmonary bypass’
- ‘risk factors’, ‘predictors’, ‘surgical risk’
- ‘Nursing’

MeSH:
- ‘aged’, ‘human’ AND
- ‘delirium’, ‘post-traumatic stress symptoms’ AND
- ‘cardiac surgical procedures’, ‘post-operative risk factors’ NOT
- ‘intensive care unit’

Search Results

Figure 2-1 shows the PRISMA flow diagram of the searched articles.

The search yielded 628 articles, of these 524 articles were excluded after title and/or abstract review, as they did not fit the inclusion criteria. The remaining 104 records were screened and 29 duplicate records were removed. The 75 articles carried over were assessed for eligibility by reading the full text articles and a further 31 studies were excluded. On closer reading, they did not meet the inclusion criteria, some were the wrong age groups and not addressing cognitive and mental health issues that this study wanted to focus on. In the final 44 studies shown in the Figure 2-1 below, 30 were included in the quantitative and 14 in the qualitative synthesis.
2.3 Data synthesis and methodological quality assessment

The resulting papers were carefully reviewed using the Critical Appraisal Skills Program (CASP) checklist (CASP 2013). Each selected study was reviewed with descriptive summaries attached to the literature in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines that supported evaluation of the quality of the studies (Page et al, 2021). The methodological quality of selected studies was examined using Strengthening the Reporting of Observational Studies in Epidemiology (STROBE, 2014) statement. Each item was scored one point, with the maximum score being 22. The STROBE statement is not an evaluation tool to assess the quality of publication but a checklist recommending what should be reported and specifies the part of the intended publication. The researcher applied the STROBE guidelines to add to the critical analysis element to the review.

The characteristics of the included articles are presented in Tables 2-1, 2-2, 2-3, 2-4 and 2.5. Data presented includes the study design and settings and the actual data collection years and timelines. Tables 2-2, 2-3 and 2-4 explain the sample size and population with the delirium. The Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines (STROBE, 2014) were used to score the studies in Tables 2-2, 2-3 and 2-4.

The researcher is aware that the checklist cannot assure the quality of the studies, however use of such scores has utility in providing a standardised framework for review and appraisal (Vandenbroucke et al, 2007). Weak or unsatisfactory reporting of studies affects the overall quality of the research evaluation process leading to misinterpretation of the strengths and weakness. STROBE, developed by a group of methodologists, researchers and editors, recognises the factual evidence along with theoretical scrutiny. This ensures the quality and helps generalise the reported findings. Table 2-2, 2-3 and 2-4 report on the study setting and examines the resulting themes of the qualitative studies. The researcher used the Critical Appraisal Skills Program – CASP checklist (2013) to review the studies for quality, relevance and scientific rigor (Baillie, Sills and Thomas, 2016).

In summary, the following tables explain the different dimensions of this study literature review. Table 2-1 includes thirteen studies examining systematic review papers on delirium. Table 2-2 adds ten studies on delirium in cardiac surgery patients. The eleven studies in Table 2-3 encompass the peri-operative risk factors in delirium following cardiac surgery.
Table 2-4 comprises of four studies focusing on short and long-term cognitive outcomes associated with delirium following cardiac surgery. The final Table 2-5 incorporates six qualitative studies examining the delirium experience.
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Design of the study</th>
<th>No of studies</th>
<th>Topic</th>
<th>Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koster et al (2011)</td>
<td>Literature Review 1999-2009</td>
<td>10</td>
<td>Risk factors of delirium after cardiac surgery.</td>
<td>PubMed, Cinahl, and Cochrane Library databases and was limited to the last 10 years</td>
<td>Identified 27 risk factors including 12 predisposing (for example age, peripheral vascular disease, depression, stroke, atrial fibrillation, cognitive impairment) and 15 precipitating risk factors (for example red cell transfusion, low albumin, low cardiac output states) contributing to post cardiac surgery delirium and suggested using a multifactorial model to identify patients at risk.</td>
</tr>
<tr>
<td>Van Der Mast and Roest (1996)</td>
<td>Systematic Review '64 -'82 &amp; '65-'82</td>
<td>16 Prospective 3</td>
<td>Delirium after cardiac surgery: A critical review.</td>
<td>Re-examination of a previous review (Smith andDimsdale, 1989).</td>
<td>Identified the vast variation in the operational diagnosis of delirium and heterogeneous sample population therefore results were not proportionate.</td>
</tr>
<tr>
<td>Kiekkas et al (2010)</td>
<td>Systematic Review 1990-2009</td>
<td>10 Med and Surgical ICU admissions</td>
<td>Psychological distress and delusional memories after critical care.</td>
<td>CINAHL, PubMed, Web of Science and PsycInfo (1990 – 2009).</td>
<td>Recall of delusional memories at various intervals after ICU discharge was associated with PTSD-related symptoms in many studies, while associations with other aspects of psychological distress were also reported, mainly feelings of fear, anxiety and depression.</td>
</tr>
<tr>
<td>Reference</td>
<td>Type</td>
<td>Publication Period</td>
<td>Number</td>
<td>Topic</td>
<td>Methods</td>
</tr>
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<tr>
<td>Zhang et al (2013)</td>
<td>Meta-analysis of clinical observational studies up to August 2012</td>
<td>16 Studies N=5891</td>
<td>Topic: Impact of delirium on clinical outcomes in critically ill: a meta-analysis.</td>
<td>Methods: Medline, Embase, OVID &amp; EBSCO from inception to May 2012.</td>
<td>Results: Delirious patients had higher mortality – odds ratio [OR]: 3.22; 95%: [95% CI]: 2.30-4.52. Significant number of patients’ required residential placements OR; 2.59; 95% CI: 1.59-4.21. Most patients had longer length of stay in the hospital - mean difference: 7.32 days; 95% CI: 4.63–10.01) and spent more time on ventilator and ICU (Mean Difference: 7.22 days; 95% CI: 5.15–9.29).</td>
</tr>
<tr>
<td>Partridge et al (2013)</td>
<td>Literature review</td>
<td>1980-2011</td>
<td>ICU, Surgery &amp; Hospice settings General ITU &amp; Surgical patients</td>
<td>Topic: The delirium experience: effect on patients relatives and staff.</td>
<td>Methods: Review of Ovid, MEDLINE, Embase, PsychINFO, British Nursing Index &amp; PubMed Synthesis draws on qualitative &amp; quantitative literature.</td>
</tr>
<tr>
<td>Gosselt et al (2015)</td>
<td>Systematic Review</td>
<td>1990-2015</td>
<td>34 articles</td>
<td>Topic: Risk factors for delirium after on pump cardiac surgery.</td>
<td>Method: A review of EMBASE, CINAHL, MEDLINE &amp; Cochrane.</td>
</tr>
<tr>
<td>Author, Year,</td>
<td>Study method</td>
<td>Sample population</td>
<td>Sample size and delirium incidence</td>
<td>STROBE Score</td>
<td>Tools used for delirium diagnoses &amp; health care staff category/categories making the diagnoses</td>
</tr>
<tr>
<td>--------------</td>
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<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Chang et al. (2008)</td>
<td>Retrospective Chart Review</td>
<td>All patients underwent open cardiac surgery</td>
<td>N=288 41.7%</td>
<td>18</td>
<td>Assessed by psychiatrists using DSM (Diagnostic &amp; Statistical Manual) - IV criteria</td>
</tr>
<tr>
<td>Kazmierski et al. (2010)</td>
<td>Prospective cohort study</td>
<td>All cardiac surgery excluding patients with pre-op dementia</td>
<td>N=260 11.5%</td>
<td>20</td>
<td>Assessed by two psychiatrists using DSM (Diagnostic &amp; Statistical Manual) IV criteria</td>
</tr>
<tr>
<td>Norkiene et al (2007)</td>
<td>Prospective &amp; Retrospective cohort study</td>
<td>On pump CABG</td>
<td>N=1367 3.1%</td>
<td>18</td>
<td>Assessed by intensivist using DSM (Diagnostic &amp; Statistical Manual) IV criteria</td>
</tr>
<tr>
<td>Rudolph et al. (2009)</td>
<td>Prospective cohort study</td>
<td>All cardiac surgery patients over 60Y of age</td>
<td>N=122 52%</td>
<td>22</td>
<td>Assessed by trained non-clinician interviewers using Confusion Assessment Method</td>
</tr>
<tr>
<td>Rolfson et al (1999)</td>
<td>Prospective cohort study</td>
<td>Elective CABG</td>
<td>N=75 32%</td>
<td>18</td>
<td>Assessment made by study physician using DSM (Diagnostic &amp; Statistical Manual) -III-R criteria</td>
</tr>
<tr>
<td>Tan et al (2008)</td>
<td>Prospective observational study</td>
<td>Elective cardiac surgery</td>
<td>N=53 23%</td>
<td>19</td>
<td>Assessment made using Confusion Assessment Method (CAM) and DSM (Diagnostic &amp; Statistical Manual) IV criteria</td>
</tr>
<tr>
<td>Veliz-reissmüller et al (2007)</td>
<td>Prospective cohort study</td>
<td>Elective &gt;60Y without history of dementia</td>
<td>N=107 23.4%</td>
<td>22</td>
<td>Assessment made using Confusion Assessment Method (CAM)</td>
</tr>
<tr>
<td>Naber and Bullinger (1985)</td>
<td>Prospective cohort study</td>
<td>18-65 undergoing elective or urgent open heart surgery</td>
<td>N=23 64%</td>
<td>17</td>
<td>Assessment made using STAI (State Anxiety), POMS (Profile of Mood States and VAS (Visual Analogue Scale) Study included assessing personality factors &amp; other psycho-social characteristics like coping, self-control, social support</td>
</tr>
</tbody>
</table>
Table 2-3 Studies on factors associated with delirium following cardiac surgery

<table>
<thead>
<tr>
<th>Author Year</th>
<th>Study method</th>
<th>Sample size and incidence</th>
<th>STROBE Score</th>
<th>Significant Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afonso et al (2010)</td>
<td>Prospective observational analysis</td>
<td>N=112 34%</td>
<td>21</td>
<td>Increased age and duration of surgery were found to be the independent risk factors</td>
</tr>
<tr>
<td>Bucerius et al 2004 (Included in table above)</td>
<td>Prospective analysis</td>
<td>N=16,184 8.4%</td>
<td>21</td>
<td>Stroke, peripheral vascular disease, atrial fibrillation, diabetes mellitus, left ventricular ejection fraction&lt;30%, urgent operation, intra-operative dialysis, increased length of operation, red cell transfusion influenced higher incidence of delirium. Off pump, surgery and younger patients showed reduced incidence of delirium.</td>
</tr>
<tr>
<td>Burkhard et al. (2010)</td>
<td>Post hoc analysis from RCT</td>
<td>N=113 30%</td>
<td>18</td>
<td>Longer duration of mechanical ventilation, raised C-Reactive Protein in blood and increased use of fentanyl were independently associated with delirium</td>
</tr>
<tr>
<td>Detroyer et al. (2008)</td>
<td>Prospective design</td>
<td>N=104 26%</td>
<td>22</td>
<td>Prolonged intubation &amp; low intraoperative body temperature. No association noted between pre-operative anxiety states &amp; severity of delirium</td>
</tr>
<tr>
<td>Kazmiersk et al 2006</td>
<td>Prospective study</td>
<td>N=260 11.5%</td>
<td>18</td>
<td>Cognitive impairment, atrial fibrillation, peripheral vascular disease, major depression and older age were associated with increased incidence of delirium.</td>
</tr>
<tr>
<td>Mu et al (2010)</td>
<td>Prospective cohort study</td>
<td>N=243 50.6%</td>
<td>20</td>
<td>Raised serum cortisol levels were associated with increased risk of delirium. Other independent factors were Age, Diabetes Mellitus and prolonged duration of operation.</td>
</tr>
<tr>
<td>Sabol et al (2015)</td>
<td>Prospective observational study</td>
<td>N=250 20.8%</td>
<td>18</td>
<td>Increased age, higher EuroSCORE II and longer Cardio Pulmonary Bypass times predicted post-operative delirium</td>
</tr>
<tr>
<td>Smulter et al 2013</td>
<td>Prospective study</td>
<td>N=142 54.9%</td>
<td>22</td>
<td>Age, diabetes mellitus, volume overload and sodium concentration noted to be risk factors.</td>
</tr>
<tr>
<td>Tully et al (2010)</td>
<td>Prospective study</td>
<td>N=158 31%</td>
<td>22</td>
<td>Showed link between pre-operative affective disorders &amp; Type D personality to post-operative delirium</td>
</tr>
<tr>
<td>Van Der Mast et al, 1999</td>
<td>Prospective study</td>
<td>N=296 13.5%</td>
<td>20</td>
<td>Old age, low albumin level and use of nifedipine associated to delirium in elderly patients</td>
</tr>
<tr>
<td>Koster et al 2008</td>
<td>Observational study</td>
<td>N=112 21%</td>
<td>20</td>
<td>Electrolyte disturbances and raised EuroSCORE (cardiac operative risk score) were linked with risk of developing post-operative delirium</td>
</tr>
<tr>
<td>Author Year</td>
<td>Study method</td>
<td>Sample Size and Population</td>
<td>Delirium Incidence</td>
<td>Follow Up Timeline</td>
</tr>
<tr>
<td>------------------</td>
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<td>-----------------------------</td>
<td>--------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Hudetz et al (2009)</td>
<td>Observational cohort study</td>
<td>N=56 Surgical N=28 Medical</td>
<td>16% in the surgical cohort</td>
<td>One week after Cardiac surgery</td>
</tr>
<tr>
<td>Loponen et al (2008)</td>
<td>Retrospective analysis</td>
<td>N=302 36m post CABG follow up</td>
<td>6%</td>
<td>36 months post CABG follow up</td>
</tr>
</tbody>
</table>
| Rothenhäusler (2005) | Prospective study | N=30 1Y FU post on pump cardiac surgery | 37%                | 12 months post on pump cardiac surgery | 21           | **Short Term**: Adjustment disorder, depression, post-traumatic stress disorder & cognitive deficits  
**Long Term**: Reduced anxiety & depression leading to improved Health Related Quality of Life (HRQoL), but 20% of patients with cognitive decline showed impaired HRQoL                                      |
<p>| Van den Boogaard et al (2012) | Prospective study | N=1292 18m follow up post ICU delirium | 27%                | 18months follow up post ICU delirium | 22           | Duration of ICU delirium was associated to longer term cognitive problems                                                                                                                                       |</p>
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Study Design</th>
<th>Study setting</th>
<th>Sample size</th>
<th>Results</th>
</tr>
</thead>
</table>
| Van Rompaey et al 2016 | Targeted interviews | 48H post delirium Gen Medical and Surgical ICU | N = 30 | Themes: Contact and Communication  
Feelings: Time implication of the delirious episode |
| Svenningsen et al 2014 | Observational Multicentre design | Recruited consecutive ICU patients | N=360 Delirium incidence 60% | Delirious patients had fewer factual memories & more delusions up to 6 months post ICU affecting their Health Related Quality of Life. |
| Laitinen, 1996        | Phenomenological enquiry | Post CABG ICU patients | N = 10 | Felt anxiety while on threshold of awareness & unawareness, ICU environment threatened a vicious circle of confusion. Known faces helped to feel safe |
| Bélanger and Ducharme 2011 | Qualitative review | 68 articles | 1990 to 2010 | Themes: Incomprehension & feelings of discomfort.  
Need to keep one’s distance & protect one-self.  
Interventions that diminish suffering |
| Lingehall et al 2015  | Qualitative interviews | Post Cardiac Surgery delirium – 12m Follow up | N = 49 ( =/>70Y) | Themes: Feeling drained, Feeling trapped, Feeling disrespected, Feeling safe. |
| Roberts et al 2006    | Observation study | 24 months, post ICU discharge Follow Up | N=41 Incidence 43% | Increased prevalence of recalling dreams which co-related to length of stay |
2.4 Findings of Literature Review

This section discusses the findings derived from the review of literature search and its relevance in developing the framework of this study. It is divided into various sub-sections beginning with the incidence of delirium and its impact on cardiac surgery patients. The researcher then focuses on the peri-operative risk factors contributing to delirium followed by an analysis of the two factors reported to have significant impact on post-operative delirium - age and intensive care unit stay. The final three sections cover the cognitive and psychological consequences of delirium following cardiac surgery finishing with an important section that includes the qualitative perspective of patients from various clinical backgrounds and set up, affected by delirium.

Delirium is a common and serious complication of cardiac surgery. A landmark review on delirium in postoperative cardiac patients undertaken by Sockalingam et al (2005) highlighted the average incidence of delirium to be around 38%. Delirium is linked with an increase in hospital length of stay resulting in additional demands on hospital resources (Inouye, Westendorp and Saczynski, 2014). McKhann et al (2002) carried out one of the largest studies, reporting a significant incidence of post-operative delirium in cardiac surgery. This study recruited a large number (n=2711) of post-operative patients to identify encephalopathic changes related to cardiac surgery. Encephalopathy in this study was classified as acute confusion and unexplained transient behaviour (that is, delirium). The incidence of encephalopathy showed in the study was a modest 6.9%. However, they also demonstrated the association between post-operative delirium, a longer length of stay in hospital and increased mortality. The authors demonstrated that delirium has a similar burden on hospital resources as a neurological event like stroke. Supporting studies by Ely et al (2001) and Franco et al (2001) confirm the high demands that post cardiac surgery delirium makes on hospital resources.

2.4.1 Incidence of Delirium

Approximately 11-25% of hospitalised older patients will have delirium (Levkoff et al, 1992; Pompei et al, 1995; O'Keeffe, 1997; Inouye, 1998; Pitkala et al, 2005). An additional 29-31% of hospitalised older patients admitted without delirium will develop incident delirium (McCusker et al, 2003). Zenilman (2017) highlighted the serious effect of post-operative delirium.
One of the earliest systematic reviews on this subject published by Naber et al (1990) showed that depending on patient population, type of operation and diagnostic criteria, the overall incidence of psychopathological complications like delirium varies between 10-50% (Table 2-1). Over the decades, surgical techniques have gradually evolved. Cardiac surgical operative cohort now includes much older people with complex co-morbidities requiring longer intra-operative times, along with increased anaesthetic and pharmacological agents. These peri-operative interlinking factors are known to trigger post-operative complications including delirium (Sadler, 1981; Bucerius et al, 2004; Amador and Goodwin, 2005). A recent publication by Järvelä et al (2018) reports a delirium incidence of 11% in post-operative cardiac surgery patients. However, the researcher recognises this study as having undertaken only on two sites and the incidence varied between them (8% and 15%). Data collection also depended on the presence of nurses on duty that were trained to use the delirium assessment tool, which may have introduced bias to the sample.

On average, patients undergoing open-heart surgery are at a 38% risk of developing post-operative delirium (Sockalingam et al, 2005; Koster et al, 2008). The initial association of delirium and cardiac surgery in the form of post-operative psychological disturbances was first published as early as the 1950s (Blachy and Starr, 1964; Fox, Rizzo and Gifford, 1954; Gilman, 1965). This 'neuropsychological' event has since been refined, expressed and explained in a few more studies using varying terminology ranging from 'Post Cardiotomy Syndrome' until more recently with the term 'Delirium' (Dubin, Field and Gastfriend, 1979; Farrimond, 1984; Van der Mast et al, 1999; Rudolph et al, 2009; Magnuson, 2019). These studies, which are almost decades apart, continue to highlight the significant impact of delirium following cardiac surgery. It is apparent from reviewing related literature that this phenomenon has been historically recognised as a significant post-operative issue in the literature and continues to remain a common and serious problem to this day.

Even though there are differences in the epidemiology of different admissions, there are vital common considerations regardless of the environment and settings. However, the reviews undertaken by (Sockalingam et al 2005; Koster et al, 2011) show that a feature of cardiac surgery patients is that they are particularly vulnerable as a group, as they more commonly have the predisposing factors that have been shown to contribute to delirium.
Additionally, in the peri-operative period following cardiac surgery, the patient's internal physiology and biochemistry often becomes markedly disrupted and this can precipitate delirium. The researcher therefore reviewed literature regarding delirium in various settings and drew comparisons with post-operative cardiac surgery delirium.

2.4.2 Impact of delirium in patients undergoing cardiac surgery

The risk of delirium is clearly high following cardiac surgery. The reported incidence varies from 3\% to 53\% (Norkiene et al, 2007; Rudolph et al, 2009). In addition, undergoing cardiac operation as an emergency or urgently places a patient at higher risk of developing post-operative delirium (Koster et al, 2008).

There are important advances in anaesthetic and surgical techniques in the last two decades that have reduced the operative and ventilation times for cardiac surgery. A report published by Morandi et al (2013) noted that the percentage of patients undergoing isolated coronary artery bypass surgery had fallen by a quarter, however the number of heart valve operations have increased over the same period along with multiple other complex procedures. Furthermore, the same report stated that there is a clearly observed trend towards a much older population with the mean age of patients increasing by more than 3 years over the 15-year period and the proportion of octogenarians undergoing cardiac surgery is rising 10-fold.

Today older patients (WHO definition of Elderly, 2016) with a chronological age of 65 years or more with reversible cardiac disease are frequently offered surgery to improve their deteriorating quality of life. Yet, undertaking surgery in older age groups brings with it a higher risk of delirium (Yildizeli et al, 2005). There is also increased mortality associated with the delirium (Amador and Goodwin, 2005). Gottesman et al (2010) showed that delirium was strongly associated with increased mortality up to 10 years after surgery. Delirium is also linked with increased risk of hospital stay (Bucerius et al, 2004) and higher risk of the need for residential care following discharge (Inouye et al, 1999).

An important review undertaken in this area by Koster et al (2011) highlighted 27 risk factors that may be contributing to post-operative delirium in patients who underwent cardiac surgery. Of these, twelve were categorised as predisposing and fifteen as precipitating factors.
Predisposing factors are those which present before the onset of delirium (for example age, gender, pre-existing dementia). On the other hand, precipitating factors tend towards triggering an episode of delirium (for example electrolyte or metabolic disturbance). In general, the more predisposing factors a patient presents with prior to cardiac surgery, the fewer precipitating factors are needed for the development of a delirium (Marcantonio, 2017). The main recommendation from the study was application of a multi-factorial model to help reduce post-operative delirium. The suggestion is that multiple patient factors must be considered together to help predict delirium. A multi-factorial model could help with targeting better care to patients identified at the highest risk of post-operative delirium.

2.4.3 Pre-operative risk factors contributing to post-operative delirium

The incidence of post-operative delirium reported in literature appears to be strongly determined by the extent of the surgical insult, co-morbidities and sedative and/or analgesic drug exposure (Vasilevskis et al, 2012). Yet in cardiac surgery as well as being exposed to cardio pulmonary bypass pump and ventilation, there are other iatrogenic factors such as anaesthesia, emboli, hypotension, inflammation and other associated clinical sequelae amalgamated with Intensive Care Unit stay. These factors increase the risk of developing post-operative delirium in cardiac surgery patients (Rudolph et al, 2009; Koster et al, 2011; Gosselt et al, 2015). Consequently, there is an array of diverse risk factor prediction models as highlighted in Table 2-2.

The systematic reviews highlighted that predisposing risk factors such as ‘depression’ or ‘cognitive impairment’ were not well defined. Additionally, there were large variations in assessment tools and personnel performing the assessments within each study. However, these studies laid the path for the next significant review in the area undertaken by Gosselt et al (2015). They undertook the most recent systematic review analysing the risk factors for delirium after on-pump cardiac surgery. They demonstrated that out of many of the probable risk factors contributing to post-operative delirium, only eleven present with strong to moderate level of evidence.

It is a robust review paper, wherein the authors added randomised controlled trials in conjunction with cohort studies requiring multivariable approach to data analysis. Age, type of
operation, previous psychiatric conditions, cerebrovascular disease, pre-existent cognitive impairment, peri-operative blood product transfusion, use of antipsychotic drugs, post-operative atrial fibrillation and ventilation times were the factors highlighted in this review. Renal impairment and post-operative oxygen saturations were promoted as delirium risk factors by a moderate level of evidence, however there was no evidence that gender, education, duration of cardio pulmonary bypass, pre-existent heart disease or heart failure are prominent risk factors. The review (Gosselt et al, 2015) made an obvious choice to make their study more selective to be able to make specific comments about an on-pump population and the authors validated this selection by justifying increased homogeneity of the sample.

There are other relatively smaller studies on pre-operative predictors for delirium in cardiac surgery. Van der Mast et al (1999) studied 296 patients and suggested that pre-operative physical conditions (old age, low level of albumin, use of a drug like nifedipine) and amino acid disturbances may be associated with delirium after cardiac surgery in elderly patients. Almost a decade later, another study by Kazmierski et al (2006) found that independent factors such as cognitive impairment, atrial fibrillation, peripheral vascular disease, major depression and progressive age were major factors in predicting delirium. Koster et al (2008) created a 'Delirium after cardiac surgery - Predictive risk checklist'. This checklist was based on electrolyte disturbances and on EuroSCORE (European System for Cardiac Operative Risk Evaluation). This risk score encompasses multiple other factors including age and gender. The specificity for identifying the risk factors for getting delirium using this checklist was 95.5%. The sample size for this checklist was relatively small (n=112). Given the small sample size, the results may not be generalisable. The authors of this study have also suggested testing this checklist model on a completely different data set to provide external validation.

Noimark (2009), in an interesting review of publications between 1980 and 2008, distinctly summarised the risks of post-operative delirium emphasising three principal variables. Firstly, the speedy onset of the episode or trauma, where the patient is unable to prepare psychologically or be physically optimised for the event (Galanakis et al, 2001; Kalisvaart et al, 2005). Therefore, emergency surgical and unplanned intensive care unit patients were shown to be at greater risk of developing delirium. The second variable was rigor of the event, which includes the length, as well as the complexity of the impact (Böhner et al, 2003; Litaker et al, 2001). This variable places cardiac surgery patients at higher risk compared to other operations (Norkiene et al, 2007). The last and the most important variable highlighted is the
patient. Within this variable, Niomark explains that there are crucial sub-categories that influence the patient’s prospects of developing post-operative delirium. The most influential one in this category is age of the patient at the time of the event.

In the present study, the researcher collected data on the peri-operative, pre-disposing and precipitating risk factors known to trigger post-operative delirium in patients undergoing cardiac surgery.

2.4.4 Impact of delirium in older patients undergoing cardiac surgery

Robinson and Eiseman (2008) showed that post-operative delirium is a common complication of major surgery in older patients. The incidence of delirium in older people undergoing cardiovascular surgery is significantly higher than in younger people with rates of between 30-50% (Tan et al, 2008; Burkhart et al, 2010). Undiagnosed delirium is also a significant problem in older people (Inouye et al, 2014; Zenilman, 2017).

There are nearly 12 million people aged 65 and above in the UK (ONS, 2018 f, e). As life expectancy has increased, time spent in poor health has also increased (ONS, 2018k). There is an increased prevalence of conditions such as cardiovascular disease in this age group (Ewbank et al, 2018). With an overall ageing population and rising numbers of cardiac procedures in older patients, associated delirium is not only a serious clinical problem with short and long-term consequences, but also an epidemiological issue with critical psychosocial repercussions.

There are several studies included in a review looking at the effect of increasing age and the predictability of post-operative delirium (POD) (Marcantonio et al, 1994; Norkiene et al, 2007). Other notable patient factors are cognitive impairment (Bickel et al, 2004; Benoit et al, 2005), depression (Leung et al, 2005), male sex (Fisher and Flowerdew, 1995), smoking (Rudolph et al, 2007), and alcohol and drug use (Kudoh et al, 2004; Redelmeier et al, 2008). Guenther et al (2013) attempted to differentiate between precipitating and pre-disposing factors but found the multifactorial nature of the phenomenon of delirium in cardiac surgery challenging for clear extrication. The patient’s functional status (Goldenberg et al, 2006) and frailty (Dasgupta et al, 2009) are additional parts of this equation that influences a patient’s risk of developing post-operative delirium.
2.4.5 Impact of Intensive Care Unit (ICU) stay on delirium following cardiac surgery

Amongst all the factors that can affect a cardiac surgery patient getting post-operative delirium, ICU stay is a modifiable risk factor (McPherson et al, 2013). Better understanding can aid in reducing such a prominent risk. Most cardiac surgery patients routinely spend a minimum of 8-10 hours in the ICU. During their ICU stay, patients usually require mechanical ventilation that can continue for at least two hours after transferring out of the operating theatre. Some patients remain on a ventilator longer, sometimes extending to several days until they become hemodynamically stable. This kind of treatment requires that patients remain in the ICU. Therefore, the researcher focused on literature related to delirium and ICU.

The incidence of delirium is so high in ICU that leading researchers have rightly proposed that mental status be included as the '6th vital sign' (Flaherty et al, 2007). More than a decade later, this is at the threshold of being accepted in current practice clinical medicine (Mohammed et al, 2019). The prevalence of delirium in the ICU has been reported as being between 20-80% (Bergeron et al, 2001; Ouimet et al, 2007; Pisani et al 2009). Incident delirium has been described as having rates of 22-83% (Ely et al 2001, Lin et al, 2008). However, this variation in the quoted incidence of delirium in different settings could also be due to the disparity of elements in the study design (for example delirium assessment tools, the length of follow up of patients and differences in practice and process, which may influence the precipitation of delirium). This is highlighted in various studies (Bergeron et al, 200; Dubois et al, 200; Micek et al, 2005; Roberts et al, 2005; Thomason et al, 2005; Pandharipande et al, 2008; Salluh et al, 2010). There is not only an extensive variation in the diagnostic tools but also disparity in the grade and clinical role of the assessor ranging from intensivists to research nurses and in some studies psychiatrists as highlighted in Table 2-2. In addition, the studies also highlight the variation in reported delirium rates, which vary from 3% to 64% showing the differences in samples selected for study and the methods used for delirium detection. In ICU, there are multiple predisposing factors, for example, cognitive impairment, age, and precipitating factors that can be associated with development of delirium including sedation, potent analgesia, drug interactions and acetylcholine levels (Aldemir et al, 2001; Van Rompaey et al, 2009). All these factors compound in the ICU making identifying and managing delirium a complex problem.

An important aspect of delirium is its form of clinical presentation. At the outset of this thesis, the researcher outlined how their interest in studying delirium escalated due to the frequency
of misdiagnosis or delayed diagnoses of delirium in intensive care units, resulting in unnecessary delay in appropriate patient management. Hypoactive delirium is commonly noted in the ICU (Svenningsen, 2013). Most healthcare personnel are able to identify a restless and agitated patient as delirious in the known context of cardiac surgery. However, to recognise a patient with delirium as the lethargic hypoactive variant is far more challenging (Roberts, 2001). In their clinical role, the researcher also recognised, that there are instances when hyperactive delirium though documented as a singular event, can easily present in a continuum as part of the delirium spectrum ranging between hyperactive and hypoactive forms. Ideally, this should be classified as ‘mixed delirium’. On reviewing the literature, there appears to be a gap in research analysing the sub types, and short- and long-term clinical sequelae (Meagher 2009; Robinson et al, 2011).

### 2.4.6 Delirium and pre-operative psychological state

Noticeably, most of the delirium studies focus on the physiological and some on the environmental risk factors. There is an obvious dearth of research on the pre-operative psychological states of patients and the contribution to post-operative delirium in cardiac surgery patients. Anxiety symptoms have been suspected to affect cardiovascular health for decades (Fish, 1964; Miles and Cobb, 1951; Nabi et al, 2010; Garfield et al, 2014). Additionally, anxiety disorders are a prognostic risk for subsequent major cardiac adverse events (Tully et al, 2014). Globally, mental health issues are on an increase (Betancourt and Chambers, 2016). Therefore, it was meaningful to understand if anxiety and other mental health disorders predispose patients to post-operative delirium. A literature review undertaken by Nelson et al (2016) inspected 10 prospective cohort studies. Three studies demonstrated severe depressive symptoms both during and after delirium in hip fracture repair patients. While studies within this review included cardiac surgery patients, it did not find any statistically significant co-relation between the two disorders.

An interesting study carried out by Tully et al (2010) looked into the association between pre-operative affective disorders in type D personality and the risk of incident delirium following cardiac surgery. Type D personality is defined as the combined tendency towards negative affectivity {for example, worry, irritability, gloom and social inhibition like reticence and a lack of self-assurance} (Denollet, 2000). A remarkable study undertaken on 142 participants
by Matsuishi et al (2019) demonstrated that Type D personality is a prognostic predictor for prolonged acute brain injury (delirium/coma) in cardiovascular patients following surgery.

Though the above findings are significant, there are not many other studies in this specific area of delirium, personality and cardiac surgery patient cohort. There is paucity in studies looking at pre-operative mental health and personality type; however, data in these studies suggests a potential relationship between the two psychiatric derangements (Pedersen and Denollet, 2006). Relatively recent, but Matsuishi et al (2019) review also suggests the need for a study focusing on preventing post-operative delirium for all types of cardiac surgery, possibly by understanding the pre-operative risk factors. This is not only important but also urgent. Lack of adequate knowledge amplifies the rapid need for further investigation. The researcher was keen to follow this through, to explore a potential link and understand this aspect of the affected patient’s journey.

2.4.7 Delirium after cardiac surgery and cognitive outcomes

There are several publications documenting the short and long-term outcomes of physical recovery of ICU/non-ICU, medical, surgical, cardiac and non-cardiac surgery patients. However, the reviews of psychological outcomes after in-hospital incident delirium only started to gain momentum in the last two decades (Cuthbertson et al, 2013). More than half of patients who experience post-operative delirium go on to develop some form of cognitive impairment up to one year following their operation (Bickel et al, 2008). The outcomes documented vary from short term unpleasant vivid memories, to no factual or delusional recall (Roberts and Chaboyer, 2004) to post-traumatic stress disorder (PTSD) Harvey et al, (2009).

A Danish study by Svenningsen (2014) analysed the severity of post-operative delirium by exploring an association between delirium, PTSD, anxiety and depression following ICU stay. It was a prospective observation study on patients over 17 years of age admitted to ICU for at least 48 hours. Of the 640 patients included in the study, 65% were noted to be delirium positive on one or more days. An assessment of quality of life post discharge was undertaken using face-to-face interviews after one week and again at two months with a final follow up at six months by telephone interview. The severity of the symptoms were found to be higher in the first follow up face to face interview compared to the second telephone follow up. Seven percent of patients had PTSD at the two-month follow up, which reduced to five percent at six
months. Depression levels remained at ten percent during both interviews. Health related quality of life (SF-36) was found to be low if patients had anxiety, depression and PTSD. The study had a good sample size and the follow up times were long enough to see marked changes but short enough to draw an association to recent major event like admission to the ICU. However, one important limitation of this study was the different modes of interview (face-to-face versus telephone) which may have resulted in some bias. The researcher recognises a similar limitation in the present study. This difference in modes of follow up was only accepted in consideration of the geographical distances that would affect the patient pathway for participating in the study. This may have also leaded to increased loss to follow up.

Davydow et al (2008) carried out a systematic review on the quality of life in general ICU survivors. Notably, this study excluded coronary and surgical patients due to the number of added confounding factors like anaesthesia and myocardial injury. In addition, this study focused on PTSD not PTSS, however the researcher believes that the results are significant and relatable in parts to their own study. For this review, two authors sequentially inspected eligible studies, examining 16,301 citations, 1908 abstracts and then including 193 full text articles. Follow up periods varied from six weeks to seven years, though most studies had PTSS assessments undertaken within the first year following discharge from ICU. The admission diagnoses ranged from pulmonary syndromes, gastrointestinal disorder, and trauma to sepsis. Three studies assessed anxiety trait, however only one drew associations to PTSD. One study excluded patients with pre-existing PTSD and only one study identified pre-existing personality disorder using semi-structured interview.

To measure PTSD, ten studies used face-face assessments, three mailed questionnaires, and two telephone interviews. In three studies, clinicians diagnosed PTSD using DSM-IV criteria, two studies employed psychiatrists to administer the SCID (Structural Clinical Interview for DSM-IV interview) similar to the present study and a clinical psychologist administered an unspecified structured interview in one of those studies. The remaining twelve studies used questionnaires that included the Impact of Events Scale (IES-R), the Post-traumatic Stress Syndrome scale (PTSS-10), the Posttraumatic Diagnostic Scale (PDS), the Davidson Trauma Scale (DTS) and the Trauma Stress Questionnaire (TSQ). Four studies gauged potential risk factors for cross sectional PTSD symptoms. Some of the highlights in this evaluation were recall of traumatic or frightening ICU experience, higher incidence of anxiety in another study. The study summarised and critically reviewed data on the incidence of PTSD in this patient
group, risk factors for developing post ICU - PTSD and the impact of PTSD on health related quality of life (HRQOL). Twenty two percent of patients developed clinically significant PTSD. Previous psychopathology, frightening memories of ICU and increased use of benzodiazepines were strong predictors noted for PTSD. They also showed the negative impact of PTSD on health related quality of life. Kiekkas et al (2010) reported similar findings in a literature review.

The researcher notes that most of these studies were in relation to Intensive Care Unit stay for medical or surgical hospital admissions. Though patients following cardiac surgery require ICU stay, the length of time is minimal compared to general ICU and usually the acuity is average and the planned pathways are straightforward. Therefore, the researcher was keen to identify studies undertaken on purely cardiac surgery patient cohort going beyond ICU stays.

A prospective study carried out in 30 patients for one year by Rothenhäusler et al (2005) showed psychiatric morbidity including post-operative delirium in 32% of patients following cardiac surgery. Other psychological features evaluated for the study were temporary adjustment disorders and depression (32.4%). The patients were assessed before their planned surgery, prior to discharge and one year after surgery using the SCID (Structural Clinical Interview for DSM-IV). The mood-state-outcome-measures showed increase in levels of PTSD in 17.6% of patients compared to before surgery and this was shown to be associated with delirium. The patients with severe depression and PTSD were referred to a psychiatric team. The pre-operative impaired health status in this selected cohort was clearly indicated on the HRQoL values. However, at the 12-month follow up, patients with cognitive loss had remarkably lower SF-36 values compared to patients without cognitive impairments. Higher value scores for SF-36 indicate better status of health and quality of life. A mean score of 50 is considered as a standard value. One of the few limitations of the study was that within a small sample size, 11.8% were lost to follow up. However, though a small sample size (n=34), this study should be credited for highlighting the fact that if untreated, PTSS symptoms such as intrusive recollections, avoidance and hyper-arousal may significantly impair the patient's health related quality of life. It is also noticeable that, involving the psychiatrist in serious cases appeared to be linked with positive improvement in the psychological states of the affected patients.
Other studies undertaken in this area also show a strong association between delirium and related PTSS (Cuthbertson et al, 2004; Schelling et al, 2004; Foa, 2006; Löf, Berggren and Ahlström, 2006). Delirium and subsequent PTSS affects patient’s quality of life even after the physical symptoms from the original hospital admission are relieved (Rothenhäusler et al, 2005; Ringdal et al, 2009). Laitinen (1996) more than two decades ago reviewed patient experiences following cardiac surgery and again only included patients undergoing coronary revascularisation. Lingehall et al (2015) qualitatively added to this data by presenting some of the patients recalled memory of vulnerability and trauma a year on after their cardiac surgery.

Delirium causes considerable psychological distress not only to the patients but also their families and caregivers (Azoulay et al, 2005; Griffiths and Jones, 2007; O’Malley et al, 2008; Bélanger and Ducharme, 2011). Rudolph et al (2009) established an association between delirium and early post-operative cognitive dysfunction. The presence of long-term cognitive dysfunction following cardiac surgery still remains unclear. When the researcher embarked on this study, there was ample research looking at outcomes with clinical tools and scales measuring Health Related Quality of Life. However, in the field of cardiac surgery, only a few studied the actual patient experience (Laitinen, 1996; Lundström et al, 2005; Hamdan-Mansour et al, 2010; Lingehall et al, 2015). Following the quantitative evaluation, the researcher hoped to gain a clearer understanding of the patient experience by following the entire pathway from referral for surgery up to discharge and follow up. This would hopefully contribute towards valuable information in this clinical area.

### 2.4.8 Delirium experience - qualitative perspective

Partridge et al (2013) carried out an examination of literature on the qualitative and quantitative data on the delirium experience of varied population groups. The authors focused not only on patients suffering from delirium, but also the relatives and staff looking after these patients in different clinical settings (ICU, hospice, surgical units). They demonstrated that patients frequently recall episodes of delirium, which commonly causes distress, and can lead to psychological consequences in the future. Unpleasant feelings such as fear, guilt, helplessness and frustration in relatives and stress with anxiety in staff members witnessing and looking after a patient experiencing delirium were also notable findings (Breitbart, Gibson and Tremblay, 2002).
Bélanger and Ducharme (2011) studied ‘Patient’s’ and Nurses’ experiences of delirium’. They gave insight into the lived experience in order to improve practice in the care of patients troubled with delirium. The nine qualitative studies drew attention to themes derived from uncomfortable feelings experienced by these patients. They range from ‘incomprehension’ to ‘the need to keep distance in order to protect oneself’ and ‘interventions that diminish suffering’. Sörensen and Wikblad (2007) studied patients with delirium in orthopaedic care where findings revealed that when delirium occurred, participants found themselves in an unfathomable state that fluctuated between reality and fantasy. Laitinen (1996) conducted a survey on ten patients who experienced post-cardiac surgery delirium. Patients reported that during their delirious episodes, they felt oversensitive to their surroundings, propelling them into a vicious circle where every stimulus was perceived to be unusually heightened.

Most previous studies undertook a qualitative assessment of feelings associated with delirium using semi-structured interviews. However, there have not been any recent studies in single patient cohorts especially in cardiac patients to capture the delirium experience; findings from published studies (Laitinen, 1996; Granberg-Axell et al, 2001; Magarey and McCutcheon, 2005; Sörensen and Wikbald, 2007) recommend further investigation in this area.

2.4.9 Delirium Care Guidelines

NICE Delirium guidance (2010) supports and draws attention to the lack of knowledge in the area of delirium affecting patients and their carers. They attribute it to a possible lack of awareness of the condition and difficulty in appropriate diagnoses. Better understanding of the consequences of delirium can help improve the support in the form of information given to patients, family and caregivers by offering appropriate counseling opportunities. However, identifying pre-operative risk factors for delirium will help in providing this support and education from the beginning of the patient journey.

The Australian guidelines for delirium published in 2008 were developed by a multi-disciplinary expert working group in 2006. They put forward recommendations for detection including diagnosis and screening of delirium in addition to assessment, prediction of risk factors and prevention of this neuro-psychiatric disorder. In 2018, Mumford, et al, published ‘The Australian Delirium Clinical Care Standard’ also called the Standard, highlighting the
various components of best practice delirium care. These comprised of clinical effectiveness along with cost-effectiveness of implementing the Standard and appraisal of the implementation process.

In the UK, NICE-103 (2010) published guidelines for the diagnosis, prevention and management of delirium. It proposed ten recommendations for delirium prevention that was developed from a systematic review of the literature. These included assessment and treatment of cognitive impairment or disorientation, dehydration or constipation, hypoxia, immobility or limited mobility, infection, polypharmacy, pain, poor nutrition, sensory impairment and disturbed sleep for considerations as factors leading to delirium. Early recognition and management of these precipitating factors could prevent the incidence of delirium. Meanwhile in the US, the American Geriatrics Society (2014) guidelines recommend principles of management to reduce delirium severity and duration, promoting safety of patient affected by delirium thereby improving outcomes.

Aldecoa et al (2017), contributed towards the European Society of Anaesthesiology guidelines on post-operative delirium. The recommendations promoted pre-operative identification of high-risk patients followed by optimal intra-operative care with early detection and management of post-operative delirium. In Scotland, SIGN – 157 (2019) guidelines included publications drawing attention to the research and practical updates in delirium prediction, prevention, health outcomes and management. The guideline also highlights the value of delirium education in improving patient care and improve outcomes.

Progressively, over the last two decades, there has been a lot of work undertaken in delirium care and endorsed in the form of guidelines around the globe. There is a common thread running through all these guidelines in that they focus on the entire patient pathway with the emphasis on prevention, early detection education and optimum management to improve the outcome of patients affected by delirium.
2.5 Conclusion

Delirium is a complex syndrome affecting cognition and other some capabilities of affected patients during their hospital stay (Ely et al, 2001; Inouye, 1998). There is a high incidence of delirium in patients who travel through post-operative Intensive Care Unit after cardiac surgery (Bilge et al, 2015; Kazmierski et al, 2010). In some cases, delirium continues to adversely affect patient’s lives and health related quality of life, even after discharge from the hospital (Rothenhäusler, 2005; Partridge et al, 2013).

More than two decades ago, Murkin et al (1995) stated that post-operative delirium and its association with subsequent cognitive decline was evident but not understood because of the scarcity of studies in this field. They also added that more data and better understanding of the pathophysiology of post-operative cognitive decline might provide insight to other neurodegenerative disease such as Alzheimer’s disease. Since then, there are numerous studies published regarding this complex syndrome. However, most of them have focused on the physical symptoms, pathophysiology, incidence, aetiology, and detection, with some on pharmacological and non-pharmacological treatments (Cole, Primeau and Mccusker, 1996; Fick, Agostini and Inouye, 2002, Lacasse, Perreault and Williamson, 2006; Van Rompaey et al, 2008). Some studies have drawn attention to the very vital preventative aspect inspecting the risk factors that could trigger delirium (Van der Mast et al, 1999; Bucerius et al, 2004; Detryoyer et al, 2008; Sabol, 2015). However, there are very few studies that analyse the effect of pre-operative psychiatric illness and physiological risk factors affecting the incidence and morbidity with delirium (Tully et al, 2010). This is particularly of note in patients undergoing cardiac surgery. Additionally, there were few studies exploring the fundamental experience of the patients affected by delirium in the context of cardiac surgery (Partridge et al, 2013; Lingehall et al, 2015).

The phenomenon of transition from physical illness to developing short or long-term psychological illness is not usually anticipated or highlighted before any surgery. Better understanding of this complex problem will aid towards an attempt in providing a seamless service to patients undergoing major and complex cardiac surgery. Analysis of the above literature clearly indicates that patients undergoing cardiac surgery are at high risk of developing post-operative delirium. There is a noticeable paucity of studies in the area of post-cardiac surgery delirium concerning a comprehensive risk factor profile, cognitive outcomes
after discharge and most importantly the qualitative experience of the patient. A quantitative study would provide information regarding the general scale of delirium and PTSS specific to cardiac surgery, the risk factors and cognitive outcomes. Additionally, from the qualitative perspective, it is even more significant to understand the depth of this unique experience for these patients. This would not only increase our understanding in this area but also influence the care needs and specific services required for this group of patients.

Delirium in cardiac surgery though well known, is not clearly understood especially its delayed effects following hospital discharge. Post-operative delirium is of interest not only to the surgical teams but also to associated specialties like Medicine of the Elderly, Neurology and Psychiatry. The literature included here emphasises the complexity of this particular post-operative neuro-psychological complication. Understandably, for cardiac surgery patients coping with this unexpected transition from physical to psychological symptoms can be extremely troublesome. This study therefore aims to identify the rates of PTSS in patients with post-operative delirium following cardiac surgery and alongside to explore the patient experience. During this process, the researcher wanted to contribute to the data available regarding the pre-operative risk factors known to cause post-operative delirium in cardiac surgery patients. Hopefully, this would help facilitate the development of effective strategies to address post-operative delirium leading to PTSS.
2.6 Research Outline

The aim of the study was to identify the incidence, peri-operative risk factors and explore patient experiences with post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery.

The objectives of the study are:
- To identify peri-operative risk factors for delirium in patients undergoing cardiac surgery.
- To measure the incidence of post-operative delirium following cardiac surgery.
- To describe the incidence of PTSS in patients with post-operative delirium following cardiac surgery.
- To explore the patient experience of PTSS following delirium.
CHAPTER 3: RESEARCH DESIGN

Crotty (1998) identifies four basic elements that should be considered in developing any research proposal. These are epistemology, theoretical perspective, methodology and methods.

This chapter establishes the theoretical underpinnings of the research design, explaining how the design addresses the aims and objectives of the study. This research sets out to explore the subject of delirium specific to the context of cardiac surgery. The study also holistically addresses the patient’s journey from the point of referral for cardiac surgery, up until three months of post-operative recovery.

3.1 Research aim and objectives:

The aim of the study was to identify the incidence, peri-operative risk factors and explore patient experiences of post-operative delirium and associated post-traumatic stress syndrome (PTSS) following cardiac surgery.

The objectives of the study were:
- To identify peri-operative risk factors for post-operative delirium in patients undergoing cardiac surgery.
- To measure the incidence of post-operative delirium following cardiac surgery.
- To measure the incidence of PTSS in patients with post-operative delirium following cardiac surgery.
- To explore the patient experience of PTSS and other associated psychological features following delirium.

The following questions were developed to elucidate the research aim.

1. What are the peri-operative risk factors contributing to post-operative delirium?
2. Is there an association between post-operative delirium and cognitive outcomes such as PTSS?
3. What are the delirium experiences for patients?
3.2 Epistemology

The researcher identified multiple layers to this study. Each layer has its own individual existence but also influences the other layers.

‘This inter-connectivity and sequential reliance on each other and therefore this research is placed within a relativist ontological position where realities are said to ...exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent on their form and content on the persons who hold them’

- (Guba and Lincoln, 1994, Pp. 27)

After deliberating between Absolutism and Relativism, the researcher decided to adopt relativist ontology, through acknowledging the existence of multiple realities constructed in people’s mind. This reinforces the decision to examine and recognise reality, not only from the perspective of the researcher but also of the research participants. The theory gives an understanding of the researcher's thought processes and unique perspective on the research subject. From the researcher's point of view, it gives the tools to regulate and authenticate their thoughts into a research process.

‘Epistemology is the theory of knowledge, dealing with ‘how we know what we know’
- Crotty (1998, Pp. 8)

In the epistemological view, it is essential to understand the role of the researcher along with the participants. The researcher continued to uphold ‘Constructivism’ that supports the idea that humans create their own realities, scaffolding their learning in the process (O'Toole and Beckett, 2010).

“Reality is shaped by the cultural, historical, political and social norms' that being the accumulation of experiences and their interpretation of experiences into a world view”

- Darlaston-Jones (2007, Pp 19)
In Constructivism, knowledge and meaningful reality coincide and are created or constructed within the individual's mind. Another aspect of Constructivism is Interpretive Constructivism, which simply advocates interpretation of reality and exploring the underlying meaning. According to the Interpretive Constructivism epistemological position, all human action passes through interpretation and the focus should be on analytical goals – asking, ‘What are the social constructs at work here and how they evolved?’ (Parsons, 2010). The researcher can used this model to understand and illustrate the experience of patients affected by delirium and acknowledge their view of living life following the event.

“Humans invent concepts, models and schemes to make sense of experience...we continually test and modify these constructions in light of new experience.”

- Schwandt (1994, Pp 125)

Therefore, meaning can change through time with new interactions and experiences. Furthermore, it is possible for collective knowledge to co-exist, leading to an emerging range of views (Guba and Lincoln, 1994). Through the post-operative interactions, the researcher wanted to identify links between the event, the experience and the circumstantial consequence. This would help complete the circle of understanding and identify how acceptable or authentic this knowledge is (Crotty, 1998; Holloway and Galvin, 2016).
3.3 Theoretical Perspective

“Different ways of viewing the world shape different ways of researching the world.”
- Crotty (1998, p. 66)

The basis of any research is finding new knowledge and uncovering new truth. To discover this truth every researcher requires a theoretical framework that gives the process and findings a formal structure. It is not set in stone however, a framework firmly grounds the research and balances its journey. Whilst there is an increase in application of mixed methods research, there is still a dearth of theoretical frameworks to guide this method. Frameworks have been compared to roadmaps for research studies. They provide rationales for the development of research questions or hypothesis.

For this study, the conceptual framework supported the researcher in representing the study in its best form. It is the unique lens the researcher has used to observe and present the study. The philosophical position informing the methodology is known as the theoretical perspective and it is within this perspective that assumptions rooted deep within the methodology are uncovered (Crotty, 1998). On that account, it is essential that the researcher be committed to a theoretical perspective that could explain the journey and inform their results. It is a set of beliefs the researcher made about the phenomenon of post-operative delirium. These beliefs or assumptions mould the questions put forward by the researcher. This clearly influences the answers and ultimately the results of the study. Popper (1972) has a philosophical approach wherein he advocates that researchers should investigate to challenge hypotheses rather than try to prove them. A mixed methods way of thinking is an orientation toward social inquiry that actively invites us to participate in dialogue about multiple ways of being and hearing, multiple ways of making sense of the social world and multiple standpoints on what is important and to be valued and cherished (Greene, 2008).

The theoretical perspective chosen for this study is Interpretivism. According to the interpretivist approach, it is important for the researcher as a social actor to appreciate differences between people (Saunders, 2012). However, the added advantage of Interpretivism is that it allows use of multiple methods in order to highlight different facets of the subject. In
the case of this study, the various aspects of interest are delirium, PTSS, post-operative surgical experience and relationship between the peri-operative risk factors and the incidence of delirium.

Mansfield’s guide (1991) was used to assess the appropriateness of and to justify the use of the Interpretivist approach for the study. The nature of reality is compound and socially constructed and the goal of the research is to ‘understand’. Delirium is multi-factorial in the nature of its onset and so is its resolution. The patient's response following delirium cannot be anticipated and the incidence of PTSS is hypothetical in the context of post-operative cardiac surgery recovery process.

Interpretivism is a theoretical perspective that can be used for qualitative, quantitative and mixed methods research in nursing, with the potential to expand understanding of human health behaviours (Benzies and Allen, 2001). The relationship between the researcher and the patients enrolled in the study is interactive, co-operative and participative. Through this study, the desired information is to find out 'what some people think and do', 'what kind of problems they are confronted with' and 'how they deal with them'. The researcher planned to develop an open and trusting relationship with patients starting at the point of recruitment into the study making the process candid but sincere.

As effective as it may seem to be, the researcher acknowledges that Interpretivism might on the face of it, also have some disadvantages. The subjective aspect of this perspective leaves the potential for bias on behalf of the researcher, however in the Interpretivist approach, the interaction of the participants and researcher are accounted for in reflexivity and other approaches to trustworthiness and credibility. These are addressed further in the Methods chapter.

Qualitative studies recognise the role of reflexivity, which is the researcher’s ongoing critique and reflections of their own biases and assumptions and their influence on the research process. However, in order to be authentic and establish continued credibility to the study, the researcher felt the need to explore further to gain clarity in the theoretical perspective. Researchers bring a worldview to their study. These are built with beliefs and assumptions about the nature of knowledge and provide a basis that can ground the research study (Creswell et al, 2011). The selection of research question and methods is therefore a reflection of the researcher’s fundamental understanding of the world. This direction of exploration guided the researcher to
'Pragmatism’. Pragmatic researchers believe that it is the research question that should drive the design and methods of a study and reject the forced choice between traditional Constructivist and Positivist ways of knowing in order to look at what is meaningful from both perspectives (Biesta, 2010).

Rather than using metaphysical concepts such a truth and reality, pragmatism accepts that there are both singular and multiple realities that are open to inquiry and orientates itself to solving practical problems in the real world (Biesta, 2010).

“Pragmatism is also a worldview which is often associated with mixed methods, focusing on the problem to be researched and provides a basis for a position that has been stated as the “dictatorship of the research question”

- Tashakkori and Teddlie (2010, Pp.21)

Pragmatic researchers also see the benefit of mixing methods as it enhances the understanding of the paradox using different viewpoints. This strengthens the complementary nature of a research question. Shannon-Baker (2015) explains that by combining complementary research that includes qualitative and quantitative approaches, it ‘complements’ the advantages and disadvantages present within each.

“Qualitative and quantitative methods as part of a continuum of research techniques, all of which are appropriate depending on the research objective”

- Casebeer and Verhoef (1997, Pp.132)

For the purposes of this study, the researcher therefore aligned with ‘Pragmatism’ to guide through the research process. This led the researcher to consider various methodologies that would best address the research aim. A Mixed Methods Research (MMR) approach was adopted to enable the researcher to address the multi-faceted research aim whilst being underpinned by a Pragmatic ontology.

The next chapter explains the details of the methodology undertaken to accomplish the stated objectives of the study.
4 CHAPTER 4 METHODS

4.1 Methodology

“Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis... As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study... Its central premise is that the use of qualitative and quantitative approaches, in combination, provides a better understanding of research problems than either approach alone.”

- Cresswell et al (2009, Pp 165)

Mixed methods have been used for many years in health and social science research. In the last two decades, the use of this combined approach not only in data collection but also in analysis and presentation is gaining increased interest (Andrew and Halcomb, 2009). Foss and Ellefsen (2002), Creswell and Tashakkori (2007) argue in support of MMR stating that it is essential to mix research designs to answer complex research questions.

Tashakori and Teddlie (2010) explain the various characteristics of Mixed Methods Research (MMR). The key characteristic that led the researcher to choose MMR was 'Methodological Electicism'. After understanding both interpretive and positivistic approaches, the researcher decided to choose MMR. This choice was made, not to erase any weaknesses of the individual epistemologies but to gain the plural strength of MMR in answering the research aim in an optimal and appropriate way. The value of the quantitative data will be highlighted and supported by the stories attached to them in order to provide explanation and understanding. In this study, the impact of the incidence of PTSS even in small numbers will be relevant if the effect on the quality of post-operative recovery is shown to be significantly disturbed even in a few affected patients. The researcher explains the process of navigating and finalising the design further on in the argument.

An important characteristic of MMR is that it focuses on the research question in determining the methods employed within any given study. However, before resorting to a particular
research method, it was also important for the researcher to understand the difference between MMR and merely using Qualitative and Quantitative methods in the same study.

“MMR is a form of research in which the investigator collects and analyses data, integrates findings, and draws inferences using both qualitative and quantitative approach in a single study”

- Cresswell and Tashakkori (2007a, Pp 207)

The researcher therefore began examining the Medical Research Council (MRC) framework for complex interventions (Figure 4-1) and its suitability for this particular study. According to the revised MRC framework (2019), one of the factors that make any research complex is the number of real life composite and multifarious situations. In this study, the focus was on delirium and PTSS that are unpredictable on an individual patient basis but are likely to occur in a population of people undergoing cardiac surgery. The aim developed for this study was to identify the incidence, peri-operative risk factors and explore patient experiences with post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery.

The approach to this multifaceted study was therefore a multi-phase design. The complex research framework designed by the MRC (Figure 4-1) also suggests that if there is a degree of flexibility of intervention permitted then mixed methods is appropriate for the programme of inquiry. However, the first section was considered a complex design and exploratory in nature leading to an intervention, the present examination is clearly not an intervention study. Whilst this was not an intervention study, it can be seen as the potential early stages of one where interventions to prevent and manage post-operative delirium and PTSS are developed. Healthcare research can be complex and by using a framework like the MRC Complex Intervention model (Figure 4-1), the researcher explains the integration of the quantitative and qualitative methods in this study. Understanding and utilising the cycle helps to explain the methodological and practical steps of the present study.
Tashakkori and Teddlie, (2010), refer to Mixed Methods Research as 'Paradigm Pluralism'. MMR can be categorised as the third method paradigm (Johnson and Onwuegbuzie, 2004; Doyle, Brady and Byrne, 2009). In certain studies, MMR is required to answer questions that may not be achieved by using a single qualitative or quantitative method alone. However, some also challenge MMR for crossing of paradigm lines resulting in poor quality research (Blaikie, 1991, Sim and Sharp, 1998). Giddings (2006) went further and reported mixed method research as marginalising methodological diversity. Although, Polit and Beck (2010) report that many areas of research can be enhanced through the appropriate utilisation of mixed methods. The researcher reviewed literature on various models of MMR categorised by Tashakkori and Teddlie (2009) and this led to the consideration of the ‘Framework for Complex Interventions’ (Figure 4-1) described above developed by the Medical Research Council (MRC 2006). There are four broad categories of MMR (Johnston, Pollard and Hennessey, 2000; Hesse-Biber and Johnson, 2015; Johnson, 2017; Creamer, 2017). The first one is a quantitatively driven design, where fundamentally the study is quantitative, complimented by the qualitative data. The second one is the reverse of the first category, qualitatively driven design, where the study at its core is qualitative with added value from the quantitative data. The next division is Interactive or equal status designs, when the study integrates the data, methods, methodologies
and paradigms. The final category is *mixed priority designs* in which the key study findings evolve from consolidating qualitative and quantitative data at the analysis stage. In Figure 4-2, Warfa (2016) explains the decision making process within a MMR study. For the present study, a sequential explanatory design was chosen as the most suitable approach for achieving the aims of this inquiry. The researcher needed to identify an embedded sample for the qualitative study and wanted to use the quantitative data to explore any perioperative risk factors that might have been identified from a large-scale survey.

![Diagram of mixed methods design types](image)

**Figure 4-2 Mixed Methods Design in Biology Education Research: Approach and Uses (Warfa, 2016)**

MMR is also known to rely on visual representations (Tashakkori and Teddlie, 2010). MMR design's data collection procedures and analytical techniques lend themselves to visual narration, which can simplify the complex inter-relationships among elements (Creswell and Clark, 2007; Niglas and Toulouze, 2010). The data collection for this study was designed to be concurrent but also sequential. This means that the two types of data were collected at the same time at different stages (Polit and Beck, 2013; Parahoo, 2014). The quantitative data provides information regarding the scale of delirium and PTSS in cardiac surgery. On the other hand, the qualitative interviews will give an insight on the actual experience. Therefore, the strength
of the qualitative aspect of this study aids the researcher to explore the issues in depth leading to a holistic understanding. Within this design, data collection is the most dynamic area (Coyle and Williams, 2000). After examining various applications, the combination involving quantitative surveys with validated measures and interviews appear to be most appropriate to this particular study and utilised to its best potential. The researcher therefore believes that this approach is best suited to answer the research questions.

Mixing methods does account for subjective and objective data. As Kertzer and Fricke (1997) pointed out, unless demographic variables were taken into account, even basic ethnography would be misleading and inadequate. Rather than conforming to a single dichotomy, the researcher followed the holistic revolution as described by Bloom (2000). This change involves re-searching, perceiving and interpreting; seeking information as widely as possible which is entirely in keeping with the pragmatist theoretical viewpoint.

"Knowledge rather than mirroring an outer world, is about making a difference...in which the pursuit of knowledge goes hand in hand with a responsibility to bring about change"

- Baert (2005, Pp 191)

For the researcher, mixed methods emerged as a credible research design on the heels of a larger debate supporting research paradigms in social sciences. MMR is the third methodological pathway that permitted combining the two modes of social inquiry (Johnston, Pollard and Hennessey, 2000; Tashakkori and Teddlie, 2010).

"A mixed methods way of thinking is an orientation toward social inquiry that actively invites us to participate in dialogue about multiple ways of seeing and hearing, multiple ways of making sense of the social world and multiple standpoints on what is important and to be valued and cherished”

- Greene (2008, Pp. 20)
Greene's description grasps the spirit of MMR; a pragmatic choice to address research problems through mixing methods with the goal of supporting all dimensions of the research body. While the quantitative method could provide empirical evidence regarding any associations between cardiac surgery, delirium and PTSS, the qualitative methods provide deeper meaning, highlighting the individual patient's experience of that journey through delirium.

The goal of applying mixed methods was not to replace either the qualitative or the quantitative approaches but to build on the strengths of both methods and minimise any weaknesses (Creswell et al, 2003; Johnson and Onwuegbuzie, 2004). Some recent discussions also recommend MMR for intentionally using multiple approaches in a single piece of research, to address one main research question to yield better results (Seawright, 2016). There is also the added attraction to gain the attention of varied groups interested in individual aspects of the methods and findings. Therefore, the researcher was influenced and supported by the MRC framework and aligned with MMR to complete this enquiry.

The study was outlined using a 'Deductive approach'. It began with understanding the theory of the present subject. Delirium is an acute health complication and is transient in nature, meaning there is a usually resolution of the symptoms within a few hours or days. There are also multiple factors that can trigger delirium. The next step was to formulate a hypothesis based on existing theory. Delirium may have short-term or long-term cognitive or other effects, for example, PTSS. In order to add depth to the data, a complementary semi-structured interview was used at the final follow up. The study design also allowed the researcher to identify cardiac surgery related potential risk factors that may be associated with delirium. The researcher then applied validated psychological tools using a planned schedule to collect data before and after surgery to answer the research questions. In addition to this, a systematic measurement of the peri-operative risk factors was undertaken. Though the study presents complexity of steps and combination of methods, the design was relatively straightforward (Figure 4-3). The researcher used the quantitative results from delirium positive patients and sequentially undertook purposeful sampling to explore their experiences of delirium in the qualitative phase. The qualitative followed the quantitative section, with a final discussion that brought the results together.
Figure 4.3 Explanation of the study phases

4.2 Setting

The setting of this study was a large teaching hospital in central Scotland. The population for this study was participants over the age of 18 years undergoing cardiac surgery on an elective or urgent basis. Seventy-five percent of the patients were from the elective outpatient referral system. These patients remained at home until the day before their scheduled operation. The urgent patients are the other twenty percent of the referrals for cardiac surgery. These patients admitted to hospital with cardiac symptoms remain in the hospital until after their surgery. The operations included were all open-heart procedures, which require the patient to be anaesthetised and ventilated for the entire duration of the surgery. The researcher reviewed the weekly waiting list for cardiac surgical procedures and identified participants eligible for the study. The researcher then shared the study material and their own contact details with these patients before they attended the scheduled Pre-Admission Clinic. Additionally, the researcher also approached in-patients referred for cardiac surgery and followed a similar approved action plan but with shorter timelines.
4.3 Study Design

The study had two phases and participants were sequentially included in the separate phases depending on the eligibility criteria. All elective patients attended Pre-admission clinic, usually arranged 2-3 weeks before the scheduled operation. Before the clinic appointment, the patients had the opportunity and time to read the study information document. At this clinic, the researcher approached the patients who met the inclusion criteria (Box 3) to explain the study and gain consent from willing participants. This was the first opportunity for the researcher to meet and develop a relationship with patients who consented to take part in the study.

Box 3: Study Inclusion and Exclusion Criteria

<table>
<thead>
<tr>
<th>PHASE I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion Criteria:</td>
</tr>
<tr>
<td>• Male or female over the age of 18 years.</td>
</tr>
<tr>
<td>• Elective and urgent (in-patients) requiring conventional cardiac surgery.</td>
</tr>
<tr>
<td>Exclusion criteria:</td>
</tr>
<tr>
<td>• Patients from the Highlands and Islands are excluded, as they are unable to attend the six-week follow up clinic due to the geographical distance.</td>
</tr>
<tr>
<td>• Redo cardiac surgery</td>
</tr>
<tr>
<td>• Emergency cardiac surgery.</td>
</tr>
<tr>
<td>• Adults with Incapacity because they are supported using a different clinical pathway</td>
</tr>
</tbody>
</table>

The Cardiac Liaison team met the in-patients referred for surgery and provided the study information at the consultation. The researcher would approach these patients at least 24 hours following the Liaison team’s visit to discuss the study process. Patients willing to participate in the study provided written consent.

There were different data sets collected through the study phases as explained in Figure 4-3.
**Box 4: Study data set applied through the different phases**

**Phase I:**
- Demography
- Checklist of pre-operative risk factors known to develop post-operative delirium.
- Hospital Anxiety & Depression scale (HAD scale)
- 4AT (Delirium Screening tool)
- Revised Life Orientation test (R-LOT) **
- TIPI (Ten Item Personality Inventory) scale

**Following several discussions with experts in Neurosciences, the researcher switched the R-LOT (revised life orientation test) to a more inclusive and broader assessment scale of human personality like the Ten Item Personality Inventory (TIPI) scale. This is a very brief measure of the big five personality domains – Agreeableness, Conscientiousness, Emotional Stability, Extraversion and Openness (Gosling, Rentfrow and Swann Jr, 2003). More details of the tool is in the next chapter and a copy of the tools used are included in the Appendix section (14, 15).**
Box 5: Checklist of pre-operative risk factors known to contribute to post-operative delirium

**Pre-operative data**

1. **Patient Demography**
   - Age
   - Gender
   - *BMI

2. **Relevant Medical Information:**
   - Elective/ Inpatient
   - Previous neurological events – stroke / epilepsy / head injury
   - Known carotid artery stenosis – Y/N
   - High risk group – dementia/ Parkinson’s disease
   - Known psychiatric Illness – Depression/ Schizophrenia/ Bipolar disorder
   - *EuroSCORE – Cardiac surgery risk assessment score.
   - Pre- operative bloods:* FBC, *U&Es, *LFTs, *TFTs, Albumin
   - Atrial fibrillation: Yes/ No
   - Urine analysis: Positive/ Negative

3. **Other Relevant Information**
   - Hearing impairment – Yes/ No (Type)
   - Visual impairment – Yes/ No (Type)

4. **Recreational habits**
   - Alcohol use – Yes/No (number of units per week)
   - Smoking – Never / Previous / Current
   - Other forms of substance abuse (Yes/No)

*The HAD scale, 4AT & TIPI scales are included in the Appendix section (11, 12, 15). Further information on tools used in the study is provided later in the Methods chapter.
The Hospital Anxiety and Depression (HAD) scale assesses patient’s mood. The 4AT was used to assess for the presence of delirium and the TIPI used to identify their dominant personality trait. To understand the post-operative delirium experience for the patient, the researcher wanted to explore the various pre-operative physiological, neurological, emotional, and psychological factors (Box 5) that could influence the incidence of this serious neuro-psychiatric syndrome. In addition, during cardiac surgery, there are multiple procedures undertaken on the most vital organs in the body. This affects the patient’s physiological balance and in turn may affect the neurological response. The researcher therefore not only included pre-operative baseline data (Box 5), but also intra-operative (Box 6) and post-operative data (Box 7) to make a cumulative examination of all the influential elements for a comprehensive study.

Box 6: Checklist of intra-operative data that could be a precipitating risk factor for post-operative delirium following cardiac surgery

<table>
<thead>
<tr>
<th>Intra-operative data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of operation: Coronary/Valve/Both</td>
</tr>
<tr>
<td>On Pump/Off pump</td>
</tr>
<tr>
<td>Length of time in Operation Theatre</td>
</tr>
</tbody>
</table>

In the study centre, following their operation, all patients are monitored in the Cardiac Intensive Care Unit for a minimum of 8-12 hours. During this period, the following data (Box 7) was collected along with regular delirium assessment as per the departmental protocol. Confusion Assessment Method (CAM-ICU) created by Inouye et al (1999) was used to identify delirium change at the beginning of every twelve-hour shift in Intensive Care Unit. The CAM-ICU is a widely-used standard tool for delirium assessment in the Intensive Care Unit. It can be completed in intubated patients. The completion rate of the CAM-ICU in the researcher’s Cardiac ITU is 100% and the incidence of delirium is routinely measured in this unit is around 18% (NHS TOMCAT data).
Box 7: Checklist of post-operative factors that may precipitate delirium following cardiac surgery

<table>
<thead>
<tr>
<th>Post-operative data:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Duration of mechanical ventilation (minutes)</td>
</tr>
<tr>
<td>• Need for re-intubation – Yes/ No</td>
</tr>
<tr>
<td>• Need for re-operation – Yes/ No</td>
</tr>
<tr>
<td>• Amount of sedation used (milligrams)</td>
</tr>
<tr>
<td>• Amount of intravenous opioids used (milligrams)</td>
</tr>
<tr>
<td>• Type of subsequent oral analgesia:</td>
</tr>
<tr>
<td>• Infection (proven/strong suspicion of infection for which antibiotics started) Y/N</td>
</tr>
<tr>
<td>• Issues with bladder/ bowel</td>
</tr>
<tr>
<td>• Urinary retention – Yes/ No</td>
</tr>
<tr>
<td>• Constipation – Yes / No</td>
</tr>
<tr>
<td>• Number of hours on ITU</td>
</tr>
<tr>
<td>• Number of hours on HDU</td>
</tr>
<tr>
<td>• Number of days on ward</td>
</tr>
<tr>
<td>• Atrial fibrillation: Yes/ No</td>
</tr>
<tr>
<td>• Incidence of Delirium : No / Yes (Hypoactive/ hyperactive/ mixed) with CAM-ICU whilst in ICU and 4AT on ward</td>
</tr>
<tr>
<td>• Timing &amp; place (ITU, HDU, Ward) of onset of Delirium</td>
</tr>
</tbody>
</table>
For every participant, the three questionnaires (HAD score, 4AT, TIPI – Box 5) were marked as per the tool guidance and the researcher updated the scores on the participant’s Clinical Research Form. The researcher reviewed the participating patient’s notes daily (Box 7) until they were discharged from the hospital. The participants were automatically included in phase IIa of the study if they were delirium positive during any part of this journey. The tools used for delirium screening and diagnoses are described in this chapter in the Measures section. For every recruited patient the three questionnaires (HAD, 4AT, TIPI) were scored in the pre-operative period either in the pre-admission clinic or in-patient setting for urgent patients as per the tool guidance. The researcher updated the scores on the participant’s Clinical Research Form. Figure 4-4 provides a summary of the peri-operative dataset applied during the first phase of the study. This is followed by the checklist of the inclusion/exclusion used for phase II of the present study (Box 8).

Figure 4-4 Phase I – Data collection of peri-operative variables
Box 8: Checklist of the Inclusion/Exclusion criteria for Phase II

<table>
<thead>
<tr>
<th>Phase II</th>
<th>Inclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diagnosed post-operative delirium during their hospital stay</td>
</tr>
<tr>
<td></td>
<td>Participants who are able to attend a follow up clinic for face-face interview.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants who continue to remain in a hospital at the time of follow up</td>
</tr>
<tr>
<td>Participants who are unable to communicate due to post-operative complications for example Stroke.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check list</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-6 weeks post discharge (face to face consult): 4AT, SCID, HADS</td>
</tr>
<tr>
<td>12-15 weeks after discharge (telephone consult): 4AT, SCID, Semi-structured interview</td>
</tr>
</tbody>
</table>

**NB:** A copy of the tools and the topic guide used for the semi-structured interview are included in the Appendix (11, 12, 13, and 17).
4.4 Measures

4.4.1 Delirium Screening Tools

There are many delirium assessment tools available (Wilson et al, 2020). They vary depending on their use and clinical application (De and Wand, 2015). The tools can be categorised sectioned according to the ones designed for single use at first presentation or different points on suspicion of delirium. They are applied daily or more frequently to monitor new onset delirium in an in-patient setting.

4AT (The 4 ‘A’s test)

The 4 ‘A’s Test or 4AT was developed as a short delirium assessment tool intended for clinical use in general settings at first presentation and on suspicion of delirium (www.the4AT.com). The 4AT can also be used daily in the post-operative phase to detect new-onset delirium. It consists of four items: an item assessing level of alertness, a test of orientation (the Abbreviated Mental Test – 4, comprising 4 orientation questions), a test of attention (Months Backward test); and an item ascertaining acute change or fluctuating course (Appendix 11). Since its publication in 2014, the performance of 4AT has been evaluated in multiple studies (Shenkin et al, 2019). The 4AT is recommended in guidelines and pathways (Davis, Searle, and Tsui, 2019, SIGN, 2019) and is considered as a standard delirium assessment tool in clinical practice (Vardy et al, 2020). The 4AT is routinely used in the researcher’s unit as a standard pre-operative screening tool as well as on the ward setting on suspicion of delirium.

CAM-ICU (Confusion Assessment Method in Intensive Care Unit)

Intensive Care Unit patients on mechanically ventilation are at high risk for the development of delirium due to multisystem acute illnesses, co morbidities, medications, and numerous other risk factors (Dubois, 2001; Setters and Solberg, 2017). There are various tools utilised especially within Intensive Care Units to establish delirium diagnoses (Pun and Devlin, 2013). The Confusion Assessment Method (CAM) is a long established instrument used for diagnosing delirium by Intensivists and other Clinicians without psychiatric training (Inouye et al, 1999; Ely et al, 2001). CAM-ICU has been constructed to have the best combination of ease, speed, reliability, and validity (Smith, Breitbart and Platt, 1995). It provides a standardised rating of delirium, which was validated against expert opinion and Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition (DSM-III-R) definitions of the
American Psychiatric Association. Ely et al (2001) reported that ICU nurses with no formal psychiatric training could reliably detect delirium in mechanically ventilated patients with a high degree of sensitivity and specificity using the CAM-ICU (Appendix 16). A meta-analysis undertaken by Ho et al (2020) acknowledged that the CAM-ICU provided good sensitivity and specificity in detecting ICU delirium. This tool is routinely used in the researcher’s unit in the ICU setting with full completion rates.

4.4.2 Mood Assessment

**HADS (Hospital Anxiety and Depression Score)**

The HADS was developed four decades ago for the measurement of anxiety and depression (Zigmond and Snaith, 1983). It is a self-administered scale consisting of 14 polytomous items scored as two 7-item subscales for anxiety and depression, each of which has cut-points for quantification. HADS was primarily created for application in hospital setting. However, its clinical popularity has spread across all settings, including screening in normal populations (Crawford et al, 2001). Since its initial, presentation, many studies have reported on the construct validity in various clinical populations. Certain issues relating to its underlying dimensionality have since come to light (Johnston et al, 2000 Bjelland et al, 2002). Several authors have suggested that the HADS be used as a total score, summing all 14 items, representing psychological distress, rather than the separate dimensions of anxiety and depression (Razavi et al, 1990; Martin, 2005). However, some data continues to support a multidimensional construct (Bjelland et al, 2002; Martin, 2005; Djukanovic, Carlsson and Årestedt, 2017). An interesting study conducted by Roberts et al, (2014) supported the use of HADS as a reliable measure for anxiety and depression assessment in female cardiac patients. When indicated, the researcher uses HADS (Appendix 12) in their routine clinical practice and is therefore familiar with the tool and considered it appropriate for its application within the present study.

4.4.3 Psychological Assessment

**R-LOT (Revised Life Orientation test)**

The researcher aimed for a comprehensive assessment of the participants before cardiac surgery. This study therefore included known characteristics covering physical/physiological and psychological (mood) domains. Additionally, it was felt that examining the psychological
aspect of the participant would appropriately broaden and complete this inquiry. In order to evaluate this dimension, the researcher initially planned to use the Revised ‘Life Orientation Test’ R-LOT (Scheier, Carver, Bridges, 1994). This instrument is a 10-item measure of Optimism versus Pessimism (Appendix 14). However, on investigating further, it was felt that optimism/pessimism would provide only a uni-dimensional impression of the related data. It might not help uncover the depth of the participant’s psychological nature. Therefore, the researcher discounted R-LOT and instead adopted the TIPI measure (Appendix 15) to examine the participant’s personality and evaluate any association with post-operative delirium. The researcher also recognised that very few studies have been undertaken in this area, supporting the decision to revise the choice of tools.

**TIPI (Ten Item Personality Inventory)**

Gosling, Rentfrow and Swann developed the Ten Item Personality Inventory (TIPI), in 2003. It is designed to measure the dimensions of the Five Factor Model (FFM) of personality – Agreeableness, Conscientiousness, Emotional stability, Extraversion and Openness. Gosling et al (2003) highlighted the effective administration and interpretation of this short instrument especially during consultations with limited time. The TIPI (Appendix 15) consists of two items for each of the five domains represented in the FFM. One item contains two desirable descriptors and the other, two undesirable descriptors (for example: for Extraversion: extraverted, enthusiastic and reserved, quiet). Each of the ten items are rated on a 7-point Likert scale ranging from 1 (*disagree strongly*) to 7 (*agree strongly*).

**4.4.4 PTSS Assessment**

**PCL (PTSD Check List)**

The researcher originally planned to use the PCL created by Weathers et al (1993). This is a questionnaire including a seventeen-item scale, designed to address the full domain of (Diagnostic and statistical manual of mental disorders) DSM-IV PTSD symptoms (Appendix 10). It identifies the three symptom groups of PTSS: re-experiencing symptoms, numbing/avoidance symptoms, and hyper-arousal symptoms. Following advice from clinical experts in Psychiatry, it was felt that this tool might fail to pick other derangements within the spectrum of disorders experienced following a trauma such as post-operative delirium. Therefore, guided
by the expertise in the field and supervisor support, the researcher decided to use the Structural Clinical Interview for DSM disorders commonly called SCID (First, 2014).

**SCID (Structural Clinical Interview for DSM)**

The Structural Clinical Interview for DSM is a universal diagnostic tool for assessing a variety of psychiatric disorders ranging from mood, sleep, eating, attention deficit, trauma and stress related derangements (First et al, 1995). The SCID is potentially capable of measuring characteristics in the spectrum of symptoms associated with stress and trauma that the PCL would be unable to demonstrate. The SCID instrument (Appendix 17) was designed to be administered by a professional, specialised in mental health with pertinent training and experience in undertaking unstructured, diagnostic assessments. However, for the purposes of some studies, non-specialty researchers, who have demonstrated competence, have been qualified to use the SCID (First, 2014). The less clinical experience and specific education the potential interviewer has, the more training is required. It added eight extra months to the study as the researcher collaborated with experts for advice, training and approval (Appendix 5) to use the tool and this also required an amendment in the research protocol. However, the researcher believes that this change helped elicit maximum credibility to the data and the study.

The researcher continued to pursue each participant’s journey remotely, starting from operating theatre followed by the Intensive Care Unit, High Dependency Care Unit and culminating on the Cardiothoracic ward, till they were discharged home or transferred to their local hospital for rehabilitation. Post-operatively, if the participant became delirium positive and if they met the inclusion criteria (Box 8) they proceeded to phase IIa of the study that included a face-to-face follow up clinic appointment at 6–8-week post discharge from the hospital. At this consultation, the researcher would undertake a repeat 4AT and HADS for comparative data. Additionally, a further SCID questionnaire was used to elicit symptoms of PTSS and/or derangements within this spectrum.
4.5 Participants

The flow chart below (Figure 4-5) explains the process of sample selection facilitating the phases of the study as per the MMR design.

Figure 4-5 Flow diagram showing sample distribution within the study design
4.6 Data Analysis

The researcher found using the multi-phase model of MMR complemented the inquiry thereby strengthening the process. Cresswell and Clark (2011) supported this and advocated mixed methods design because the findings from one approach can be greatly enhanced using a second source of data.

![Sequential Explanatory Design used for data analysis](image)

Though the study design provides the framework for data collection sequence, it is also essential to prioritise the data sets and appropriately integrate the sequential stages (McEvoy and Richards, 2006). By using this design, the researcher got the opportunity to explore the entire patient experience (Figure 4-6). The results from one method describing the phenomenon of delirium confirmed the extent of the issue and that was complemented by the data collected using the qualitative inquiry.

According to Tashakkori and Teddlie (2010), MMR provides emphasis on diversity at all levels of the research enterprise. The present study, supported by literature review, identifies the pre-operative risk factors known to cause delirium in high-risk patients. The derangement in these physiological factors can contribute to developing a neurocognitive complication (delirium)
which may subsequently lead to an adverse psychological outcome like PTSS. In order to meet all the objectives and address a range of perspectives on post-operative delirium, a MMR design approach was felt to be most appropriate. A singular design would not be able to elicit the different understanding of the layers of the study in its best form.

The present research was largely based on two concepts that are explained in the literature review section. Firstly, that the pre-operative risks factors influences the incidence of delirium following surgery. Secondly, the study was designed to explore the delayed after-effects of delirium in the form of PTSS. Though there is an element of justification, there is also an obvious journey of discovery, which the researcher hoped to achieve organically by using MMR. Tashakkori and Teddlie (2009a) suggests that this discovery component not always, but is often brought about by the qualitative data analysis part of MMR. Additionally, MMR is known to have a cyclical approach to research (Tashakkori and Teddlie, 2010), which includes both deductive and inductive logic in the same study. The sequential flow chart above (Figure 4-6) explains the process.

The research question for this study included assessing the magnitude of the phenomenon of delirium and PTSS, the frequency of its occurrence and a degree of description and contextualisation. The important factor that guides the researcher's decision in choosing an MMR design is that it helps answer the research question in the most comprehensive manner. MMR has been shown to offer a contextualised and holistic view of the research problem whilst still providing a rigorous methodological framework (Andrew and Halcomb, 2009). In this study, whilst it was important to identify the risk factors for delirium, it was also essential to identify and relate to the actual experience of delirium and PTSS. The researcher hopes this data enables future research to develop the knowledge and tools to address post-operative delirium and any subsequent PTSS. The qualitative data could be valuable in understanding vulnerable areas and potential actions could be recommended to address it. This again reflects the fundamental principles of the MRC framework of pragmatic understanding, intentional observation, holistic exploration and purposeful explanation.
4.7 Ethical Considerations

The researcher, by virtue of clinical experience, anticipated this study to face a few challenges. This study includes adults who may potentially, although transiently, become cognitively impaired due to delirium. Additionally, there is also a possibility of temporary or permanent debilitation involving speech and neurological activity due to stroke following surgery.

4.7.1 Adults with incapacity

One of the most important considerations for recruitment in this study was adults with incapacity. The centre where the researcher practices has clear guidelines to support adults with incapacity based on the guidance by *Adults with Incapacity (Scotland) Act 2000 (AWI Act)*. They follow a different care pathway, wherein they are provided with additional specialised input from community and social care agencies due to their known vulnerabilities. Additionally, there are a disproportionately small number of patients with incapacity, referred for cardiac surgery (none recorded in the 18 months before the start of recruitment).

4.7.2 Non-English speaking patients

Non-English speaking patients referred for cardiac surgery require multiple arrangements to be made for the clinical teams to be able to undertake some of the routine activities like assessment, history taking, consent and information sharing. The researcher is aware that, there is added pressure on the patients and the service to deliver the same standard of care as other patients. This causes increased anxiety in these patients and the supporting next of kin.

Besides the logistical issues of booking a translator, the researcher had noted that not every tool identified for the study was adapted in all languages. The researcher therefore decided to exclude this group from the study. The researcher was concerned of the generalisability of the study, however only two non-English speaking patients presented to cardiac surgery in the 18 months preceding the study recruitment phase.

4.7.3 Withdrawal of Consent:

For this study, the patients were formally consented at the point of recruitment. Following that, verbal consent was acquired at every stage in the process. The researcher was prepared to accept withdrawal of consent due to potentially generating circumstantial distress at the nature of follow up enquiry. However, reassuringly, the researcher observed only mild distress from
a patient who sounded anxious and fearful during the follow up telephone call. On enquiring further, the patient wished to continue with the interview.

4.7.4 Loss of follow up information:
Due to the absence of an insight into their own delirium episodes there was a possibility of patients’ being unable to recall the experience in order to constructively comment on it. The researcher was mindful of this issue. However, rather than this possibility limiting the study, in contrast it was organically shaped to become a theme in the qualitative analysis in this present inquiry.

4.7.5 Potential distress to participants:
In their experience of looking after patient with delirium, the researcher has witnessed patients with delirium exhibiting nervousness, anxiety, anger and irritation on many occasions. It was predicted that the follow up interview might reproduce this memory and possibly elicit a similar nature of response. The researcher in their clinical role is trained and accustomed in handling fragile situations involving distressed patients. The researcher planned to appropriately transfer these skills in supporting any patient obviously disturbed by this component of the process. As part of the ethical care of these patients, the researcher also planned to refer these participants for specialist psychological support by collaborating with their GP.

4.7.6 Confidentiality:
Qualitative health care research can be more intrusive than quantitative research (Holloway and Wheeler 1995). Therefore, the researcher took every precaution to anonymise the data right from the outset. Every participant record had a serial number and the clinical record forms were filed and locked in a cabinet with access only to the researcher. The computerised data set only recorded the patient’s initials up until the time of the follow up. Recordings of telephone interviews were made on an encrypted digital device and downloaded into a secure NHS database. The files were password protected and only recognised by participant’s serial number.

The transcripts were simply given participant numbers and did not contain any other identifiable information. The researcher remained vigilant to the fact that to maintain
confidentiality, it was important to conceal and alter details however, it should not compromise or detract from the richness of the content (Guenther, 2009).

4.7.7 Health Professional’s dual role:

As a professional nurse, an individual’s primary concern is the health and well-being of the patients, whilst as a professional researcher, there is commitment to recognising objective, evidenced based data that in turn progresses the knowledge and improves the care of the patients. However, role conflict can be a real issue (Fowler, 1988) as there may be an obvious dichotomy in roles at the same time.

As a Clinical Nurse Practitioner, the researcher creates a professional bond with patients in their care. However, there was a concern whether this relationship might coerce the patients to participate in the study. Mander (1988) claims that patients are particularly vulnerable because they are a ‘captive population’. Following discussion with the multi-disciplinary team within the department, it was decided that the potential participants would be introduced to the researcher only as a researcher rather than clinician until after the completion of the consent process. This role conflict put restrictions on the researcher’s clinical roster yet conferred the advantage of being embedded in the clinical team providing a better understanding of the processes and pathways referring to the Emics and Etics: the insider/outsider debate (Headland, Pike and Harris, 1990). The researcher managed to travel easily between the roles of a scientific observer/social analyst to being part of the care provider without compromising on any of the related beliefs and credentials.

Another aspect to this dual role scenario meant clearly reminding oneself and the participant that the follow up episodes were investigative rather than in a clinical or counselor capacity. The researcher was prepared to encounter distressed and disturbed patients, although clearly knew the boundaries and facilitated specialist and clinical attention appropriate to the situation. This helped elicit the most valuable results. Despite dealing with this daunting duality in the roles throughout the research study, the researcher categorically confirms that the person as a patient always took precedence to the person who is a participant in the study.
The study received sanction from the South East Scotland Research Ethics committee (Appendix 3). Subsequently, an amendment was submitted following review of the PTSS tool to gain approval for the section. In addition to the Ethics panel, the researcher also attained endorsement and consent from the University ACCORD board and the relevant NHS stakeholders. Copies of the approval forms are included in the Appendix section (4).

### 4.8 Conclusion

In conclusion, philosophically, MMR moves past the paradigm wars by offering a logical alternative. In practical terms, using MMR means the researcher sequentially mixed and combined quantitative and qualitative research techniques, methods, approaches and concepts into a single study. And as recorded in the *Educational Researcher* that 'MMR realistically is an attempt to legitimate the use of multiple approaches in answering a research question rather than restricting or constraining researcher's choices’ (Morgan 2014, pp.104). Therefore, the researcher felt using MMR guided by MRC framework would do justice to the study and holistically value and answer the research question.
CHAPTER 5: QUANTITATIVE DATA - Results and Discussion

The data analysis is undertaken in two sections starting with quantitative followed by qualitative data. This chapter looks at the quantitative data.

The overall aim of the study was to identify the incidence, peri-operative risk factors and explore patient experiences with post-operative delirium and associated post-traumatic stress syndrome (PTSS) following cardiac surgery.

The following questions facilitated examination of the research aims:

1. What is the incidence of PTSS (Post Traumatic Stress Syndrome) in patients who developed delirium following cardiac surgery?
2. What is the difference between HADS (Hospital Anxiety and Depression Score) before and after cardiac surgery?
3. Is there an association between patient’s dominant personality trait and the incidence of delirium?
4. Can pre-operative risk factors predict post-operative delirium?

5.1 Statistical Analysis

The study explored the association between clinical, biochemical, patient and operative factors with the risk of developing post-operative delirium. The researcher used SPSS software to manage statistical analysis for descriptive data and for modelling used R [Version 4.0.3 (2020-10-10)]. The analysis of data was separately conducted for each of the below outlined research questions. Below is the analysis plan with presentation of general findings.

1. What is the incidence of PTSS in patients who developed delirium following cardiac surgery?

The incidence of PTSS in participants who developed delirium following cardiac surgery was determined using descriptive statistics. This question was answered by reporting the proportion of included participants who developed delirium, and those that developed PTSS. Using SCID (Structural Clinical Interview for DSM-III), the incidence of PTSS as determined in patients who developed delirium following surgery and data interpreted using descriptive statistical analysis.
2. **What is the difference between HADS before and after cardiac surgery?**

The Hospital Anxiety and Depression Scale (HADS) was performed before surgery and at the first follow up visit in Phase IIa of the study after cardiac surgery. The pre-operative scores provided a baseline for all 404 patients who underwent cardiac surgery. The data was not normally distributed. Since they were not normally distributed, paired and unpaired comparisons were made using the Wilcoxon Signed Ranks Test or the Mann Whitney U test respectively.

3. **Is there an association between patient's dominant personality trait and the incidence of delirium?**

The researcher was curious to find out if there is an association between personality and the risk of developing delirium. Ten Item Personality Inventory (TIPI) used in this study is a tool which recognises the five different domains of an individual's personality, that is Extraversion, Agreeableness, Conscientiousness, Emotional Stability and Openness. The tool includes two items for each of the five domains. Each item consists of two desirable labels and the other, two undesirable labels (for example, for Extraversion: extraverted, enthusiastic and reserved, quiet). Each of the ten items are rated on a 7-point Likert scale ranging from 1 [disagree strongly] to 7 [agree strongly] (Gosling, Rentfrow and Swann, 2003).

On analysing the data, a baseline dominant personality was noted for the 404 recruited participants before surgery. Only two traits could be analysed since the numbers were low in the others. A Chi-squared test was used to compare the proportions with and without delirium for each dominant personality trait.

4. **Can pre-operative risk factors predict post-operative delirium?**

To answer this question all the pre-operative risk factors were tabulated. Logistical regression models were constructed and covariates were selected according to STROBE (Strengthening the Reporting of OBServational Studies in Epidemiology) guidelines (Vandenbroucke et al, 2007). In addition, the researcher used their clinical experience and judgment along with the review of the literature of variables with plausible association with delirium risk.
5.2 Univariate analysis

The study recruited 406 participants, however two underwent alternative cardiac procedure (TAVI) rather than conventional open-heart surgery. They were completely excluded from the study and therefore the statistical analysis. Thus the total study population was 404. Of the recruited participants, 18.1% (73) developed delirium. This was determined by either CAM-ICU or 4AT positive scores following surgery (Figure 2-1 and 4-3).

The mean age of the study population was 67 years (SD 10.5) and 292 (72%) were male. This proportionately reflects the general gender distribution of patients referred for cardiac surgery to a heart centre in Scotland (TOMCAT 2018). The EuroSCORE which is a European System for Cardiac Operative Risk Evaluation (Appendix 18) provides a simple, additive risk model in European adult cardiac surgery patients was calculated to be 4.77 (SD 2.62) across the study population, which suggests a moderate level predicted risk of 30-day mortality score following cardiac surgery. Only 11% (45 patients) of participants were inpatients admitted to the hospital before the scheduled date for surgery for management of an acute cardiac event or who had decompensated whilst waiting to be referred for surgery.

**What is the prevalence of post-traumatic stress syndrome in patients who developed delirium following cardiac surgery?**

PTSS symptoms may include the feeling of being numb and/ or detached having a flat affect, as well as a self-report of cognitive disconnection in the form of failure in optimum concentration and memory (Vance et al, 2018). The SCID (Structural Clinical Interview for DSM-IV interview) tool was used to identify the characteristics in the spectrum of symptoms associated with stress and trauma following cardiac surgery.

Two out of the 18 patients who had developed post-operative delirium in Phase I showed evidence of PTSS in Phase IIA. This is 3.12% with a 95% CI of 0.54% to 11.81%. One of the two participants was a 77 year old male who was an inpatient at the time of recruitment to the study. He had a history of anxiety and depression, his EuroSCORE was noted to be 6 (moderate predicted risk of mortality). He was found to have a dominant domain 3 personality (Conscientiousness) as per the TIPI scale and he underwent a valve replacement surgery. The second PTSS positive participant was a 78 year old female, who also underwent a valve replacement surgery. This participant’s EuroSCORE was noted to be 12 (high predicted risk
of mortality). She had with no psychiatric history and dominant personality blend of types two and three (Agreeableness and Conscientiousness). There were few similarities noted in both patients. They were both inpatients requiring valve replacement surgery. Post-operatively, both participants also developed atrial fibrillation, which is a common irregularity of the heart rhythm following cardiac surgery.

What is the difference between HADS score before and after cardiac surgery?

The Hospital Anxiety and Depression Scale scores were performed before surgery and at the first follow up visit in Phase IIa of the study after cardiac surgery. The pre-operative scores provided a baseline for all 404 participants recruited in the study. The pre-operative baseline HADS scores were compared to the post-operative HADS scores for patients who developed delirium and repeated in the face-to-face clinic six to eight weeks after surgery.

The median HADS score changed from 10 pre-operatively (Inter Quartile Range 6-15) to 4.5 following surgery (IQR 3-9, p<0.001). A HADS score of 0 to 7 for either subscale is considered as being in the normal range, a score of 11 or higher suggests probable presence of a mood disorder and a score of 8 to 10, indicative of the presence of an intermediate state. In the present study, though this is a highly significant difference, interestingly, there was no association between the pre-operative HADS and the risk of post-operative delirium (odds ratio 1.00, 95% CI 0.96-1.05, p = 0.892).

Pre-operatively, female participants numerically showed higher HADS A (Anxiety) and HADS D (depression) scores, which dropped across both genders after surgery at apparently similar, rates (Figure 5-1).
Figure 5-1 Spaghetti plots showing HADS A (left plot) and HADS D score (right plot) before and after cardiac surgery stratified by sex

Each grey line represents an individual (dashed as males and solid as females). The solid blue and red lines represent the average value with red as females and blue as males.

When stratified by age into those above and below 65 years, younger participants had higher HADS A and D scores prior to surgery; however, reductions post-operatively were more marked in these patients and the differences between age groups therefore narrowed after the procedure (Figure 5-1). They scores were not noted to be statistically significant.
Figure 5-2 Spaghetti plots showing HADS A (left plot) and HADS D score (right plot) before and after cardiac surgery stratified by age

Each grey line represents an individual (dashed as >65 years and solid as <= 65 years). The solid blue and red lines represent the average value with red as <= 65 years and blue > 65 years.
3. Does patient's dominant personality trait influence the incidence of delirium?

In patients with delirium, 34% (n = 25) had a dominant domain 3 (Conscientiousness) compared to 28% (n = 91) in the non-delirium group (p = 0.36) as seen in Table 5-1. Two patients (2.7%) had a dominant domain 4 (Emotional Stability) in the delirium group compared to 26 patients (8%) in the non-delirium group (p = 0.18). The analysis was undertaken doing a Chi square test to evaluate the difference in proportion. There was no significant difference found in the distribution.

<table>
<thead>
<tr>
<th>Dominant Personality Domain (%)</th>
<th>All patients</th>
<th>Delirium Negative</th>
<th>Delirium Positive</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain 3 Conscientiousness</td>
<td>119 (29.3)</td>
<td>91 (28.0)</td>
<td>25 (34.2)</td>
<td>0.36</td>
</tr>
<tr>
<td>Domain 4 Emotional Stability</td>
<td>28 (6.9)</td>
<td>26 (8.0)</td>
<td>2 (2.7)</td>
<td>0.18</td>
</tr>
</tbody>
</table>

4. Can pre-operative risk factors predict post-operative delirium?

Although HADS scores changed significantly after surgery, there was no association between the pre-operative HADS score and the risk of post-operative delirium (odds ratio 1.00, 95% CI 0.96-1.05, p = 0.89). In the univariate analysis Age at time of Surgery and renal function were noted to be the two significant factors associated with post-operative delirium. To answer this question all the peri-operative co-variables were tabulated for analysis (Tables 5-3, 5-4, 5-5, 5-6) and a multivariate regression model applied to the data. Though in univariate analysis, renal function approached significance, in multivariate analysis following adjustment with age, the association was not statistically significant.

Twelve patients who remained longer than 48 hours on Intensive Care Unit. Two patients developed multi organ failure requiring intensive life support and were subsequently transferred to their local district general hospitals. One died while in the ICU, few days after their surgery and, one required laparotomy for ischaemic bowel. Another patient developed a
dense stroke and therefore excluded from the second phase as per the study criteria. The remaining seven patients who had longer than average stay due to various reasons and developed delirium did not show any functional or cognitive decline.
Table 5-2 Baseline characteristics and peri-operative risk factors stratified by delirium

<table>
<thead>
<tr>
<th>Peri-operative Co-Variables</th>
<th>All Patients</th>
<th>Delirium Negative</th>
<th>Delirium Positive</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number</td>
<td>404</td>
<td>325</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Inpatient/ Outpatient (%)</td>
<td>363 (89.4)</td>
<td>288 (88.6)</td>
<td>68 (93.2)</td>
<td>0.353</td>
</tr>
<tr>
<td>Age (mean (SD))</td>
<td>66.81 (10.50)</td>
<td>65.55 (10.73)</td>
<td>71.63 (7.97)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender = M (%)</td>
<td>292 (71.9)</td>
<td>237 (72.9)</td>
<td>50 (68.5)</td>
<td>0.536</td>
</tr>
<tr>
<td>EuroSCORE (mean (SD))</td>
<td>4.77 (2.62)</td>
<td>4.44 (2.54)</td>
<td>6.00 (2.60)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BMI (mean (SD))</td>
<td>29.33 (5.53)</td>
<td>29.21 (5.54)</td>
<td>29.67 (5.54)</td>
<td>0.527</td>
</tr>
<tr>
<td>Other Co-morbidities (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory disease</td>
<td>72 (17.8)</td>
<td>52 (16.0)</td>
<td>17 (23.3)</td>
<td>0.188</td>
</tr>
<tr>
<td>Renal disease</td>
<td>44 (10.9)</td>
<td>27 (8.4)</td>
<td>15 (20.5)</td>
<td>0.004</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>72 (17.8)</td>
<td>52 (16.0)</td>
<td>19 (26.0)</td>
<td>0.064</td>
</tr>
<tr>
<td>Neurological disease</td>
<td>54 (13.4)</td>
<td>41 (12.6)</td>
<td>13 (17.8)</td>
<td>0.326</td>
</tr>
<tr>
<td>Carotid disease</td>
<td>2 (0.5)</td>
<td>1 (0.3)</td>
<td>1 (1.4)</td>
<td>0.807</td>
</tr>
<tr>
<td>Dementia/ Parkinsonism</td>
<td>1 (0.2)</td>
<td>0 (0.0)</td>
<td>1 (1.4)</td>
<td>0.413</td>
</tr>
<tr>
<td>Psychiatric illness</td>
<td>77 (19.1)</td>
<td>59 (18.2)</td>
<td>17 (23.3)</td>
<td>0.399</td>
</tr>
<tr>
<td>Active endocarditis</td>
<td>6 (1.5)</td>
<td>4 (1.2)</td>
<td>1 (1.4)</td>
<td>1</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>79 (19.6)</td>
<td>59 (18.2)</td>
<td>19 (26.0)</td>
<td>0.171</td>
</tr>
<tr>
<td>Pre-op Blood Results (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deranged Full Blood Count</td>
<td>43 (10.6)</td>
<td>28 (8.6)</td>
<td>13 (17.8)</td>
<td>0.034</td>
</tr>
<tr>
<td>Deranged Renal Function</td>
<td>34 (8.4)</td>
<td>22 (6.8)</td>
<td>11 (15.1)</td>
<td>0.037</td>
</tr>
<tr>
<td>Sensory Impairment (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing impairment</td>
<td>24 (5.9)</td>
<td>15 (4.6)</td>
<td>8 (11.0)</td>
<td>0.069</td>
</tr>
<tr>
<td>Visual impairment</td>
<td>20 (5.0)</td>
<td>11 (3.4)</td>
<td>9 (12.3)</td>
<td>0.004</td>
</tr>
<tr>
<td>Elimination Issues (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bladder issues</td>
<td>43 (10.6)</td>
<td>31 (9.5)</td>
<td>12 (16.4)</td>
<td>0.132</td>
</tr>
<tr>
<td>Bowel issues</td>
<td>7 (1.7)</td>
<td>4 (1.2)</td>
<td>3 (4.1)</td>
<td>0.231</td>
</tr>
<tr>
<td>Substance Abuse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol excess</td>
<td>35 (8.7)</td>
<td>27 (8.3)</td>
<td>7 (9.6)</td>
<td>0.903</td>
</tr>
<tr>
<td>Current smoker</td>
<td>44 (10.9)</td>
<td>36 (11.1)</td>
<td>7 (9.6)</td>
<td>0.136</td>
</tr>
<tr>
<td>Pre Op Anaesthetic regime (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-op ETOH</td>
<td>176 (46.6)</td>
<td>145 (47.2)</td>
<td>29 (42.6)</td>
<td>0.581</td>
</tr>
<tr>
<td>Pre Med</td>
<td>329 (83.1%)</td>
<td>265 (83.1)</td>
<td>62 (84.9)</td>
<td>0.353</td>
</tr>
<tr>
<td>Operation (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.047</td>
</tr>
<tr>
<td>Coronary Surgery</td>
<td>151 (37.6)</td>
<td>133 (40.9)</td>
<td>18 (24.7)</td>
<td></td>
</tr>
<tr>
<td>Valve Surgery</td>
<td>185 (46.0)</td>
<td>146 (44.9)</td>
<td>38 (52.1)</td>
<td></td>
</tr>
<tr>
<td>Combined Surgery</td>
<td>62 (15.4)</td>
<td>43 (13.2)</td>
<td>16 (21.9)</td>
<td></td>
</tr>
<tr>
<td>On Pump/ Off Pump (%)</td>
<td>333 (82.8)</td>
<td>267 (82.2)</td>
<td>62 (84.9)</td>
<td>0.693</td>
</tr>
<tr>
<td>Dominant Personality Domain (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dom 3 - Conscientiousness</td>
<td>119 (29.3)</td>
<td>91 (28.0)</td>
<td>25 (34.2)</td>
<td>0.358</td>
</tr>
<tr>
<td>Dom 4 - Emotional Stability</td>
<td>28 (6.9)</td>
<td>26 (8.0)</td>
<td>2 (2.7)</td>
<td>0.182</td>
</tr>
<tr>
<td>HADS Score [mean (SD)]</td>
<td>11.25 (6.59)</td>
<td>11.31 (6.68)</td>
<td>10.74 (6.13)</td>
<td>0.501</td>
</tr>
<tr>
<td>4AT pre-op score [mean (SD)]</td>
<td>0.01 (0.30)</td>
<td>0.02 (0.33)</td>
<td>0.00 (0.00)</td>
<td>0.636</td>
</tr>
</tbody>
</table>
5.3 Multivariate analysis

Multivariate logistic regression models were created using factors that were significant in univariate testing and other variables that were considered clinically important to include in the study. In the following model, the seven significant univariate predictors of delirium were included with gender for an outcome of delirium (Table 5-3).

Table 5-3 Multivariate model 1 of peri-operative risk factors for post-operative delirium

<table>
<thead>
<tr>
<th>Model 1 - Labels</th>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age per unit increment</td>
<td>1.05</td>
<td>1.01</td>
<td>1.09</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.11</td>
<td>0.60</td>
<td>2.09</td>
</tr>
<tr>
<td>EuroSCORE, per unit increment</td>
<td>1.08</td>
<td>0.92</td>
<td>1.26</td>
</tr>
<tr>
<td>History of renal disease</td>
<td>1.33</td>
<td>0.38</td>
<td>4.40</td>
</tr>
<tr>
<td>Deranged full blood count</td>
<td>2.05</td>
<td>0.90</td>
<td>4.44</td>
</tr>
<tr>
<td>Deranged renal function</td>
<td>1.25</td>
<td>0.33</td>
<td>4.57</td>
</tr>
<tr>
<td>Visual Impairment</td>
<td>2.54</td>
<td>0.90</td>
<td>6.97</td>
</tr>
<tr>
<td><strong>Type of surgery (reference as coronary bypass)</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Valve surgery</td>
<td>1.26</td>
<td>0.62</td>
<td>2.60</td>
</tr>
<tr>
<td>Combined cardiac procedure</td>
<td>1.89</td>
<td>0.84</td>
<td>4.27</td>
</tr>
</tbody>
</table>

Adjusting for various covariates ‘age’ was significantly associated with risk of delirium (odds ratio 1.047, 95% CI, 1.006 - 1.090). Therefore, it can be seen that in this multivariate model, only age remains an independent predictor of delirium, with an estimated 5% increased risk for delirium per added year as shown in Table 5-3.

Both, EuroSCORE and pre-operative renal derangement were positively associated with risk of delirium; however, the confidence bands crossed the null and were not significant. Renal disease was included in the model with no renal disease being the referent. For the operation type, CABG was the referent and the adjusted risk of delirium in participants undergoing valve surgery was 1.26 (95% CI 0.62 to 2.60) and adjusted risk of delirium in participants undergoing both valve and coronary bypass was 1.89 (0.84 – 4.27).

The researcher used sequential models to explore the additive association between co-variates and occurrence of post-operative delirium (Table 5-2). The model co-variates were chosen based on the researcher’s clinical acumen according to STROBE guidelines.
Table 5-4 Multivariate model 2 of peri-operative risk factors for post-operative delirium

<table>
<thead>
<tr>
<th>Model 2 - Labels</th>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age per unit increment, years</td>
<td>1.05</td>
<td>1.01</td>
<td>1.10</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.18</td>
<td>0.61</td>
<td>2.27</td>
</tr>
<tr>
<td>EuroSCORE, per unit increment</td>
<td>1.10</td>
<td>0.94</td>
<td>1.29</td>
</tr>
<tr>
<td>HADS (Total)</td>
<td>1.00</td>
<td>0.96</td>
<td>1.05</td>
</tr>
<tr>
<td>Deranged renal function</td>
<td>1.89</td>
<td>0.88</td>
<td>4.05</td>
</tr>
<tr>
<td>Inpatient setting</td>
<td>1.71</td>
<td>0.59</td>
<td>4.97</td>
</tr>
<tr>
<td>Alcohol excess</td>
<td>1.34</td>
<td>0.52</td>
<td>3.48</td>
</tr>
<tr>
<td>History of arrhythmia</td>
<td>0.91</td>
<td>0.47</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Type of surgery (reference as coronary bypass)

<table>
<thead>
<tr>
<th>Model 2-4 Labels</th>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve surgery</td>
<td>1.27</td>
<td>0.61</td>
<td>2.63</td>
</tr>
<tr>
<td>Combined cardiac procedure</td>
<td>1.65</td>
<td>0.69</td>
<td>3.93</td>
</tr>
</tbody>
</table>

Table 5-5 Multivariate model 3 of peri-operative risk factors for post-operative delirium

<table>
<thead>
<tr>
<th>Model 3 Labels</th>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age per unit increment, years</td>
<td>1.07</td>
<td>1.04</td>
<td>1.11</td>
</tr>
<tr>
<td>Ventilation Time, hours</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Amount of sedation, milligrams</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Amount of analgesia, milligrams</td>
<td>0.86</td>
<td>0.52</td>
<td>1.43</td>
</tr>
<tr>
<td>Cardiopulmonary bypass time, minutes</td>
<td>1.00</td>
<td>1.00</td>
<td>1.01</td>
</tr>
</tbody>
</table>

In adjusted analysis, there was no significant association between the use of different types of opioids and delirium (Table 5-5). Compared to morphine, the odds ratio for oxycodone was 0.71 (95% CI 0.38-1.24). The odds ratio for other intravenous analgesia was 1.92 (95% CI to 0.64-5.74).

Table 5-6 Multivariate model 3 of peri-operative risk factors for post-operative delirium

<table>
<thead>
<tr>
<th>Model 4 Labels</th>
<th>Odds Ratio</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time, per hour</td>
<td>1.02</td>
<td>0.77</td>
<td>1.35</td>
</tr>
<tr>
<td>Oxycodone (referent morphine)</td>
<td>0.71</td>
<td>0.38</td>
<td>1.34</td>
</tr>
<tr>
<td>Other IV analgesia (referent morphine)</td>
<td>1.92</td>
<td>0.64</td>
<td>5.74</td>
</tr>
<tr>
<td>Age per unit increment, years</td>
<td>1.07</td>
<td>1.04</td>
<td>1.11</td>
</tr>
<tr>
<td>Cardiopulmonary bypass time, minutes</td>
<td>1</td>
<td>1</td>
<td>1.01</td>
</tr>
</tbody>
</table>
5.4 Summary of key findings

Four hundred and six patients were recruited and peri-operative data of 404 participants were collected at various stages of the participant’s journey in the unit marking different phases of this study. There was a range of validated tools and known predisposing and precipitating factors included in the data sets. Out of 73 patients who developed post-operative delirium, 68 were followed up 6-8 weeks after surgery. The SCID tool detected PTSS in only two patients at their follow up.

The comparison between pre and post HADS score showed that women had a higher Anxiety score before surgery and the HADS score reduced across both genders after surgery. In addition, pre-operatively older patients were less anxious compared to younger patients (Figure 5-2).

The multivariate analysis of the data showed that patients with renal impairment had a 1.8 fold increase risk of delirium in fully adjusted models; however, the confidence interval crossed the null. In the fully adjusted model, only ‘age at time of surgery’ retained significance as an independent predictor of delirium. It is worth speculating as to whether the study was underpowered, that is, would a bigger sample size allow showing a significant effect for other variables.

The fact that EuroSCORE is highly predictive in univariate testing (p<0.001) but not predictive in the multivariate model highlights that it is not supplementing any additional information about delirium risk beyond age alone. EuroSCORE is a validated risk assessment tool for surgical outcomes in cardiac surgery. However, it was not helpful for determining delirium risk in the present study and different approaches should be examined for the purpose. The other factors that are predictive in univariate testing (deranged bloods, renal disease, and visual impairment) are commonly seen in more complex or frailer patients. It may be that measures of frailty might capture this information and add to the prediction of delirium more than age.

In summary, from the analysed quantitative data on the patients who developed post-operative delirium, Age at time of cardiac surgery is the only co-variable attributed as a significant risk factor.
5.5 Discussion

This chapter evaluated the analysis of the quantitative data and discussed pertinent studies in specific areas that support interpretation of the findings.

Amongst the 404 participants recruited to this study, 73 developed post-operative delirium. Univariate analysis identified ‘age at time of surgery’ and ‘deranged renal function’ as the two covariates likely to contribute as risk factors for delirium. However, applying multivariate regression model to the data showed that 'age at time of surgery' was the only risk factor that could independently predict patients’ potentially developing delirium following cardiac surgery.

The researcher attempted comparison of these results to related studies (Zaal et al, 2015; Koster et al, 2011; Van Rompaey et al, 2008). Bilotta et al (2013) undertook a systematic review of studies identifying predictors and pre-operative risk factors for post-operative delirium. These risk factors were divided into four groups: demography; co morbidities; surgery and anesthesia-related components. Within the four groups, there were sub-divisions, specifying pre-disposing and precipitating risk factors in developing post-operative delirium. The researcher notes that the systematic review included all operations and cardiac surgery with the related co-factors (cardio-pulmonary bypass pump) was only one of the categories.

In an interesting systematic review of studies surveying ICU delirium by Zaal et al (2015), 33 studies were included. They substantially reported that age, dementia, hypertension, pre-ICU emergency operation or trauma, Acute Physiology and Chronic Health Evaluation II score, mechanical ventilation, metabolic acidosis, delirium on the prior day, and coma are risk factors for delirium. They clarified that gender was not associated with delirium, and that use of the drug dexmedetomidine led to lower incidence of delirium. Additionally, the review also stated that there was moderate evidence that multiple organ failure is a risk factor for delirium. Comparison made to the present study highlights the conspicuous differences in the causes for ICU admission. Secondly, the varied length of stay following cardiac surgery and any other general ICU admission is notably different, which in turn affects the ventilation and sedation timings and related adverse effects.
Dasgupta and Dumbrell (2006) undertook a systematic review on non-cardiac surgery patients. More than 95% of the studies showed association between age and post-operative delirium. This review stated that they did not find a significant relationship between deranged renal function and delirium following surgery. However it is important to note that this was a review of non-cardiac surgery patients and cardiac surgery is known to cause significant renal insult compared to other non-cardiac operations (Talar et al, 2005).

Böhner et al (2003) reviewed a vascular cohort of patients at risk of developing delirium. The study only included patients with advanced age and confirmed that patients over the age of 65 years are at risk of developing delirium. This was followed up by Balasundaram and Holmes (2007), confirming that, in addition to age, cognitive impairment and mood disorders can influence the risk of patients developing delirium. Within this specific patient cohort another study (Sasajima et al, 2000) supported the findings that age continues to be the strongest predictor for developing post-operative delirium. However, similar to the previous systematic review, compelling nonetheless, this study cohort had major differences with regards to use of extra-corporeal support in the form of cardiopulmonary bypass machine and length of ventilation. Another study, which closely supported the findings of the present research was by Marcantonio et al (1994), that showed that 9% of patients developed post-operative delirium in a large cohort (n=1341) of non-cardiac surgery patients. Independent predictors included age (>70 years or older) and abnormal pre-operative deranged electrolytes were shown to contribute towards the incidence of delirium. Though this study was published more than two decades ago, and on non-cardiac patients, their recommendation was of value, to risk stratify patients before surgery to improve overall surgical outcome. The researcher acknowledges that some of the above findings are dated to some extent and are not directly comparable as they were general surgery and/or general ICU not a cardiothoracic cohort of patients.

Kazmierski (2006) conducted a study on 260 patients who underwent open-heart surgery. On analysing the records of the 11.5% of the patients who developed delirium, advanced age was one of the significant factors along with cognitive impairment, atrial fibrillation, a history of peripheral vascular disease and major depression. Although there have been previous studies highlighting a link between depression or depressive symptoms and delirium, the patient cohorts have been non-cardiac (Benoit et al, 2005; Schneider et al, 2002). These studies encouraged the researcher’s interest in including depression assessment before and after surgery to identify a comparative value for significance. However, in this sample, depression
was not identified as a risk factor. This may be due to the small sample size being unable to draw any associations.

In parallel to the risk factor studies, there have also been multiple efforts undertaken in creating a risk prediction model with regard to delirium. Some of the notable systematic reviews were Van Meenen, et al (2014) on post-operative delirium; Chen, Yu and Zhang (2020), on ICU delirium; Lee, et al (2017) on ICU delirium following cardiac surgery and Wassenaar et al (2018) comparing two ICU risk prediction models. Rudolph et al (2009) developed a delirium prediction model for cardiac surgery patients. The independent factors presented in that study of 122 patients showed that a previous neurocognitive event, depression and deranged albumin levels were strongly associated with the risk of patients developing delirium following cardiac surgery. The recommendation was to closely monitor these patient groups and to implement interventions in order to reduce the incidence of delirium. However, the sampling was very selective and only patients above the age of 60 years were recruited in this study. Secondly, the data underwent careful multivariate analysis and the emphasis was on creating a prediction model. Likewise, in the present study, the researcher wanted to create a predictability in risk factors for delirium in cardiac surgery patients. However, unlike the Rudolph et al (2009) study, which was limited to age and type of surgery, the researcher was able to include a wider range of items.

There have been several attempts made to develop a delirium risk prediction model. However, a systematic review and independent external validation in cardiac surgery ICU patients undertaken by Lee, et al (2017) has brought an interesting point to light. The review showed that few models have been directly compared with one another or been validated in a non-partisan (independent) data set. The systematic review determined ratification of the risk prediction models of delirium (using the CAM-ICU tool) following cardiac surgery. They examined the flexibility and transferability of the risk prediction models on a prospective participant sample of 600 successive patients undergoing cardiac surgery at a university hospital in Hong Kong from July 2013 to July 2015. The review concluded that the present models predict delirium risk in ICU after cardiac surgery with a conservative margin of efficiency thereby making it far less reliable for day-to-day clinical application. The researcher maintains that creating a model for delirium risk prediction in cardiac surgery patients, will always remain challenging due to multiple strong co-variates. However, a good understanding
of the independent risk factors and an attempt made to modify their exposure is the safest way at present to manage the incidence and prevalence of post-operative delirium.

In the next section, the researcher focused on the most important finding from the quantitative data analysis that is the association between age and post-operative delirium. Following that, there is discussion on the other significant risk factors like renal function, length of Intensive Care Unit stay, pre-operative mood and personality in relation to post-operative delirium. The chapter finishes acknowledging the limitations along with recommendations to mitigate the study findings.

5.5.1 Age and post-operative delirium

The global population is ageing and the World Health Organisation (WHO) forecasts that by 2050, the population aged sixty years or more will double, whilst those aged eighty years or more will reach 400 million (McMurray et al, 2012). Ageing is commonly measured by chronological age and as a convention, a person aged 65 years or more is often referred to as 'elderly' (Orimo et al, 2006; WHO, 2010). This age related data should also be considered in association to healthcare and associated morbidity. There have been various conclusive studies highlighting this issue published in the last two decades specifically linked to delirium. This compelling rise in the longevity statistic is likely to impact on the number of older people requiring cardiac surgery. This in turn will see a consistent rise in the incidence of delirium unless means can be found to reduce and manage this risk.

Delirium is thought to occur in one third of older patients having emergency abdominal surgery (Engelberger et al, 2012), up to 50% of hip fracture patients (Lee et al, 2011) and in 9-11% of patients in heterogeneous non cardiac surgical cohorts (Flinn et al, 2009; Franco et al, 2001). Studies in various other surgical settings have found that age is a factor that plays a significant role in predicting post-operative delirium. Kaneko et al (1997) studied 36 patients over the age of 70 years undergoing gastro-intestinal surgery and found that 17% developed delirium. However, this study also assessed the role of sleep (or rather lack of sleep) in these older patients contributing to their delirium following surgery. The researcher recognises that there are not many studies undertaken in the area of sleep and delirium, possibly due to the practical
difficulties in measuring sleep. Additionally, though interesting, the researcher did not want to add another complexity to the present study by incorporating sleep.

Noimark (2009) found that the probability of developing post-operative delirium was much higher in older patients. Other related studies have also supported this finding (Koster et al, 2008; Tan et al, 2008; Afonso et al, 2010). With increasing age comes various co-morbidities (Rich et al, 2001), with one study indicating that 79% of hospitalisations for congestive heart failure (CHF) in USA occurs in persons over the age of 65 years. CHF is also shown to be a leading indication for hospitalisation in older adults. Additionally, CHF contributes to over 250,000 deaths in USA each year and 88% of these deaths are in persons over 65 years of age. So whilst age is clearly a main contributory factor, it may be the presence of other illnesses that leads to delirium (Böhner et al 2003; Litaker et al, 2001; Kalisvaart et al, 2005; Leslie and Inouye, 2011; WHO, 2012). Nonetheless, all these studies were undertaken on older patients in non-cardiac, general, vascular and orthopedic surgical settings. However, the researcher focused on studies where age is a considered risk factor for delirium in cardiac patients.

A study by Norkiene et al (2007) showed that out of 1367 patients, only 3% developed delirium. Additionally, of the eight factors identified towards developing post-operative delirium, age was identified to be the most prevalent component. As Goldberger, Peng and Lipsitz (2002; Pp 25) aptly points out that 'many cellular and organ processes deteriorate with ageing, resulting in a progressive loss of the ability to cope with physiologic stress'. Although, older patients may undergo operations with a low rate of complications, they are less able to endure surgical stressors compared to a younger patient. The above data clearly shows the link between age and delirium in all patients including and especially patients following cardiac surgery. Additionally, this age-related high incidence of delirium brings with it other linked issues. It is not only the incidence of delirium in the elderly which is a concerning factor, it is the delay in length of recovery and the associated personal and financial cost implications some of which may be long term. Between 32%-96% of elderly patients with new onset of symptoms of delirium will leave the hospital without resolution of the symptoms (Rudolph et al, 2010) and it may take weeks or months to resolve.

Delirium is also associated with loss of functional abilities and there may be a consequent loss of independence (Inouye, Westendorp and Saczynski, 2014). In the present study, of the 73 participants who developed delirium, 68 were followed-up in a review clinic 6-8 weeks (about
2 months) after discharge from the hospital. The participants in this study continued to remain delirium symptom free at the follow up clinic following surgery. There may be several reasons for this, most notably advancements in perioperative care including early mobilisation and physiotherapy. Additionally, this cohort of patients spends a relatively brief span of time in the Intensive Care Unit. This meant a limited period of inflammatory insult, reduced quantities of stronger drug use, and shorter lengths of invasive ventilation. These might have aided in their sense of re-orientation returning to normal. The association between delirium and prolonged mechanical ventilation has also been reported, for example in a meta-analysis conducted by Zhang, Pan and Ni (2013).

Another aspect for consideration is that age can usually be associated with frailty. Whilst ageing and frailty are often simplistically thought of as synonymous, they are distinct, though common mechanisms underlie both processes (Graham and Brown, 2017). Frailty is defined as a state of vulnerability to poor resolution of homeostasis after a stressor event (Clegg et al, 2013). Frail individuals have been found to be at increased risk of developing delirium (Leung, Tsai and Sands, 2011). Frailty in general does not always equate with illness but is an indication of compromised reserves. Therefore as cardiac surgery brings a sizeable insult on the body, such impacts should be something that the surgical team should plan for and in turn prepare the patients physically and psychologically for especially if patients are older or considered frail. The normal age-related decline in functional reserve, which results in a limited ability to respond to stress is called 'homeostasis' (Troncale, 1996). It is therefore relevant that not only older, but, older frail patients be identified before surgery by utilising appropriate validated tools, as advocated by the British Geriatrics Society (Turner and Clegg, 2014). "Frail" and "Fit" may be considered two ends of a continuum with the risk of post-operative delirium growing as one becomes increasingly frail (Jung et al, 2015).

The researcher considers not including a frailty marker in their pre-operative assessment could be argued as the main limitation in the current study and further research is proposed focusing on this area. For patients with multiple morbidities, nearing the end of their life, using a goal oriented rather than the traditional disease oriented approach to collaborative decision-making is advisable (Reuben et al, 2003). Therefore, when the clinical team assesses the patient, the first step would be to identify the patient's overall life goals if possible using open-ended questions, define the disease entities, prognosis and treatment options and then offer
recommendations including all the above information. This may be initiated by the Primary Care Team and followed up by the Medical team before referring a patient for surgery.

As discussed, older people are at higher risk of developing delirium and its long-term consequences. These potential complications should be fully discussed with the patient prior to surgery. Following this consultation and understanding the consequential pathway, if the patient is agreeable to go ahead with the operation, the next key point is 'informed consent'. Even well-educated patients may have difficulty grasping concepts of risk (Apter et al, 2008). Decision aids may improve patients' understanding of their condition, treatment options, and outcome probabilities (Coulter and Ellins, 2007). It might also influence a patient's decision to avoid surgery in favour of less-invasive treatments (Légaré et al, 2011). Following the results of this study, the researcher, in their unit has re-visited the importance of a ‘Heart Team’ that includes multi-disciplinary involvement from the point of patients being referred for cardiac surgery. This is a multi-disciplinary team including different relevant staff groups and various appropriate, representative specialties. They support and advocate a safe decision-making process.

5.5.2 Renal dysfunction and post-operative delirium

In the present study, multivariate analysis did not show a significant association between deranged renal function and delirium. However, the researcher would like to emphasise that the results of univariate analysis were significant therefore; it is argued the finding may have been under powered in the present study and that renal function should be explored and discussed in relation to clinical implications. Additionally, this study used the EuroSCORE (cardiac risk prediction score) calculator which marks the creatinine clearance rather than the isolated serum creatinine level (Nashef et al 2012) which may have influenced the findings.

Pre-operative compromised renal function has been identified as a potent indicator of mortality following cardiac surgery for more than two decades (Mangano et al, 1998; Roques et al, 1999) and supported by a subsequent study in the same area (Tan et al, 2008). Drug metabolism by the kidneys is affected in the older patient due to a decrease in the volume of distribution of hydro soluble drugs and a decreased rate of renal excretion of drugs (Cova and Balducci, 2004). Ageing renal cell mass gradually declines from 250-270 g at age 50, to 180-185g at age 90.
(Adkins et al, 2003). The result is a decrease in the glomerular filtration rate of approximately 1ml/kg/1.73m² per year after 40 years of age (Adler, 1968). This, resulting renal insufficiency leads to toxin build up in the system potentially contributing to transient cognitive impairment presenting as delirium (Sasajima et al, 2012).

The impact of acute kidney injury on post-operative delirium can be mitigated in the following ways. The first step is optimising the patients before surgery (pre-habilitation). Following that enhancing intra-operative set up for example using off pump techniques rather than cardiopulmonary bypass (SCTS Blue Book, 2013) and shortening cardiopulmonary times (Hausenloy and Yellon, 2015) would also be helpful. Another significant change would be to improve the haematocrit value to between 21% and 25% (Saczynski et al, 2012) and by achieving sufficient levels of oxygen delivery (Vives et al, 2014). Though it is common, acute kidney injury is usually reversible, fully or partially, but it is also a factor where the risk can be reduced before surgery. Optimisation for surgery is discussed in more detail in the ERAS (Enhanced Recovery after Surgery) section (Section 5.5.5).

Age clearly is a pre-disposing risk factor; however limiting modifiable precipitating factors like deranged renal function can improve outcomes. The researcher discusses some of the relevant points related to study findings for mitigating these risk factors, optimising patients before surgery to reduce the incidence of delirium. Smulter et al (2013), differentiates between pre-disposing and precipitating factors contributing to delirium in older patients after cardiac surgery with cardiopulmonary bypass. The results suggested that when combining the two sections, the predictive power of the model was boosted, thereby emphasising the strength of preventive approach within the precipitating factors. The researcher therefore suggests reviewing the following factors – Polypharmacy, Pre-habilitation and Enhanced Recovery in their present practice focusing on improving the pre-operative state of patients referred for cardiac surgery.

5.5.3 Polypharmacy

Half of older adults receive a dose of potentially inappropriate medication during their surgical hospitalisation (Finlayson et al, 2011). Therefore, all pre-operative medications should be reviewed, and inappropriate medications should be stopped using START & STOPP (Screening Tool for Older Persons’ potentially inappropriate Prescriptions) criteria (Barry et al
5.5.4 Pre-habilitation

Pre-habilitation is a growing approach shown to be effective in patient optimisation before major surgery and minor procedures. Pre-habilitation is a process of enhancing functional capacity pre-operatively to facilitate a patient's ability to withstand physiological stress (Ditmyer, Topp and Pifer, 2002).

Some studies on small heterogeneous samples using single interventions like strength training have generated mixed results on older patients undergoing general and cardiovascular surgery (Carli et al, 2010; Jack, West and Keck, 2011; Mayo et al, 2011). More recently, there has been encouraging work undertaken in this field looking at multi-modality interventions. A study by Li et al (2013) demonstrated that in 81% of older patients undergoing colorectal procedures, applying tri-modal pre-habilitation programs including nutritional supplementation, anxiety reduction and a prescribed exercise program led to a return to baseline function at 8 weeks postoperatively in comparison to only 40% in the pre-intervention control group. Another landmark study undertaken in a before and after design on the effect of preoperative comprehensive geriatric assessment and multi modal pre-habilitation education including home exercise, nutrition, relaxation techniques and pain management demonstrated promising results. Patients who underwent the intervention were significantly optimised. It helped reduce their risk of developing pneumonia (20% in standard care vs. 4% with pre-habilitation), delirium (19% vs. 6% respectively). Additionally, length of stay also fell from an average 16 to 12 days with the intervention (Harari et al, 2007). These studies have shown that prehabilitation positively affects the patient journey by reducing the incidence of delirium through influencing the multi-factorial nature of risk factors precipitating delirium.

Both these studies encourage the researcher’s view on advocating the pre-habilitation model, which supports information and education on important aspects of change during the recovery process. This entrusts patients and their families to take ownership of their diet, nutrition, smoking cessation, managing alcohol intake, which in turn optimises and prepares the patients...
for the anticipated surgical insult. A significant effort may be required in terms of education for primary care and medical teams to empower them to identify health goals especially for older patients before referring them for cardiac surgery. Nurse Practitioners in the cardiothoracic department are in a unique position to identify these patients before surgery and recommend them to specialist teams for pre-habilitation (for example referring to smoking cessation team or dietician to optimise patients before they are scheduled for surgery).

5.5.5 ERAS: Enhanced Recovery after Surgery

ERAS is a global effort to deliver standardised peri-operative care resulting in reduced complications, improved patient experience and efficient use of health care resources (Pędziwiatr et al., 2015). This concept has been used in colorectal surgery successfully for almost two decades (Kehlet, 2015). A systematic review and meta-analysis undertaken by Noba et al. (2020) determined that the application of ERAS protocol reduces length of stay and risk of complications thereby making significant savings on hospital resources. A prospective observational pilot study in this area was undertaken by Fleming (2016) to assess the feasibility of pre-operative care bundle for enhanced recovery following cardiac surgery. The researchers clearly showed a feasibility and potential for improving post-operative morbidity after cardiac surgery. The focus was on reducing well known complications of cardiac surgery like delirium by 46% (Saczynski et al., 2012) and acute kidney injury by 30% (Vives et al., 2014) and associated mortality by almost 50% (Chertow et al., 1998).

The peri-operative ERAS bundle includes avoiding prolonged periods of fasting, pre-operative carbohydrate drinks and anaemia prevention. Intra-operatively, there is utilisation of short-acting anaesthetic drugs, lung protective ventilation, and timely antibiotic administration. Post-operatively, a continuing multimodal analgesic regime avoiding long-acting opioids, early extubation, followed by mobilisation, enteral nutrition following surgery and appropriate treatment of nausea and vomiting are employed. The guidelines also focus on delirium prevention, screening and early management (ERAS, 2015). The present study pre-dates the inception of ERAS in the cardiothoracic unit at the researcher’s hospital. In the centre where the researcher practices, ERAS was at its infancy during the study period. A few complimentary steps were underway at the data collection phase (for example improved information sharing amongst patients and staff, encouraging smoking cessation, reviewing pre-operative fasting times and peri-operative nutrition and hydration). However, this study has
now galvanised the concept and work is underway to establish a standard ERAS framework in the centre. The researcher believes that even slight changes along the patient pathway can complement the process of ERAS thereby reducing the risk of developing delirium following surgery. The researcher recommends more focus should be placed on the fundamental aspects of ERAS to optimise the care and reduce the incidence of delirium and associated peri-operative mortality following cardiac surgery.

5.5.6 Diagnoses of Delirium

All studies reviewed by the researcher related to delirium following cardiac surgery used psychiatric interviews or validated assessment tools to diagnose delirium. Most studies used DSM-IV (Diagnostic and statistical Manual of Psychiatric disorders) criteria or the CAM (Confusion Assessment Method) and others used ICD-10 (International Classification of Diseases) and only a few used MMSE (Mini Mental State Examination).

The utilisation of either DSM-5 or ICD-10 is recommended as the reference standard diagnostic criteria for delirium assessment (Kotfis et al, 2018). According to DSM-5, the criteria for delirium are disturbance of attention, developed over a short period (hours or days), changes from baseline, fluctuated in severity during the day and additional disturbance in cognition (Table1-1). The disturbance is a direct physiologic consequence of another medical condition, substance intoxication or exposure to toxin, substance withdrawal, or because of multiple aetiologies (DSM-5, 2013). Katznelson et al (2010) showed that using reliable tools could enhance appropriate screening of delirium. This review also highlighted that the type of delirium that get identified most commonly is the hyperactive and hypoactive types of delirium get under reported due to the subtle nature of the presentation. Therefore, it is important for clinicians to utilise appropriate tools to make accurate diagnoses of delirium early in order to facilitate timely treatment and supportive management.

The delirium assessment tools applied in the department where this study was conducted are CAM-ICU and 4AT on the ward and clinic setting. However, prior to commencement of the present study, it was noted in the Cardiothoracic ICU, that a significant number of delirium cases were being missed and therefore untreated. On further enquiry, this was attributed to a limited understanding in the use of delirium screening tools. The researcher undertook an audit cycle to address this concerning gap in the knowledge that lead to mismanagement of the
condition. After a three-week education session, with regular follow up training, there was a remarkable increase (83%) in the incidence of delirium compared to before the education and training sessions. On further examination, it was clear that, rather than an increase in the number of patients with delirium, the prevalence was a reflection of the effect of focused delirium assessment training programme. It clearly increased the understanding of delirium diagnostic and screening methods. This data was presented and discussed at the Unit Mortality and Morbidity meeting.

Knowledge is clearly necessary but by itself is insufficient to bring about change in behaviour and learner outcome (Davis et al, 1999). However, there is some evidence that interactive CME (Continuous Medical Education) sessions that enhance participant activity and provide the opportunity to practice skills can affect change in professional practice and bring about positive health care outcomes. Two years later, during the initial data collection phase of the present study, the researcher noted reduced incidence of delirium recorded following cardiac surgery. On discussion with MDT (Multi-Disciplinary Team) and review, the transient drop was attributed to a number of factors. The trend though very reassuring also highlighted the improvement in practice that was undertaken in delirium care and management in the unit. Significant efforts had been undertaken by the MDT on the patient pathway, which clearly reflected on the prevalence of post-operative delirium. Patients at higher risk of developing delirium were identified at the pre-operative clinic. Early interventions like smoking cessation were instituted as early as possible. Patients who were known to the clinical team with a history of excess alcohol consumption were prescribed a supported withdrawal programme. The researcher observed the focus was on pre-operative education and maintaining delirium care standards, which includes screening and timely diagnoses. Reinforcing this concept, Tauro et al (2014) stated that education improves understanding and awareness of delirium and a care pathway focuses attention on this area, improving patient safety and quality of care.

A systematic review undertaken by Estabrooks, Wallin and Milner (2003) features individual determinants of research utilisation and clarifies this relationship of research education reflecting on health provision. Chow et al (2015) showed that nursing knowledge and documentation of delirium using the CAM as well as nursing confidence in identifying delirium all significantly increased after a formal geriatrician guided educational intervention. A later publication by Byrnes (2019), as part of their thesis also corroborates with the same theory that the use of delirium education was found to be a supportive tool to improve nurse's knowledge
of delirium prevention and management. They added that continued education is necessary to help the team to stay up to date with the knowledge.

The researcher strongly agrees with the finding and supports having 'Delirium Champions' that undertake this role as part of ongoing Quality Improvement. This was clearly seen when the researcher visited the John Munk Cardiac Institute in Toronto, Canada. There is an established multi-disciplinary team focusing on delirium related quality improvement projects, education, research and audit and this clearly has an impact on their incidence of delirium and avoids unexpected burden on their clinical teams and resources. Consultant Psychiatrist, Dr. Sanjeev Sockalingam, whose landmark study (Sockalingam et al, 2005) on post cardiac surgery delirium has been significant in the field, leads this team. This was a forward thinking set up for the researcher to see in 2013. The team leads on delirium related initiatives, monitors trends through audit, facilitates education on latest evidence-based research and is effective in controlling and managing delirium. It was a positive experience demonstrating the application of appropriate services designed to identify and manage this group can make a significant difference to “real world” patients in a clinical setting.

5.5.7 Delirium and PTSS

One primary research question in this study was to identify one of the delayed sequelae of delirium in terms of PTSS in patients who had delirium following their cardiac surgery. In the next section, the researcher discusses further findings of the study in relation to the psychological sequel of Anxiety, Depression, and PTSS.

In this study, the participants who developed post-operative delirium were initially followed up 6-8 weeks after discharge from the hospital. Subsequently, 16 participants were selected to be followed up three months after the operation. The primary outcome was assessing for PTSS. Surprisingly but reassuringly, the prevalence of PTSS was only 3% in this cohort. The SCID tool also assessed anxiety and depression in relation to posttraumatic stress symptoms. The participants were also assessed for anxiety and depression before and after surgery. Interestingly, the cumulative HADS scores improved following surgery. Only two patients presented with increased levels of anxiety requiring post-operative specialist psychiatric referral.
A systematic review by Langan et al (2017) reported on psychiatric consequences following delirium. The review included 370 patients with delirium and more than 100 patients without delirium in various clinical groups. They found that depressive symptoms were almost three times higher in patients with delirium than in patients without delirium. However, statistically there was no significant difference shown in anxiety levels in both groups. Rothenhäusler et al (2005), on the other hand, showed different results. On follow up of 34 patients post Cardio Pulmonary Bypass, not only had a relatively high number of patients developed delirium but of those who did, all 11 patients showed consequential short term adverse events like features of depression, six developed PTSD, six major depression and 13 patients had clinically significant cognitive deficits. However, at the 12-month follow up, the severity of depression and anxiety disorders were shown to be markedly improved. There was not a similar recovery in the cognitive function scores resulting in impaired HRQOL. Rothenhäusler’s (2005) study was undertaken more than a decade ago. Since then, there has been tremendous improvement in cardiac surgery techniques, delivery of anaesthesia, types of analgesia and length of stay in Intensive Care Unit. Secondly, the Rothenhäusler study cohort was noticeably different, carried out on a small number of participants and the tool used for PTSD was PTSS-10, which has some limitations. It was too sensitive as it was tested for reliability and consistency on a selected sample of German Armed Forces, mainly young men. Therefore, there are some variation and limitations of these findings in relation to the current study. However, conversely the present study acknowledges the reduced period for follow up was an unavoidable limitation due to the study being part of an academic PhD programme.

Rymaszewska et al (2003) recorded depression in 26%, three months after CABG, Blumenthal et al (2003) found 38%, six months post CABG and Pirraglia et al (1999) documented 26%, six months following CABG. Though these studies have included all patients following coronary surgery, delirium was not a criterion for inclusion. However, a study undertaken by Tully (2010) showed clear links between major depression and incident delirium following surgery. The 158 patient cohort in this study like the present inquiry also underwent cardiac surgery. Davyddow (2009), in the systematic review suggested that depression and anxiety are sequelae of within-hospital delirium and thus the delirium and affective disorder association is likely to be bi-directional. Analysis of the data in the present inquiry, demonstrates that there may not be an association between post-operative delirium and subsequent psychological consequences.
A key issue is that the present study has found different results compared with earlier studies. The researcher speculates that this could be due to several reasons, including advances in care but also differences related to measurement in terms of variation in assessment methods. Another point the researcher highlights is the paucity in studies related to cardiac surgery and PTSS related to delirium. A recent study undertaken by Marra, Pandharipande and Patel (2017) examined Intensive Care Unit delirium and ICU-related PTSD. An important issue highlighted in this study was managing sedation appropriately; as suggested over-sedation can lead to inadequate information processing which in turn can delay recall and may cause PTSD (Granja et al, 2008). McGiffin, Galatzer-Levy and Bonanno, (2016) proposed attending to depressive symptoms before a critical care admission might reduce the incidence of Post–ICU PTSD. Garrouste-Orgeas et al (2012) advocated involving family members and carers in recording ICU diaries to help minimise PTSD. The researcher points out that cardiac surgery is mostly an elective procedure and that ICU stays are relatively shorter duration. In addition, many patients benefit from better physical health after surgery compared to compromised living due to heart problems before surgery. Post-operative recovery may also improve their exercise tolerance affecting their general well-being after surgery.

In conclusion, to this section, this study has tried to investigate the psychological after-effects of delirium. Though the primary focus of the study was on PTSS, the other aspects of psychological derangements like depression and anxiety were not overlooked. In the present study, two participants required referral to specialist psychiatric teams for follow up for persistent levels of high anxiety and depression. However, the results highlight that these patients had scored high in their pre surgery HADS score as well.

The topics discussed in the remainder of the chapter are critical urgency of operation, influence of personality traits as a risk factor to developing delirium, Intensive Care Unit stay and long-term functional decline following post-operative delirium.

5.5.8 Urgency of operation and associated preparation

Ansaloni et al (2010) evaluated the risk factors associated with post-operative delirium in elderly patients undergoing general surgery. Out of the 351 patients enrolled in the study, 17.9% of the cases were classified as emergency procedures and 13.2% of patients developed delirium. Another similar study undertaken by Koebrugge et al (2010), on a vascular cohort of
patients where the overall incidence of delirium was 23%, only 14% were elective and a significant number of 59% were emergency operations. However, in the present study the analysis of data showed that the recruited patients were either elective or urgent inpatients. The emergency patients were excluded from the study as per the study criteria. There was no direct link found between incidence of delirium and urgency of cardiac surgery in the selected cohort.

5.5.9 Personality trait and post-operative delirium

A conceptual framework of depressive and anxiogenic disorders proposed by Watson (1989) inferred those disorders with a high negative affectivity component, that is, generalised anxiety disorder, will be associated with delirium more than panic disorder. This study also evaluated persistent personality traits with respect to delirium, that is, the specific combination that negatively affects morbidity outcomes in cardiac patients (Denollet, 2005).

A study conducted by Shin et al (2016) demonstrated that a personality trait of neuroticism and conscientiousness might affect elderly patients' risk of developing delirium. They also found that this theory was applicable if patients were undergoing the procedure under regional anesthesia. Therefore, the findings of this study have propelled the debate but there is no significant evidence base to support a connection between personality trait and risk of developing delirium. Additionally, Smith et al (2004), who studied personality traits and delirium, showed that hostility, a sub factor of neuroticism, could be suggested to be a strong risk factor for the development of physical disease such as coronary artery disease. Yet there is no strong evidence to link hostility to delirium directly in the plethora of personality trait studies published in the last two decades. A related point about personality trait and PTSD proposed by McGiffin et al, (2016) was that expansive personality traits including extraversion and conscientiousness showed greater resilience to PTSD compared to neuroticism and negative emotionality.

In the present study, the TIPI scale was used to identify a patient’s personality before surgery to consider any link to post-operative delirium. However, there was no clear association between a particular personality domain and post-operative delirium.
5.5.10 Length of ICU stay

Identifying patients prior to surgery at greater risk for delirium could lead to early intervention and appropriate management in the intensive care unit as a delirious state is associated to within-hospital falls {Hill, Vuu and Walsh (2007)}; longer hospital stays {Stevens et al (1998)}; increased mortality risk {Norkiene et al (2007)} and increased costs {Leslie et al (2008)}. Patients after cardiac surgery routinely stay in the ICU for an average of 12 hours. The striking message in the study published by Griffiths and Jones (2007) was that 'awake' intensive care unit patients are not necessarily free of significant brain dysfunction. They concluded that long-term implications, particularly debilitating conditions such as PTSD meant that there is need for improved post intensive care unit rehabilitation care.

The dramatic extent of cognitive decline in general ICU patients was demonstrated by a study published by Pandharipande et al (2013) who followed patients for a year after admission to a mixed medical/ surgical ICU with respiratory failure or cardiac or septic shock. The results from this observational study showed that at 12 months up to a third patients had cognitive scores similar to patients with traumatic brain injury or mild Alzheimer's disease. A significant point highlighted in this study was that longer duration of delirium corresponded with worse global cognition and executive function.

The researcher highlights the difference in length of ICU stay has an overall impact on the cognitive states of the participants. The average length of stay on ICU for the participants in this study was 24-48 hours. And the results reported show that the seven patients who had longer than average stay due to various medical reasons and developed delirium did not show any functional or cognitive decline.

5.5.11 Long term functional outcomes after cardiac surgery

Post-operative delirium has been associated with functional decline at one month following cardiac surgery and subsequent deterioration in functional capacity in one year (Rudolph et al, 2010). Koster et al (2011) showed quality of life affected in 300 cardiac surgery patients affected by delirium. Although the researcher was rigorously assessing only for symptoms of any residual delirium or PTSS, informal review did not show participants altered by any significant functional or cognitive decline. Another study by Rudolph et al (2007) assessing
functional outcomes of 602 patients, 6-8 months following surgery showed that there was evidence of functional decline at 12 months, after adjustment for age, cognition, co morbidity and baseline function. However, the study concluded that this trend was found to be statistically insignificant. The present study appears to be in line with this review paper and from the findings, it appears that routine cardiac surgery and the relatively limited amount of ICU stay may have reduced the incidence of post-operative delirium and subsequent PTSS.

5.6 Strengths and limitations in relation to the findings

Strengths of the study include its prospective and detailed study design in phases capturing the whole spectrum of the event (delirium) providing a comprehensive story. The main strength of the study is the sample size and the use of consecutive participant allocation, thereby reducing the chance of selection bias.

One of the limitations of the study was inability to diagnose patients with PTSD by a specialist psychiatry health professional as shown in some previously published studies. However, the researcher took advice from experts on the most effective tool to use which changed the methodology but maximised the ability to detect symptoms. Two patients with known cognitive impairment were excluded, as the researcher did not wish to disturb a well-set up-pathway for these patients. This could be considered as a limitation to the study as cognitively impaired patients have a higher likelihood of developing delirium (Sanders et al, 2014). The researcher also felt that pre-operative frailty assessment information would have been a significant addition and therefore limiting the explorative range of this study. Another category (n=1) that was excluded from the second phase of the study were patients who developed difficulty related to speech impairment following surgery, for example stroke. This was because the validated tools could not be applied on those with such impairment. In addition, the study was carried out in a single tertiary centre; therefore, the findings may not be directly applicable in other areas.

5.7 Conclusion of findings

The main finding of this study is that of the measured variables, ‘age’ was the only factor that was associated with post-operative delirium. The rate of delirium was comparable to other studies. This study did not find an association between pre-operative depression and anxiety
states and incidence of post-operative delirium. Additionally, there was no association between any personality domain and delirium.

The study also reviewed the psychological after-effects of post-operative delirium. Only two patients with delirium developed PTSS. This is an interesting and important discovery that to some extent conflicts the findings in some other studies that have shown that delirium is linked with PTSD and PTSS. This finding requires further evaluation in relation to exploring the factors in patients with delirium that modify the risk of PTSS. These factors could include duration of ICU stay, sedation practice, timing of rehabilitation and the overall approach to psychological care. The results also suggest there was a significant reduction in HADS A score after surgery (p<0.001) however the point to highlight is that the pre-op HADS score was not associated with delirium. This thesis is about delirium rather than the relationship between cardiac surgery and anxiety levels, however, the researcher recognises that it is still an important finding is therefore highlighted.
This chapter includes a detailed description of the approach used to collect and analyse the qualitative data. The qualitative data provided a rich insight into the feelings and experiences of the participants undergoing cardiac surgery, which could not have holistically been covered using the quantitative approach. The section concludes with the strengths and limitations of this part of the study.

To explore the patients’ experience of delirium in hospital and its possible after-effects, the researcher developed a semi-structured questionnaire. Drawing from the researcher’s clinical experience, and review of relevant literature, a topic guide was created with questions that included focal issues that would provide a framework to the interview session. This set-up would lead the direction of questioning and subsequent discussion. The researcher hoped that the key questions would elicit maximum relevant information. It was also felt that it would give the patients the opportunity to ask some unanswered questions a few weeks after the actual event of post-operative delirium. In addition, at this point, it would possibly also give the participants an opportunity for closure if desired, perhaps from the acute, short-term physical discomfort, their transient psychological derangement, the upheaval of having heart disease and then recovering from major surgery.

6.1 Research Aim

The overall aims of the study were to identify the incidence, peri-operative risk factors and explore patient experiences of post-operative delirium and possible associated post-traumatic stress syndrome following cardiac surgery. This section endeavours to delve further and highlight the depth of the participant’s encounter with post-operative delirium.

‘Researchers have to be clear and transparent as to what they have brought to the table by way of expectations or commitments’

- McLeod and Balamoutsou (2001, Pp. 204)
6.2 Participants

6.2.1 Selection and recruitment for this section

The study was undertaken in the cardiothoracic unit in a large teaching hospital in central Scotland. At the outset of the study, participants were consented after being given comprehensive information regarding the study objectives, phases and follow up plans. This included the 6-week follow up in the hospital and possibly a three-month post-operative telephone interview. There was an informed consent taken at all stages, written at the start phase-I, followed by verbal confirmation at phase IIa and Phase IIb. The researcher confirmed the date and time of the first outpatient visit at the time of participant’s discharge from the hospital. All patients undergoing cardiac surgery routinely attend a follow up clinic arranged by the cardiac surgeon to review the patients around six weeks following discharge from the hospital. The researcher carried out the study follow up to this existing clinic.

At the first face-to-face follow up, only validated tools were used which largely supported the completion of the quantitative dataset (Table 6-1). As well as the Clinical Research Form, the researcher took notes accompanying the clinical information. These notes had more detailed reflections on the participants’ condition and background that helped the researcher to develop a bond and build a relationship beyond the existing clinical record. This also facilitated the process of reflexivity within the research environment and assisted the decision to select patients for phase IIb. At the beginning of the telephone interview, the researcher obtained verbal consent in addition to the initial formal written consent as part of processual consent.

During the second follow up, which was conducted via telephone, the researcher used a topic guide (Appendix 13) to navigate through the semi-structured interview. This interview formed the basis of rich qualitative data that assisted in understanding the patient’s real journey as they recovered following post-operative delirium.
Table 6-1 Study Follow Up Schedule

<table>
<thead>
<tr>
<th>4-6 weeks after discharge</th>
<th>12-15 weeks after discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to Face consultation</td>
<td>Telephone consultation</td>
</tr>
<tr>
<td>• 4AT</td>
<td>• 4AT</td>
</tr>
<tr>
<td>• HADS</td>
<td>• SCID</td>
</tr>
<tr>
<td>• PCL – For PTSD**</td>
<td>• Qualitative semi-structured Interview</td>
</tr>
</tbody>
</table>

4AT: Four ‘A’s Test for screening delirium; HADS: Hospital Anxiety and Depression Scale

PTSD: Post Traumatic Stress Disorder; PCL- PTSD Check List

SCID: Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders

6.3 Sampling

For qualitative studies, the aim is to collect and understand in-depth information in a smaller number of patients compared to the quantitative approach as demonstrated in this study. Out of the 404 patients, 73 patients developed post-operative delirium and were therefore eligible to participate in phase IIa of the study. Of these, 16 were selected and agreed to participate in the interview process in phase IIb of the study. The researcher used ‘purposive sampling’ (Tables 6-2 and 6-3) for this section to identify patients who appeared to be able to provide a detailed history and who were invested in telling their stories and hoping to better understand their issues with delirium. The researcher also aimed to have a spread of age group, gender and type of surgery (Table 6-4). To ensure adequacy of the study sample, it was useful for the researcher to consider the concept of saturation, which can add to the quality of the research (Endacott and Botti, 2005).
Table 6-2 Phase IIa Inclusion/Exclusion Criteria

**Phase IIa**

*Inclusion criteria*
- Diagnosed with post-operative delirium during their hospital stay
- Patients able to attend a follow up clinic for face-to-face interview.

*Exclusion criteria*
- Patients who continued to remain in a hospital at the time of follow up
- Patients who are unable to communicate due to post-operative complications, for example stroke.

Table 6-3 Phase IIb Inclusion/Exclusion criteria

**Phase II b**

*Inclusion criteria*
- All patients noted to be positive for Post-traumatic Stress Syndrome were included in phase IIa
- Purposive sampling method was used to identify patients who would provide depth and diversity of responses (Patton 2002)

*Exclusion Criteria*
- Once the study reached a saturation point.
Table 6-4 Demography of participants in Phase IIb

<table>
<thead>
<tr>
<th>Participant Number</th>
<th>Age Group</th>
<th>Gender</th>
<th>Type of Cardiac Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50-55</td>
<td>Female</td>
<td>Coronary surgery</td>
</tr>
<tr>
<td>2</td>
<td>65-70</td>
<td>Male</td>
<td>Valve surgery</td>
</tr>
<tr>
<td>3</td>
<td>60-65</td>
<td>Female</td>
<td>Valve surgery</td>
</tr>
<tr>
<td>4</td>
<td>60-65</td>
<td>Male</td>
<td>Coronary and Valve surgery</td>
</tr>
<tr>
<td>5</td>
<td>70-75</td>
<td>Male</td>
<td>Coronary Surgery</td>
</tr>
<tr>
<td>6</td>
<td>80-85</td>
<td>Male</td>
<td>Valve Surgery</td>
</tr>
<tr>
<td>7</td>
<td>75-80</td>
<td>Female</td>
<td>Valve surgery</td>
</tr>
<tr>
<td>8</td>
<td>55-60</td>
<td>Female</td>
<td>Coronary surgery</td>
</tr>
<tr>
<td>9</td>
<td>75-80</td>
<td>Male</td>
<td>Valve Surgery</td>
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<tr>
<td>10</td>
<td>80-85</td>
<td>Male</td>
<td>Valve surgery</td>
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<tr>
<td>11</td>
<td>65-70</td>
<td>Male</td>
<td>Coronary surgery</td>
</tr>
<tr>
<td>12</td>
<td>70-75</td>
<td>Female</td>
<td>Coronary and Valve Surgery</td>
</tr>
<tr>
<td>13</td>
<td>50-55</td>
<td>Female</td>
<td>Coronary Surgery</td>
</tr>
<tr>
<td>14</td>
<td>60-65</td>
<td>Female</td>
<td>Coronary Surgery</td>
</tr>
<tr>
<td>15</td>
<td>70-75</td>
<td>Female</td>
<td>Coronary and Valve Surgery</td>
</tr>
<tr>
<td>16</td>
<td>65-70</td>
<td>Male</td>
<td>Coronary and Valve surgery</td>
</tr>
</tbody>
</table>

The meaning of saturation and how this is achieved is distinctive for different methods (Fusch and Ness, 2015). Presently, there are several models relating to saturation in qualitative research (Saunders and Lewis, 2017). Some researchers have determined that further supplementary factors can influence a qualitative sample size, and therefore saturation in qualitative studies.
The seven factors that might affect the potential size of a sample: “the heterogeneity of the population, the number of selection criteria, the extent to which ‘nesting’ of criteria is needed, groups of special interest that require intensive study, multiple samples within one study, types of data collection methods use and the budget and resources available.”


Jette, Grover and Keck (2003) suggested that expertise in the chosen topic could also reduce the number of participants needed in the study. In this case, the researcher was guided by their two decades of experience in the cardiothoracic specialty. The knowledge of the process and the expertise in looking after the patients in this specialty proved invaluable. The researcher acknowledges the obvious role conflict, yet also the advantage of being embedded in the clinical team providing a better understanding of the processes and pathways referring to the Emics and Etics: the insider/outsider debate (Headland, Pike and Harris, 1990).

Emic is the insider perspective and Etic is the outsider perspective, however, the researcher feels that through this dichotomy, there is an internal negotiation and dialogue to create an enriched viewpoint. The process can also add strength to the project by adding depth and breadth to it. Buckley et al (2014) highlighted that emic option and qualitative arrangements can create novel concepts that can reveal interesting factors adding to the context of the research and practice. The researcher managed to travel between the roles of a scientific observer/social analyst to being part of the care provider team without compromising the related beliefs and credentials. The researcher in their clinical role participates as a care provider for patients on the cardiac surgery pathway. Within that role, there is a good understanding of the surgery and the related processes. This helped in making the patients comfortable from the outset and the participants were confident with the level of care provision. However, the ethical principles of the research study guided the researcher’s engagement with the patients who participated in the study. The researcher was clear with the patients at the time of consent and continued to remind the patents and self about the importance of this merged separation of roles.

The researcher planned to enroll between 20-25 patients out of the 73 participants in phase IIb of the study. Strauss and Corbin, (1998) and (1990) suggested that saturation is a 'matter of
degree'. According to them, when the inquiry reaches a point when the content being uncovered does not add anything more to the overall story, this is the point of saturation. Theoretical saturation is inextricably linked to the practice of theoretical sampling and concurrent practices of data collection and analysis in grounded theory (Hennink, Kaiser and Marconi (2017); Morse (2015); O’Reilly and Parker (2013); Saunders and Lewis (2017), Vasileiou et al (2018). These papers emphasized that theoretical saturation cannot be estimated prior to the data collection process. As the interview process progressed, similar themes began to emerge and increasingly familiar experiences and concerns were expressed. This nevertheless created richer data with every additional sigh of relief that the operation was over, the nervous laughter while remembering certain episodes, the dismay that the physical symptoms had not completely resolved and also the pleasant surprise for some participants with regard to the rate of recovery after an operation deemed to be a ‘major’ procedure.

Nelson (2017) promoted ‘conceptual density’ or ‘conceptual depth’. However, the researcher was keen to be influenced by the quality that is the richness, diversity and complexity of the data rather than simply the quantity of data as suggested by Fusch and Ness (2015). By the 12th patient, the themes were becoming repetitive and no new themes were emerging. Therefore, the researcher decided to stop after the 16th patient interview when the data was considered to be definitely saturated. It was not the frequency but the variation of the same theme noted that helped the researcher reach the point of saturation. Gentles et al (2015) advocates that the aims of the study are the ultimate driver of the project design, and therefore the sample size.

6.4 Methods
6.4.1 Data Collection
Data for this phase was collected through telephone follow up around three months after cardiac surgery. The patients who agreed to participate in this phase of the study were reminded about this session at their 6-8 week face-to-face clinic follow up. Participating patients were also asked about the feasibility of day and time to conduct this follow up. The researcher offered to give them a reminder call a day or two before the actual session. However, most patients declined that offer and appeared to make a note of the follow up with their other appointments. Two patients phoned the researcher to rearrange the date and time due to unforeseen circumstances. The follow up interviews were conducted between April 2018 and May 2019.
Rubin and Bellamy (2012) note that qualitative interviewing 'requires intense listening, a respect for and curiosity about people's experiences and perspectives, and the ability to ask about 'what is not yet understood'. Therefore gaining trust and re-establishing rapport are essential to this process (Fontana and Frey, 2005) There is a need to develop a 'trusting personal relationship' to encourage open, honest and detailed accounts (Rubin and Bellamy, 2012) especially when exploring people's personal experiences, which might be of a sensitive nature.

The researcher met the patients almost daily to go through their charts and review their progress while they were in the hospital for their operation. The contact would be long enough to establish and maintain a trusting relationship. The researcher was aware that the final follow up interview would have relied on the effective relationship that was built from the first day of contact until the discharge followed by a long break leading on to a face-to-face follow up. There was a shorter gap between the first and second follow up interview, and the participants were aware that the last follow up interview would not be face-to-face. There was an implied reassurance that the relationship would continue at the same level of trust. The patients re-checked the researcher’s contact details at the time of discharge from the hospital. At this point, the researcher would gently remind the participants of the boundaries set at the beginning of the study, the need to continue respecting it to authenticate the study and reinforce the role of the researcher and arrangements made with the clinical teams.

In order for the interview process to be most effective, the researcher consciously maintained an active role throughout it. This included expressing an interest in what was being said, informing the participant that there are no right or wrong answers, listening for clues in tone of voice, giving the participant time to reply, pacing the interview and trying to approach the subject fresh with each participant which may help unlocking a detailed account (Legard, Keegan and Ward, 2003). The researcher felt comfortable and familiar with this technique having had previous experience during a 10-year longitudinal research study utilising telephone follow up. In addition to this and probably the most important asset the researcher had is 25 years of clinical experience in which communication in all its forms is central. The researcher drew upon their own experience as a nurse to facilitate relationships with participants as well as most of the techniques listed above, which appeared to work well making it a smooth, revealing and in one patient’s own words 'therapeutic experience'.
6.4.2 Telephone Interviews

Comprehensive phone interviews are being increasingly used in multi-stage research studies (Irvine, Drew and Sainsbury, 2013; Cachia and Milward, 2011; Ward, Hoare and Gott, 2015). Face to face, interviews are viewed as the 'Gold Standard' for qualitative research (McCoyd and Kerson, 2006). There is a known bias against telephone interview technique in Qualitative Research (Novick, 2008) however this method is used extensively in Quantitative Research (Carr and Worth, 2001; Sturges and Hanrahan, 2004). The absence of reading body language and the non-verbal cues is thought to result in loss of contextual and non-verbal data. Nevertheless, telephone interviews have advantages too. Some of these include decreased cost and travel, ability to reach geographically dispersed respondents, and interviewer safety (Novick, 2008). In this study, the study participants were from different parts of South East Scotland. The agreed pre admission clinic, surgery and first follow up is part of their routine clinical pathway. An additional review clinic could be excessive especially during patient's recovery following cardiac surgery and suffering complications such as delirium. It would also include more and potentially unnecessary travel.

Chapple (1999) noted that while entire books have been written about the advantages and disadvantages of telephone interview for the purposes of social survey work, much less has been written about telephone interviewing as a means of gathering qualitative data. There is clearly a need for well-designed studies comparing interview modalities in Qualitative Interviews. Whatever the argument, the researcher as far as possible followed the basic principles of effective communication while conducting the telephone follow up.

6.4.3 The Interview

The interview started with introductions followed by processual consent. Following this, the researcher would re-visit the agreement of verbal consent and reminder of the nature of this follow up session including the recording procedure. Then the researcher would perform the 4AT tool to screen for any ongoing delirium. The interviews were conducted in a conversational but professional tone. The researcher attempted to maintain the focus of the interview without sounding abrupt or disinterested in the details of non-research related conversation. Every question was asked with the exact same wording to reduce variability and maintain data reliability and integrity (Burke and Miller, 2001).

The interviews were semi-structured with a mix of open-ended and close-ended questions (Appendix 13). The interviews largely followed the questions outlined in the topic guide, which
was devised following discussion with colleagues and program supervisors with experience and interest in delirium. Sometimes the interviewee needed to be probed for elaboration on certain answers and sometimes they would have to be tactfully reminded the question to bring focus back to the interview. The semi-structured nature of the interview gave both parties scope to add spontaneous information. Once all questions were answered, the researcher would summarise the conversation and request the participant their thoughts and agreeability on it. The interview would always end open-ended allowing the study participant to ask any questions or share any related thoughts.

6.4.4 Recording

The interviews were recorded on an encrypted digital device. The recordings were downloaded and transcribed following every interview. The notes were then re-read to make sure they were complete and accurate.

*In this way, the process of 'writing research differently' may depend upon researching words in a different manner perhaps to engage in the formative powers of interviewing.*

- Whatmore (2003, Pp3)

6.4.5 Transcription

Each of the 16 interviews was given an identification number. Any identifiable data within the interviews were removed and the script anonymised before transcription. One by one, the researcher transcribed the interviews. Four random interviews were selected to be transcribed by two separate colleagues to check for accuracy of transcription, maintain quality standards and non-bias within the researcher interviewee circle.

6.4.6 Data Analysis

The researcher reviewed various techniques to be able to best analyse the data gained at the interviews.

‘Select and Sort’ and ‘Code and Retrieve’ are some of the fundamental techniques advocated by Maxwell (2008) in the handbook for Applied Social Research. This is on the background of Turner (1983), who showed how 'Theory Emergence' in Qualitative Research is interlinked with processes of 'Theory Construction' where you acquire notions, leading to construction of associations. These ideas are then analysed and then certified before being grouped into categories that convey specification, explication, exploration and elaboration of theories.
Thematic Analysis by Patton (1990) and Alhojailan (2012) constantly compares interviewee responses with the goal of organising the data into systematic categories of analysis by seeing recurring themes. It is important to see the forest (and not all the trees) to see progress in the work. Though this method has been criticised as requiring more transparency, the researcher felt this suited the study best to capture the essence of the patient experience following a troubling experience like delirium. The researcher followed the 15-point checklist of criteria where appropriate for effective thematic analysis (Braun and Clarke, 2006). In addition, to overcome the researcher's own lack of experience in qualitative research, appropriate academic supervision was sought along with understanding previous work using this method in healthcare research (King, Horrocks and Brooks, 2018; Vaismoradi, Turunen and Bondas, 2013; Nowell et al, 2017).

**Box 9: Braun and Clarke's (2006) six phases of thematic analysis**

<table>
<thead>
<tr>
<th>Six phases of thematic analysis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Familiarising yourself with your data</td>
</tr>
<tr>
<td>2. Generating initial codes</td>
</tr>
<tr>
<td>3. Searching for themes</td>
</tr>
<tr>
<td>4. Reviewing themes</td>
</tr>
<tr>
<td>5. Defining and naming themes</td>
</tr>
<tr>
<td>6. Producing the report</td>
</tr>
</tbody>
</table>

Thematic analysis according to Braun and Clarke’s (2006) model begins with familiarising of the data (Box 9). The researcher engaged with this first phase by listening to the recordings and reading the transcriptions several times. This helped the researcher start not only getting to know the material but also providing an opportunity to immerse, absorb and reflect on it. Every interview was replayed and listened to on a headset. As the dialogues took place and the transcribed scripts were produced, the researcher manually noted down words and phrases that felt vital to the participant and meaningful to the process of their recovery. There were several multiples of highlighted words that were filtered into similar themes and content. These themes then formed a thread and created separate individual features and narratives. For the researcher, the derivation process felt like from an ocean of conversations, there were microscopic
discoveries when put together magnified into profound stories. In hindsight, it was a fulfilling experience, ‘immersive’ in every sense of the word and was informative throughout the analysis process. Writing down the initial thoughts (Figure 6-1 and 6-2) helped with the conceptualisations of the themes.

The recurrent themes led the researcher into the second phase of creating the preliminary codes (Figure 6-2) derived systematically from the collected data. The researcher contemplated the idea of using Computer-Assisted Analysis of Qualitative Data (CAQDAS) with a package like NVIVO. Such methods have some advantages including speed of data handling, enhanced rigor, and facilitating steady and consistent coding schemes. This may aid in the theme decision making process. In order to understand this apparently helpful system of data analysis, the researcher undertook training sessions. Use of the package appeared to be readily achievable task. However, the researcher felt that there could be an element missing which could possibly be the spirit of qualitative data analysis where the researcher immerses themselves in the data, possibly for extended periods but emerges with the core meaning of the data intact. Therefore, the researcher decided to manually analyse the data. Converting to manual coding, though labour intensive, brought the spirit of the data back in this study for the researcher.

Phase three of the process began with collating the data and specifically coding them into ambient themes and sub-themes that represented the core transcript data. It involved linking these codes into themes, which separately encompasses all the expressions, and authentically illustrates them.

‘A theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set’

- Braun and Clarke (2006, Pp.82)

The next phase included extracting and categorising quotations that corresponded to one or more of the themes. During this stage, it became clear that some of the themes required strengthening by collapsing and amalgamation to create a major theme. The researcher therefore enrolled these together to create a sub-theme (for example: residual physical symptoms following surgery was varied, affecting different systems of the body and still
caused significant disturbance to the participant’s recovery process and in turn their quality of life).

Thus, Table 6-5 was developed to encapsulate the key sentiments propelled by the themes.

To come up with truthful, credible and resonating categories, the researcher has to become a persuasive narrator, a 'strong poet' that comes with experience.

- Rorty and Richard, 1989 (Pp. 192)

The fifth phase made all the evolving motifs and points more concrete creating the final structure of meaningful themes (Table 6-6) leading the qualitative data analysis to its final stage. This stage involved an in-depth reasoning into the analysis of the data and its connection to the main study, the theoretical framework and the existing evidence in this area. For each theme, all the participant quotes were synthesised to develop the central excerpts. The researcher then produced a summary for each theme using the content from the interviews. In relation to each theme, the researcher asked the question: ‘So what?’ in order to identify the key issues (Braun and Clarke 2006). To complete this phase before moving to the last stage, the summaries were compared to exclude duplicates and to ensure that the data was presented in a systematic, logical and meaningful order.

The final phase involved examining and interpreting the condensed data from a rich source into a concise report explaining the deeper meaning of the dialogues and quotes during the interviews. To ensure validity, descriptive results were accompanied by rich and deep verbatim quotations to support the findings (Noble and Smith 2015). The interpreted findings are reported along with the detailed description of the results. The researcher used both 'manifest' (disclosed) and 'latent' (implied) content analysis (Graneheim and Lundman, 2004). They clarify how the two types of content analysis differ in depth and in level of abstraction.

In summary, the thematic analysis began with the researcher becoming familiar with the data. It sometimes took multiple readings of the same data in order to be able to attempt a deeper participation with the process. Every reading was followed by reflections, which brought out identification of recurring patterns. These words were reproduced in the form of memos (Figure
6-1 and 6-2). These visual notes helped to create strings of connections. The researcher also consulted with their Supervisor, an expert in qualitative research, regarding the coding structure, also providing rigor to the approach and strengthening the process.

6.4.7 Transcripts and Analysis

An interesting book by David Silverman (1998) capturing Harvey Sacks' interpretation of 'Social Science and Conversation Analysis' was an apt and timely read for the researcher. The book pointed out that Conversation works in two ways. First, we are influenced by what others say (as with memory and others controlling our minds). The researcher interprets the use of ‘controlling’ as influencing someone’s thought process. However, after that the content of their speech can provide us with a set of resources for interpreting their words and actions. In the context of the interview process, it may effectively mean gaining a greater understanding of someone’s expressed words with regard to their experience. And the phrase ‘seeing it through their eyes’ reminded the researcher to try and to understand the individual’s experience and make sense of that in line with other’s experiences of the same or a similar event, in this case the event being delirium following cardiac surgery.

The researcher was reminded that the interview was about exploring people's thoughts in relation to the event of delirium experienced in the hospital but had to keep their mind open to the data leading the process in the direction it needs to move. Stiles (2003) draws attention to the phenomenon of permeability on the researcher's side so that researchers are open to changing their expectations and understanding the process of interacting with the data. Rennie (2012) explained; how categories come from data (“induction”) often require an emphatic or intuitive leap by researcher (“abduction”). They added that ultimately the information resonates with the researcher's and audience's own experience and is assessed by them in careful reading of their data or the examples given (“deduction”).

As the researcher carried out an inductive 'step by step' thematic analysis, it was noted that the themes were largely related to the data itself, rather than overshadowed by the theoretical framework of ‘Interpretivism’ or laterally ‘Pragmatism’. This helped the researcher to understand their data more deeply and then develop a relationship between their theory and participant's expressed reality.
Figure 6-1 Manual Code Structure and Development of THEMES - 1
Step II of thematic analysis involves assembling initial codes in an organised format. Table 6-5 below highlight the recurring nature of some of the words and phrases.

<table>
<thead>
<tr>
<th>Used Words &amp; Phrases</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worried</td>
<td></td>
</tr>
<tr>
<td>Don't feel right in my head</td>
<td></td>
</tr>
<tr>
<td>Muddled</td>
<td></td>
</tr>
<tr>
<td>Frightened</td>
<td></td>
</tr>
<tr>
<td>Loss of confidence</td>
<td></td>
</tr>
<tr>
<td>Butterflies in the stomach</td>
<td></td>
</tr>
<tr>
<td>Anxious</td>
<td></td>
</tr>
<tr>
<td>Don't feel myself</td>
<td></td>
</tr>
<tr>
<td>No regrets having the surgery</td>
<td></td>
</tr>
<tr>
<td>Memory problems</td>
<td></td>
</tr>
<tr>
<td>Feel good talking to you</td>
<td></td>
</tr>
<tr>
<td>Back to normal</td>
<td></td>
</tr>
<tr>
<td>Don't feel I have even had an operation</td>
<td></td>
</tr>
<tr>
<td>Don't remember being delirious</td>
<td></td>
</tr>
<tr>
<td>Family sometimes remind me</td>
<td></td>
</tr>
<tr>
<td>Remember the hallucinations</td>
<td>Vivid, amusing, fascinating, frightening</td>
</tr>
<tr>
<td>Overestimated post-operative pain</td>
<td></td>
</tr>
<tr>
<td>Residual concerns</td>
<td>Arthritis, palpitations, pins &amp; needles in the arm, shoulder pain, tiredness, light headed, anaemia</td>
</tr>
</tbody>
</table>

Once the data was placed in this format, the researcher was able to initiate step III.
The transcribed interviews were analysed using a 'thematic approach' uncovering five main themes (Table 6-6).

'What I remember or not' (failure to recall details during period of delirium)
'Not right in my head' (recall Information juxtaposed with relative's accounts)
'My body' (focus on physical recovery after surgery)
'No regrets' (Right decision to undergo surgery despite complications)
'Reassurance' (relief and comfort gained with follow up)

Table 6-6 List of derived themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>'What I remember or not'</td>
<td>Memory problems, Remember the hallucinations, Don't remember being delirious, Family sometimes remind me</td>
</tr>
<tr>
<td>'Not right in my head'</td>
<td>Don't feel myself, Muddled, Loss of confidence, Anxious, Don't feel right in my head, Butterflies in the stomach, Frightened</td>
</tr>
<tr>
<td>'My body'</td>
<td>Residual physical concerns</td>
</tr>
<tr>
<td>'No regrets'</td>
<td>Overestimated post-operative pain, Don't feel I have even had an operation, Back to normal, No regrets having the surgery</td>
</tr>
<tr>
<td>'Reassurance'</td>
<td>Feels good talking to you</td>
</tr>
</tbody>
</table>

For the purposes of this study, the researcher used selective sampling and 16 patients were followed up in phase IIb. This stage included a telephone follow up around three months after patient's discharge from the hospital. This follow up interview was profound in providing insight into the actual patient experience. The timeline for this interview was chosen to be three months after the event, based on the understanding that the patients would have acquired some sort of distance to the actual event and therefore may be able to talk about it with relative ease (Granberg-axell, Bergbom and Lundberg, 2001). However, it was not too far in the distance to forget significant details.
6.5 Discussion of Qualitative data analysis

After acute illness, peak recovery is 1-2 years after initial injury for physical functioning (Herridge et al, 2011). There is a bigger emphasis on mortality after major operation and relative morbidity, so the residual psycho emotional issues can occasionally be overlooked. Common consequences of critical illness is delirium (Cavallazzi et al, 2012) and associated functional decline (Hermans and Van den Berghe, 2015) that can lead to prolonged periods of disability, reduced endurance, anxiety and depression (Kress and Hall, 2014; Cuthbertson et al, 2013; Hill et al, 2016; Pandharipande et al, 2013). Hashem, et al (2016) have captured interesting data in their systematic review of qualitative studies evaluating patient outcomes of survivors of critical care illness following hospital discharge. They have shown that ICU survivors may admit to affirmative emotions including contentment in life following discharge; satisfaction: however may continue to experience an expanse of physical, mental, social and functional after-effects.

The themes from the present study are detailed and discussed in the following section.

'What I remember or not'

Most patients commented on the failure to recall the episodes of delirium (episodic memory loss). Some patients seem to recall the staff members looking after them or trying to stop them from doing something.

**Participant 15:** “It was really frightening. I remember thinking I was on a flight and I had my head on Frank's shoulder. I was wakened up by this strange sound, twitching or shaking or flickering. I felt someone gently slap my face but nothing...I was definitely out of it.”

**Participant 3:** “Oh, it was the worst experience of my life. The doctor kept saying it is the drugs and I kept saying I know because I would not do or say anything like that.”

**Participant 9:** “Well for me it was all real, Jack raising the bed up to the ceiling and me unable to climb down was all really happening. It is only when Lorna told the nurses and they explained what it was, I stopped going trigger happy with Morphine. That is when it all started to settle. But it was not pleasant at all... weird and unpleasant.”

**Participant 10:** “Oh! it was such a horrific experience I remember every bit of it. I used to climb out of my bed and this is with the cot sides up (laughs). I was such a nuisance for the staff and all the other patients around me.”

**Participant 7:** “I don’t remember much, but I was told I was all over the place for a couple of nights. I am glad I don’t remember that (laughs). My family say they were scared and worried for me.”
However, there was a general loss of specific autobiographical recollection of the event. Some participants said that they felt 'vulnerable' and most of the patients were apologetic for their presumed misbehaviour during their delirious phase.

Participant 14: “That were really bad and weird but nothing since. That was a really bad night, I feel awful. I was not sure where I was and everyone around me were sleeping but I thought they were dead and someone was coming to get me next so I had to get out of that place. I was so scared. I just wanted to go to my mother, but my mother died in 1985 so I am not sure why I was looking for her to help. It is so bizarre but I remember all of it. I am so sorry.”

Participant 1: “I did not want to sound ridiculous but I felt frightened. . How do I explain.. My daughter is in Asia right now and I feel anxious for her all the time. And I did not tell my husband because I don’t want to worry him about it... Anyway it is all over now.”

Participant 13: “Yes, it was embarrassing some of it, I should write a book about all the adventures, I went on whilst I was still in the hospital bed, that is of course, only if I remember, should I try recollecting.. don’t think so.”

Race, Keane and Verfaellie (2011) pointed out that any cognitive interruption in physical recovery is worsened by memory loss.

Participant 15: “I sometimes have trouble with short term memory since the operation. But given my age, I will be 73 soon, I am not surprised if I don’t remember or recollect things occasionally. ”

Participant 14: “My mood is generally fine, I am usually a positive and cheery person and that has not changed. I sometimes get upset if I forget things”

Participant 1: “I think it varies, sometimes I remember everything and sometimes I feel muddled.”

Participant 6: “Well.. my memory..er .. Vaguely yes, some parts I do”

Participant 16: “I sometimes don’t recall what I did yesterday.. let alone three months ago. It has been worse since I have come out of the hospital, but I suppose that has to be expected.”

Participant 13: “I can’t remember much from the hospital but sometimes I can get generally anxious and that has always been my problem but I know how to deal with it and get on with it.”

Participant 4: “Of course, I remember the delirium...” (laughs)

Participant 2: “I am glad to say the madness is well and truly behind me. But my wife tells me it was the urinary catheter that was the trouble maker and once that was out everything returned to normal... or normal for me should I say. ”

Two studies with contradictory views about the subject were McNally (2005) and Ehlers et al (2002). McNally, stated that in general traumatic events, terrifying at the time, are very clearly remembered by those to whom they occur and seldom or never forgotten. On the other hand,
Ehlers et al, added that the essence of such an event is almost always firmly established in the memory, only details become distorted. In defense of the present study, the researcher draws attention to the data on PTSS described in the quantitative discussion chapter. Since out of the 71 patients only two developed PTSS, therefore, McNally’s argument does not entirely fit this cohort. There can be some parallels drawn between Ehler's comments and the present study explored in the next section. Walker et al (2015) explains the 'fading affect bias', whereby feelings associated with unpleasant events fade faster than the ones associated with pleasant events, which they implore indicates healthy coping mechanism.

Participant 15: “It was a big deal at the time, my life was turned completely around but glad it is all behind me now.”

Participant 13: “Not any more it was for a little while, may be a few days after it happened, but by the time I got out of the hospital I stopped thinking or worrying about it completely.”

**Not right in my head:**

This would usually be in the form of 'Perceived stigma' of delusions and hallucinations. Affirmation of the event and the context of the staff members and explanation by a family member or the researcher would usually settle the doubt. There was also perception of 'de-humanised care' (Todres et al, 2009) felt during some periods of delirium requiring contextual explanation by family member or another staff member.

Participant 13: “Regarding the hallucinations, I did not say that to anyone but it made me very anxious. I did not quite know where I was… I did not really know what it was but I did not feel right in my head, I felt like I was losing control”

Participant 12: “I could not talk about it, you would think I was making it up, I was just being silly”

Kean et al (2017) identified 'unscheduled status passage' from prior self to critically ill self as a theme in a longitudinal study of ICU survivorship. In order to move on, patients need to regain autonomy.

Participant 13: “No I can’t hold interest in doing anything at all. I have three books here I cannot get into any of them. I don’t have any particular interest in getting dressed or going out since the operation”.

Participant 1: “I think it is the confusion that seems to be the biggest problem. I think of something and then forget what I was meant to be doing. That makes me anxious. I feel something bad is going to happen... not to me... but my family...not sure”
Participant 16: “I think it’s all about the confidence, I have lost my confidence. I don’t like going out. I know I should walk a lot more but I just don’t…”

Participant 2: “Now it’s just getting on top of the memory problem and anxiety. Then I should start going out.”

Participant 12: “Only when I get tired sometimes I don’t feel right. Can’t pinpoint but I just know it.”

Lundberg et al (2015) proposed exploring the application of ‘recovering autonomy’ model in these critical scenarios. This includes adjusted nursing care activity according to the patient’s changing physical and mental health needs, staff continuity for trusting relationships, patient coaching to reinforce supportive and inclusive decision making and planned confidence building exercises. The researcher agrees there is room for the carers to start involving the patient following a life changing health event by providing support, develop co-ownership, and regain some control. If the perceived loss of control during the hospital stay hampers subsequent physical and mental recovery, small steps towards this change in direction of autonomy may go a long way. Including patients in the decision, making process by the health care team, family and carers may be instrumental in the recovery plan. It has to be recognised that every patient will require varied amounts of support and the response will be largely different. The starting point will be invitation to participate in the recovery trajectory thereby gaining trust in the process and people around them. This can lead into partnership roles progressing to taking more control. Understanding the change of the patient role from a passive care recipient to an active decision maker in his or her own care will be vital in their recovery journey.

The focus of care also needs to migrate towards emotional convalescence. This process is significant along with patient's ability to regain the tools needed for self-care, as well as understanding how his or her trauma will effect recovery and a return to their previous level of functioning (Johns, 2014). Incorporating the family early on into the discharge planning from can lead to a better understanding of the process and individual pathway. By engaging the patient and his or her family in discussions about recovery and any expected changes in care, the transition from one level of care to another can be made more seamless.
'My body'

Physiologically, prospection depends on episodic memory, prospective memory, emotional stability and hypothetical thinking (Osman, 2014). These normal cognitive functions can be affected during critical illness due to lack of sleep, physical exhaustion and delirium. Patients felt that once these inter-related factors were amended, physical recovery ensued leading to the belief of 'restoration'. It was important to each one of them that they felt physically able to feel 'recovered'.

Participant 4: “I am just pleased that my confidence is getting better and better every day. We try and walk everywhere and we have a deal if I want to have a drink, I have to walk to the pub and back... and I am quite happy to do that.”

The immediate physical representation of their current self had to match their pre admission self (Corner, Murray and Brett, 2019) for them to feel that the operation was successful. However, if the person's mind is telling them one thing about who they are and what they are capable of doing and their body is telling them another, they cannot start thinking about the future until they reconcile that difference (Osman, 2014).

Participant 16: “The operation went off well but the situation with my teeth seems to be the bigger problem. So by not taking my teeth out, they nearly killed me now that is my problem.”

Participant 10: “With regards to the pain in my spine, they tell me that is just time and I understand that. I respect everything they did for me in Edinburgh but sometimes, due to this pain I feel I am going backwards.”

Participant 3: “I have lost an awful lot of weight which I think is rather nice but my husband does not think so. Because of the medications and disturbed bowels, my diet has also changed. I don’t know I don’t feel myself at all.”

Participant 1: “I still see some floating things, now they said this could be a compressed nerve which could be giving me neck pain and visual symptoms. I have been to the opticians and they said my eyesight was perfect.”

Participant 14: “As you know, I have an aneurysm; sometimes I have pain or slight discomfort in the stomach, only if I sleep on my left hand side.”

Participant 9: “Absolutely, don’t get me wrong I still look like a wreck what with my eye patch for my ptosis, people must be avoiding me, must think who is this freak”

Participant 16: “And one good news is that I don’t have a thymoma because cancer would have been another worry.”

Participant 6: “Yes once the effusion has cleared I can get walking a lot more than I am able to do now. I am looking forward to that.”
Participant 8: “I take Diazepam whenever I need them, I used to do that before the operation but I take a lot less now, only occasionally.”

Participant 5: “The only problem I still have is the right leg where the vein was taken from is a bit slow.”

Participant 11: “I have this pain in the head and shoulders and occasional pins and needles and I feel light headed”

Participant 3: “I am generally well but I have had these palpitations since the operation and I am waiting to get an appointment next week with the doctor”

Participant 10: “I can be a bit impatient and it is frustrating not to be able to do everything.”

Participant 11: “I am also worried about my Sleep Apnoea. May be I should get re-assessed to see if there has been any changes”

All participants in the study were free of any delirious symptoms by the time of discharge from the hospital. It was reassuringly the same status at the time of their follow up. One participant was concerned about their irregular heart rhythm, which developed after the surgery. This troubled them in the form of occasional palpitations. Their biggest concern was that it may become a permanent feature of their health and they may never recover from it. The researcher clearly notes the emphasis on physical health more than other aspects of holistic living.

Mental disorders can delay help seeking, reduce the likelihood of detection and diagnosis, or do both (Prince et al, 2007). Irregularity in mental health can be an important cause of long-term disability and dependency (Mathers and Loncar, 2006). WHO's 2005 report attributed 3·7% of all years lived-with-disability to neuropsychiatric conditions: the five major contributors to this total were unipolar depression (11·8%), alcohol-use disorder (3·3%), schizophrenia (2·8%), bipolar depression (2·4%), and dementia (1·6%). The researcher strongly endorses the WHO (2005) slogan that “there can be no health without mental health”. There remains an urgent need to continue to highlight the balance between mental and physical health to maintain holistic equilibrium.

'No regrets'
As part of the interview, all participants were asked this question – ‘Before the operation if they would have known of every post-operative complication they endured, would they still undergo the procedure?’ There was an overwhelming and convincing affirmative from all the
participants. They wished they had not felt so ‘rubbish’ and ‘vulnerable’ during their hospital stay however, the improvement in their cardiac symptoms and the consequential positive change in their quality of life meant that undergoing the operation was 'worth it'. This was an intriguing but heartening theme for the 'curious' researcher and the 'caring' nurse.

Participant 15: “To be honest I don’t even feel I have had the operation”

Participant 10: “I am a workaholic and I am pleased that I am able to get back to that now.”

Participant 12: “Oh absolutely, what a difference. I have big long corridors in my house and I have to go on the stairs to get to the laundry and it is nae bother now.”

Participant 16: “It was not as bad as I expected it to be actually. It has not been a big problem. Yes, I was getting very restless and could not understand why they don’t let me go to my house. I now understand. I am glad they send me to Ninewells hospital for rehabilitation. I was there only for a couple of days. I could then manage myself at home.”

Participant 5: “Now my family think, after the operation, I should take it easy, but I feel happy as Larry, started working in my shed ... getting on with my life really. “

Participant 9: “I find recovery amusing and fascinating but no not upsetting at all... there is so much going on in life. Both my sons are coming down from Edinburgh and they are terrific boys, we will be going sailing soon.... so really looking forward to it.... Life is good.”

Participant 5: “Absolutely fine... new man”

Participant 12: “You have no idea, I did not have a life at all before surgery and now I have started to live again, some tweaks and adjustments but definitely got some quality to my life. And I am sure it will only get better. To answer your question in one word YES.”

Participant 7: “One thing that astonished me most was how little pain I had or have. I cannot believe after such a big operation we were told about pushing the button (Morphine) but did not need much at all. Yes, pleased I had the operation, very pleased that I came thro [373x301] through it and don’t have to get my family worried about anything now.”

Participant 4: “I live on a hill so occasionally I do get slightly breathless when I reach the top but I recover very quickly now compared to before the operation.”

Participant 14: “I used to sleep with 6-7 pillows almost sitting up, now at the most I have to use two what a drastic improvement, I am so chuffed about it.”

Participant 11: “Without a shadow of doubt.. It has been life changing. No, it’s all good. Shame the surgeon could not sort out my hearing along with the heart.”

Participant 5: “I am involved with the amateur radio club so that keeps me busy. I am back to reading now because I need to lecture in a couple of weeks. I could not have done that before the operation.”

Participant 11: “I have started on my patio now and it is coming along nicely”
A systematic review conducted by Hashem et al (2016) highlighted ten qualitative studies that highlighted spectrum of positive emotions related to a satisfied life during recovery following critical care illness. The emotions ranged from renewed motivation and finding strength (Walker et al, 2015; Ramsay et al, 2014). This may also be the reason for the 16 patients followed up in phase IIb, in various forms unanimously expressed no regret in undergoing the operation despite the unpopular suffered complications.

Researcher: “Tell me knowing what you know of your experience of cardiac surgery, and having had the complications, if you were given the choice to undergo this operation again would you go for it?”

Participant 9: “I don’t even have to blink once; my answer would be yes in a shot.”

'Reassurance'
Most participants felt meeting someone again in the hospital talking about the event helped them 'set the record straight', 'reset' and 'get back to normal'.

Participant 6: “It is nice to talk about it after the event in past tense”

They felt they could re-start their life journey interrupted by the operation and compromised by complications such as delirium. Presence of caring staff and next of kin is the most important factor with regard to participant's coping with grave illness and their sense of security, hope and sense of well-being (Nussbaum, 2003; Shattell, Hogan and Thomas, 2005). In this study, some of the reassurance has come from the patients recollecting the experience of being cared for even in the most challenging circumstances. However, some of this may be an account of the patient-stay recounted by their relatives. Follow up sessions also give patients an opportunity to make sense of experiences and aid the process of recovery and moving on (Samuelson and Corrigan, 2009).

Participant 15: “That was awfully nice of you to have phoned me; I really felt good talking to you.”

Participant 7: “Oh! It was awfae nice of you to phone and check on me”

Participant 14: “It was really nice of you to phone me. And, I am sorry to have been such a nuisance in the hospital. Thanks for keeping in touch.”

Participant 6: “I am pleased the information I gave you was useful and you did pay attention to the details”

Participant 11: “I understand, I respect what you lot have done for me and I will be sensible going forward”
Participant 9: “You have explained everything I wanted to know and that has reassured me a lot”

Participant 10: “Thanks very much for the call and the time you gave and had to listen to me ranting.”

Angus and Carlet (2003) published an interesting paper contextualising the clinical impressions, particularly about medium term outcomes, that is. the first 12 months after discharge. Survivors of critical illness emerge from a highly technical acute hospitalisation, filled with arcane therapies and enigmatic disease processes (delirium) Azhari (2010). Additionally, post discharge care may be complex and sometimes poorly planned (Iwashyna, 2010).

Participant 5: “Talking to the team and you, has helped prepare me and the people around me in terms of expectations. And the cardiac rehab team have been good too. Margaret comes with me so there is no excuse or backing out.”

In this context, a valid point made by Pun and Ely (2007) is that research agenda needs to broaden, to encompass not only the risks of mechanical ventilation but also other potential risk factors such as dysregulated inflammatory cascades, specific organ failures and frequent delirium. The researcher strongly agrees with this point and has therefore included clear and extensive information on post-operative delirium in the unit’s pre-admission talk. The patient and the carers often appreciate this, especially following recovery from an unfortunate incidence of delirium after cardiac surgery.

6.6 Summary of qualitative findings

The qualitative data from the present study has been a revelation for the researcher in terms of the dimensions of responses that helped develop the themes. Participants occasionally required support with recollection either from their next of kin or from member of the health care teams during their hospital stay. Some participants had quite dramatic and vivid recollection of their delirium episodes. This was also associated with guilt, embarrassment and apology for the perceived inconvenience caused to others around them especially the health care team looking after them. Of these, two patients had clear memory of the distressing nature of the delirium experience. Over the course of their recovery, the researcher notes that the participants were generally focused on the physical recuperation and the ones who had residual psychological concerns were under the care of specialist psychiatry team. Some patients had clearly moved on from their cardiac symptoms and were redirecting their attention to any other troubling physical matters. Broadly, the participants were appreciative of the follow up appointments,
wherein some managed to get an understanding of their hospital experience, few acknowledged attaining closure. The most striking theme was even after having one or more complications during their post-operative phase, all participants shared a feeling of generalised relief with reported improved quality of life rather than any qualms, remorse or dissatisfaction.

The researcher attributes this positive shift to a number of plausible reasons. This change may be because most of the participants were informed and prepared before their surgery, giving them an opportunity to process and set realistic expectations. The interview took place 6-8 weeks after their discharge from the hospital. During this period, the participants had opportunities to engage with rehabilitation teams who generally help support their physical and psychological recovery. Most patients reported complete or considerable resolution of their cardiac symptoms, boosting their quality of life. This may also have attributed to developing the ‘reassuring’ and ‘no regret’ theme in the study cohort following discharge after cardiac surgery.

The next section explains the principles of rigour applied to the present study.

6.6.1   Ensuring quality in qualitative research

Quality is a very important consideration to have in qualitative research. The researcher was a relative novice in qualitative research and based their work on guidelines created by Noble and Smith (2015) in this area. The researcher, to strengthen this study adopted the suggested strategies.

The first strategy is accounting for biases (both personal and theoretical) which may influence the findings. Noble and Smith (2015) have suggested that the best way to achieve this is to be reflexive. The researchers have used their own flexibility and creativity, which is primarily influenced by their experience of looking after patients undergoing cardiac surgery sometimes complicated with delirium. The researcher is used to conducting follow up face-to-face clinics in their role as a Nurse Practitioner. Additionally, the researcher has drawn their experience of undertaking follow up telephone calls in the role of a research coordinator for 10 years as part of a RCT.
"Reflexivity is an essential requirement for good qualitative research and refers to the pieces of critical reflection on the knowledge we produce, and our role in producing that knowledge"

- Braun and Clarke (2014, Pp. 37)

The researcher met the participants for the first time when they attended the pre-admission clinic before surgery. By the time of this attendance, the participants would have a copy of the study information sheet send out to them to read, understand and possibly decide if they wish to participate. One of the researcher's colleagues who co-ordinates the pre-admission clinic would enquire about participating in the study. If the patient was agreeable, they would be introduced to the researcher for consent thereby beginning the first phase of the study. However, even if the relationship was established at the point of pre-assessment, the patients were reminded in the presence of a family member that they were allowed to withdraw from the study at any point. Additionally, the patient and their family were re-assured that withdrawal from the study would not affect their clinical care at any point. They were also verbally re-consented at the start of a new phase to take onto account any change of mind and respect patient's will and freedom of participation throughout the process. Guba and Lincoln (1994) describe building rapport and trust with participants prior to interview as a way of improving credibility. Additionally, the researcher was also aware that it was important not to gloss over any information from the interview based on pre-conceptions (Braun and Clarke, 2014).

This study has not only been interesting but also surprising on many levels. Data analysis was where the researcher set on the path without a known destination. The researcher was guided by the principle of reflexivity throughout the process. By objectively following the course, the researcher affirmed the rapport developed between the two parties – the study participant and the researcher. These facilitated the smooth running of the interviews and possibly made the participants comfortable and open about their experience rather than influence their responses and in turn the outcome. The results were unforeseen at many levels and this supports the researcher's sense of objectivity and lack of bias.

The next approach was to identify any biases in the sampling and ongoing critical reflection of methods to assure purpose and extent of data analysis. The researcher followed the criteria
proposed by Guba and Lincoln (1994). These included *Credibility*, which is the confidence in the truth, *Transferability*, showing that the findings have value of application in different contexts, *Dependability*, focusing on consistency on repetition, and *Confirmability*, that supports neutrality influenced by the respondents rather than the researcher’s motivation and bias. Therefore, though Purposive sampling was used to enhance depth and collect rich data, there was potential for bias in selection. The aim was not to acquire a sample that was statistically representative of the population or to achieve generalisation (Palinkas et al, 2015). On the contrary, purposive sampling was used for the identification and selection of information-rich cases for the most effective use of limited resources (Patton, 2002).

Noble and Smith (2015) recommend including rich verbatim descriptions of participant's accounts to support findings and engaging with other researchers to reduce research bias. Some of the interview quotations have been included in the findings chapter to allow for individual interpretations and add credibility to the study. There were periods of mental blocks and stalemates. Though the researcher undertook all the analysis, themes were discussed with supervisors and this assisted in progressing the work. Moreover, as Lincoln and Guba (1994) point out, often referred to as 'peer debriefing' exploring the analysis and conclusions with a supervisor allowed for the development of additional perspectives and explanations at various stages of the process of data collection and analysis.

The next section discusses the strengths and limitations of the study.

### 6.7 Strengths and limitations

The most meaningful strength of the study was the use of an inductive style of the study design within a qualitative model. Thematic analysis gave the study a broad and open platform to develop itself. The semi-structured interviewing technique gave enough room for the participants, to be engaged and express themselves. The topic guide facilitated the flow of the interview to answer the overall research question.

Another strength of the study is the sample size in both arms of the study. It was a considerable number of participants, considering this study is part of an academic project and therefore the researcher was undertaking it on their own. The researcher also followed the principle of saturation in order to complete phase II rather than a pre-determined number. Within the sample
size there was also a good representation of age and gender similar to the demography of patients undergoing cardiac surgery. The study is Mixed Method Research in an Explanatory Sequential Design that provides a potential explanation of qualitative data for some of the quantitative findings. It offers data informing the basis of some of the patient experiences. The findings support the use of qualitative approaches alongside quantitative methods.

“Without rigor, research is worthless, becomes fiction, and loses its utility”

They study also had some weaknesses that need to be acknowledged. The study did not recruit patients with cognitive impairment. Technically, this would have been a complex process as routinely patients with cognitive impairment follow a separate clinical and care pathway. Unintentionally, the researcher failed to recruit any patients who did not speak English. There were only three patient referrals within the data collection period that required interpreters during their hospital stay. Two patients did not fulfill the inclusion criteria as one was having re-do procedure and the second patient was from the Highlands of Scotland and would not have been able to attend the first follow up appointment. Unfortunately, this person also developed a dense stroke and was aphasic at the time of transfer from the hospital. The third person did not agree to participate in the study. The researcher highlights that studies on the impact of pre-operative altered cognitive state and post-operative delirium in cardiac surgery is very sparse (Guenther et al, 2020; Veliz-reissmüller et al, 2007).

Using the telephone as means to conduct the second follow up might be considered as another limitation to the study. The study covered a large geographical area. The participants would be excessively inconvenienced if they had agreed to attend two post-operative follow up clinics rather than just their routine one 6-8 weeks after surgery. This would certainly have affected the sample size due to participant drop outs. Secondly, the researcher is undertaking this research along with a full time clinical commitment. It would have been difficult for the researcher to commit to follow ups in participant’s homes when they live several miles away from the hospital. Third and possibly an important factor was the researcher's skill and previous experiences in conducting telephone follow up. The previous RCT they were involved in included 216 patients followed up for 10 years. Considering all these points, it was felt prudent to arrange the second follow up by means of a telephone call.
Applicability of the study findings is probably one of the most important threads that helps complete the study. In any research, there is an imperative need to derive and apply findings to other people, contexts and settings. All social science research is interested in generalisable knowledge that is after all part of the definition of science (Campbell, 1979). Due to the smaller numbers compared to its quantitative counterpart and lack of statistical probabilities and confidence intervals, inferences cannot readily be drawn with qualitative studies.

However, the least qualitative research can tell us is what is 'possible' and this can be done 'qualitatively' by describing the sample well. Stiles (2003) explained the phenomenon of generalisability to 'transferability' capturing the interpretative leap of transferring the findings from a study to other people, contexts, situations or settings. This study results similarly has numerous transferable characteristics, which should be embarked upon in order to progress the care pathways of patients affected by delirium after cardiac surgery. Quantitative researchers put forward reliability, objectivity and validity to provide the trustworthiness of the examination. In contrast, qualitative researchers’, favour dependability, credibility, transferability and confirmability as trustworthiness criteria for qualitative investigation (Guba, 1981; Schwandt, Lincoln, and Guba, 2007). Table 6-7 below, includes terms appropriate to aspects of trustworthiness (Guba, 1981; Wallendorf and Belk, 1989).

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Quantitative terms</th>
<th>Qualitative terms</th>
</tr>
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<tbody>
<tr>
<td>Truth value</td>
<td>Internal validity</td>
<td>Credibility</td>
</tr>
<tr>
<td>Applicability</td>
<td>External validity/ generalisability</td>
<td>Transferability</td>
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<tr>
<td>Consistency</td>
<td>Reliability</td>
<td>Dependability</td>
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<tr>
<td>Neutrality</td>
<td>Objectivity</td>
<td>Confirmability/ Integrity</td>
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</table>

In conclusion, to this chapter, the researcher quotes Angus and Carlet (2003, Pp. 24):
"Critical illness should be seen as a trajectory beginning with sudden acute deterioration and ending when the patient has gained health and a quality of life that he or she can accept".
7 CHAPTER 7 CONCLUSIONS

In this final chapter, the researcher will summarise the findings of the present study, discuss the strengths and limitations of the study, consider implications of findings, and outline suggested directions for future research.

Delirium is a syndrome defined as an acute state of confusion and inattention, which may be accompanied by an altered level of consciousness and disorganised thinking (Cole, 2005). There have been several studies undertaken on post-operative delirium on various surgical cohorts, the most extensively studied clinical group are those undergoing orthopaedic surgery (Van Meenen et al, 2014). Chen et al (2020) reviewed a meta-analysis including a combined sample size of 13,286 cardiac surgery patients. They reported an incidence of delirium ranging from 4.1-54.9%. One of the eight risk factors for delirium highlighted in the study was age. Patients with post-operative delirium following cardiac surgery have poorer outcomes (Mangusan et al, 2015). Post-operative delirium after cardiac surgery may be associated with increased mortality and readmissions to the hospital, as well as poorer cognitive and functional outcomes (Koster and Van der Palen, 2009). Neurocognitive complications following cardiac surgery can impact patient quality of life and subsequently affect their long term outcomes (Indja et al, 2017).

The aim of this study was to identify the incidence, peri-operative risk factors and explore patient experiences with post-operative delirium and associated post-traumatic stress syndrome following cardiac surgery.

The objectives of the study were:
- To identify peri-operative risk factors for delirium in patients undergoing cardiac surgery.
- To measure the incidence of post-operative delirium following cardiac surgery.
- To describe the incidence of PTSS in patients with post-operative delirium following cardiac surgery.
- To explore the patient experience of PTSS following delirium.
Integration of approaches contributes to the inferential transparency of a mixed methods research study, which is "a type of methodological transparency that explicitly links the contribution of the qualitative, quantitative and mixing strands to the conclusion drawn from the study."

- Creamer (2017, Pp 213)

The present study has an explanatory sequential design. It begins with the quantitative phase and after analysing the data proceeds to inform the qualitative stage of the study. Igo et al (2005) describes the process of integration methods to facilitate individual participant selection in purposive sampling. The premise of creating a joint display is to support the organisation of the follow-up sampling group, which is interpreted and presented by the researcher for this study in (Table 7-1).

<table>
<thead>
<tr>
<th>Literature Review topics</th>
<th>Research Questions</th>
<th>Quantitative Findings</th>
<th>Qualitative data</th>
<th>Themes</th>
</tr>
</thead>
</table>
| Pre-disposing factors    | Anxiety & Depression | Older patients were noted to be less anxious compared to younger female patients. | - Loss of confidence  
- Anxious  
- Butterflies in the stomach  
- Frightened | Not right in my head! |
| Precipitating factors    | Delirium           | Older patients were noted to be most significant risk factor for delirium | - Memory problems  
- Remember the hallucinations  
- Don't remember being delirious  
- Don't feel right in my head  
- Muddled | What I remember or not? |
| Delirium                 | PTSS               | There was no significant correlation between the two variables | - Overestimated post-operative pain  
- Don't feel I have even had an operation  
- No regrets having surgery  
- Back to normal | My body'  
*No regrets'  
Reassurance' |

"A joint display is a way to integrate the data by bringing the data together through a visual means to draw out new insights beyond the information gained from the separate quantitative and qualitative results."

- Gutterman, Fetters and Creswell (2015, Pp 555)
7.1 Peri-operative risk factors for delirium following cardiac surgery

There are multiple known pre-operative conditions associated with post-operative delirium include anaemia, dehydration, electrolyte abnormalities, and signs of malnutrition (Fineberg et al 2013; Trabold and Metterlein, 2014). The risk factors associated to post cardiac surgery delirium are recognised to be age, diabetes, pre-operative depression, cognitive impairment, carotid artery stenosis, NYHA (New York Heart Association) functional class III or IV, time of mechanical ventilation and length of ICU stay (Chen, Yu and Zhang, 2020). Advanced age has been shown to be a significant, independent risk factor for delirium following cardiac surgery in some other cardiac studies (Chung et al, 2015; Trabold and Metterlein, 2014). This data was poignant as the average age of patients undergoing open-heart surgery is recognised to be in their mid-60s (O’Neal et al, 2013). This invariably separates age as a risk factor of most interest to health care professionals looking after patients requiring cardiac surgery.

In the present study, reviewing the quantitative data of the participants who developed post-operative delirium, Age at time of cardiac surgery was the only co-variate attributed as a significant risk factor. With regard to psychological risk factors, this study did not find an association between pre-operative depression and anxiety states and incidence of post-operative delirium.

With regard to psychological risk factors, this study did not find an association between pre-operative depression and anxiety states and the incidence of post-operative delirium. Additionally, there was no association between any specific personality domain and delirium. The study also measured the psychological aftereffects of post-operative delirium. The results suggest there was a marked reduction in HADS A score after surgery (p<0.001). However, significantly the pre-op HADS score was not associated with delirium. This study is about post-
operative delirium rather than the relationship between cardiac surgery and anxiety levels, however, the researcher recognises that it is still an important finding is therefore highlighted in the conclusion. Within the pre-operative risk factors, another area of interest to the researcher was association of participant’s unique personality domain to post-operative delirium. There was no significant relationship noted between any specific personality domain and participant’s developing delirium following cardiac surgery.

7.2 Incidence of post-operative delirium and PTSS

The present study recruited 404 participants, with a mean age of 67 years (SD 10.5) and 292 (72%) participants were male. Seventy three participants (18%) developed post-operative delirium. Two out of these 73 participants who had developed post-operative delirium in Phase-I showed evidence of PTSS in Phase IIa. This rate is proportionate to 3.12% with a 95% CI of 0.54% to 11.81%. One of the two participants was a 77 year old male who was an inpatient at the time of recruitment to the study. He had a history of anxiety and depression, EuroSCORE was 6, found to have a dominant domain 3 personality (Conscientiousness) as per the TIPI scale and underwent a valve replacement surgery. The second participant who was recorded PTSS positive was a 78 year old female, who also underwent valve replacement surgery. This participant’s EuroSCORE was noted to be 12, with no psychiatric history and dominant personality blend of two and three (Agreeableness and Conscientiousness). Besides post-operative delirium, both patients developed atrial fibrillation following surgery.

In summary, the association between post-operative delirium and PTSS was very low. Only two participants were recorded positive for PTSS out of the 73, therefore the relationship is considered to be non-significant.
7.3 Exploring patient experience following delirium

The transcribed interviews were analysed using a 'thematic approach' uncovering five main themes. The researcher found the themes to be multi-layered, remarkable and unanticipated at the very least. Delirium is known to be a complex syndrome and exploring this patient experience was bound to be impactful. The researcher in their clinical experience over the years have found some patients recollecting delirium as a life-changing event. However, guiding the participants through reviewing their delirium experience in this study revealed a different dimension and it was an eye-opener for the researcher.

‘What I remember or not' (failure to recall details during period of delirium)

The features of delirium could sometimes be invisible (undetectable) therefore difficulty in recollection of the actual event or at best hazy memories were not surprising for the researcher. However, delirium does make an impact on the health care staff as well as the family members who witness it. Therefore, during the recovery period, there is plenty background commentary about these episodes. Therefore the recall was patchy and not smooth flowing. But the participants who had the most vivid and amusing memories relayed the information with some ease and sometimes humor along with it. Whatever the experience, the memories were expressed along with gratitude or in some cases apology for any misdemeanor.

'Not right in my head' (recall Information juxtaposed with relative's accounts)

It was evident that some participants were struggling with the feeling of disturbed equilibrium. This maybe because mentally they had not reached their pre-morbid level of attentiveness and speed of processing information. In the pre-operative education session, the patients are informed about this period where they feel foggy headed and the effect it might have on decision making. The researcher attributes it to the factors like sedation, anaesthesia, disturbed
sleep and analgesia. It is usually predicted to last for 6-8 weeks till balance begins to resume. However, in some patients it may take longer due to other additional factors like post-operative delirium and its after-effects.

‘My body’ (focus on physical recovery after surgery)
The participants could monitor their physical recovery daily. On enquiry, they would report periods of swift progress, occasionally followed by periods of plateau and no change. In some unfortunate cases, there would be an additional complication like a chest infection or wound issue further delaying their recovery. However, due to the nature of invisibility in the mental health progress, the participants may have felt it was easier to converge their focus on measurable areas of recovery like their body. The researcher believes there is more work to be undertaken in this area for patients and staff to acknowledge that there has to be a balance in mental and physical recovery in the holistic healing process.

'No regrets' (Right decision to undergo surgery despite complications)
The theme where the participants had no regret following their operation surprised the researcher the most. Some of the participants faced multiple complications and underwent a very challenging course in the hospital. However, when queried, none of the 16 patients expressed regret about having the surgery. This may be because the known, challenging associated features of the operation like pain, delirium, loss of control on their own body was present for only a limited period of time. All of that was mostly in the past and participants remarked on their improved quality of life following their surgery. The value on engaging in physical, recreational and social activities is obviously of high importance for most of the participants. Before surgery, due to morbidities, some of the patients were limited in
undertaking these activities of their choice or even simple daily tasks. The operation has given them another opportunity to return to it and the participants were mostly grateful for it.

'Reassurance' (relief and comfort gained with follow up)
The researcher acknowledges that undergoing cardiac surgery is a significant life event. Some patients live with a heart condition for years and for some it is a sudden shocking revelation. Whatever the pre-operative trajectory, the peri-operative journey will be remarkable and different for each patient. Having a team of professionals preparing and supporting them through this mostly unknown path is recognised in this theme. The researcher believes that the informative resources provided at the clinic, the care provided during their hospital stay and the follow up support are all included in this theme. It was an overall feeling of gratitude and relief at reaching this point in their recovery process. However transition from the hospital environment to their own home though comfortable can be anxiety provoking at the same time for patients and their family. The feeling of uncertainty can be worrying and upsetting at the same time. A follow up phone call as part of the interview may have also helped settle some of the unanswered questions that arose once discharged from the hospital. This reassurance was considered as ‘caring’ in a different form.

7.4 Strengths and limitations of the study
The study design allowed a prospective and comprehensive timeframe for data collection, which included the entire peri-operative journey of every participant undergoing cardiac surgery. This gave the researcher an opportunity to appraise the integral delirium experience of individual participant. The large sample size also helped support the data thereby strengthening the study. One of the limitations of the study was smaller number of inpatients recruited compared to ones admitted from home on an elective basis.
Another, significant limitation was that the study excluded patients with diagnosed cognitive impairment. The reason that these patients were excluded was that they follow a different peri-operative pathway which is set up to better support them. Though there are only small numbers of these patients in the clinical service, inclusion in the study might have affected the patient pathway used and in turn the patient journey over the course of their hospital stay.

7.5 Implications of findings for practice
The study has highlighted the need for holistic assessment and continued psychological support for the patients even after discharge from the hospital. Patients need to know what delirium is and what they might experience. Carers on the other hand also need to be prepared for this experience. Information about post-operative delirium and what they may have to witness would be part of their education. Achieving this should involve pre-operative advice and also provision of written information such as that provided by the Scottish Intercollegiate Guidelines Network (SIGN).

Appropriate patient selection including age associated frailty assessment is essential with adequate explanation of the significant risk of delirium to patient and including their next of kin during the consent process. There are several frailty assessment tools and multiple criteria to define it. Whatever the choice of objective method to identify a frail patient, it is important to highlight that a frail patient will have a higher risk of mortality and morbidity, delirium being one of them. Understanding the frailty measure of the patient before surgery can help the team offer an enhanced, tailored, supportive peri-operative care to the patient.

Focusing on principles of enhanced recovery may also aid in post-operative recovery. Following the results of this study, the researcher, in their unit has revisited the importance of
a ‘Heart Team’ that includes MDT involvement from the point of patients being referred for cardiac surgery. This multi-disciplinary team includes relevant staff groups and various appropriate, representative specialties. They support and advocate a safe decision-making process. In addition, there is a tremendous shift in advocating ERAS to all patients. As enhanced recovery is at its infancy in the researcher’s unit, there are great strides made already prompted by the present study. Also, this inquiry has galvanised the concept of pre-habilitation and reviewing polypharmacy. The pre admission work up is being revised with increased attention to the information and patient education sections.

Although, age was the only risk factor directly linked with incidence of delirium following cardiac surgery a few other important features became apparent during this study. Firstly, the importance of education and increased awareness of delirium as a significant post-operative complication. By introducing an educational programme, the team in the researcher’s unit was able to ensure long term improvements in the service offered to the patients attending the centre for cardiac surgery. The team was more competent using screening tools and was able to identify patients with delirium sooner. Secondly, the present study highlights that though it is important to anticipate and reduce risk factors; however, a holistic pathway is the one that not only cares for the patients but also acknowledges and supports the carer’s expectations and prepares them for the journey.

The researcher is keen to share the knowledge derived from the present study. The distribution of this information begins at grass root levels amongst students in medical, nursing and allied health professionals streams who will be involved in caring for patients in various health care settings. Also, including platforms like conferences and webinars are of value in order to spread to a wider number of health care teams. The researcher believes this would be helpful not only
in cardiothoracic surgery but across specialties like Medicine of the Elderly and Neuropsychiatry.

Besides dissemination of the results, the researcher is looking forward to expanding the scope of application of the results. This would range from General surgery, Vascular surgery and others that may follow a similar pathway like the cohort of patients in the present study. The researcher also hopes that adding frailty as a risk factor to review in the future will be interesting and add an important dimension to the study in addition to age at time of surgery.

7.6 Suggested directions for future research

Since this PhD began in 2014, there has been significant progress in the number of studies conducted in delirium research. However, the findings from this research will further strengthen the knowledge in this area. In the last decade, several studies have demonstrated an association between pre-operative frailty and associated morbidity leading to increased mortality. However, only a few examined the impact of frailty on hospital-acquired syndromes like delirium related functional decline in cardiac surgery patients. The researcher suggests an in-depth exploration in this area.

Due to restraints in PhD timescales, the participants in this study were followed up only on two occasions. The last one was three months following discharge from the hospital. Time permitting a longer timeline of 6 months and one year may have highlighted associated issues with post-operative delirium. Further research to determine longer term effects in similar patient group would be recommended.
The findings suggest that in this unit delirium is not strongly linked to PTSS. This is potentially encouraging news given that ICU delirium is globally thought of as leading to adverse consequences. However, the researcher believes that more work needs to be done in this area to understand the reasons for low incidence of PTSS in this particular study. Another suggestion is replicating the study in other cardiothoracic units to assess if the results will be similar to this study or vastly different. The researcher also recommends a review of the tool for measurement which may also possibly influence the incidence of PTSS.

7.7 Summary
This thesis has addressed the important question around post-traumatic stress syndrome in patients with delirium following cardiac surgery. Advanced age has been identified as the most significant risk factor in predicting delirium. Deranged psychological states and particular personality types did not have a direct association to the incidence of post-operative delirium. Though the standardised tools found insignificant numbers of PTSS, the qualitative stories have been a revelation, highlighting the patient experience of delirium during their journey undergoing cardiac surgery. While the experience of delirium was deeply disturbing for the participant, partial to memory and recall aided by their families, the need to focus on their physical recovery was highlighted to be of more value. Any support was welcome and follow up systems like ‘keeping in touch’ phone calls were appreciated and reassuring to help settle any residual issues.
8 References


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McMurray, J. J., Adamopoulos, S., Anker, S. D., Auricchio, A., Böhm, M., Fonseca, C. (2012). ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. *European heart journal, 33*(14), 1787-1847.


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Tomcat 2013 and 2019 – tomcat clinical systems, Philips healthcare, Amsterdam, is an electronic cardiac surgical database.


www.GeriatricsCareOnline.org


## Appendices

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<td>Delirium screening tool – 4AT</td>
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<td>R-LOT (Revised – Life Orientation Test)</td>
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<td>15</td>
<td>TIPi – Ten Item Personality Inventory</td>
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<td>16</td>
<td>CAM-ICU (Confusion Assessment Method – Intensive Care Unit)</td>
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<td>17</td>
<td>SCID – Structured Clinical Interview for DSM 5</td>
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<td>EuroSCORE</td>
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Appendix 1: PRISMA Checklist

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<th>Checklist item</th>
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<tr>
<td><strong>TITLE</strong></td>
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<tr>
<td>Title</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
</tr>
<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>Provide a structured summary including, as applicable: background, objectives, data sources, study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
</tr>
<tr>
<td>Objectives</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>Indicate if a review protocol exists and if and where it can be accessed (e.g., Web address) and, if available, provide registration information including registration number.</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
</tr>
<tr>
<td>Information sources</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
</tr>
<tr>
<td>Search</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
</tr>
<tr>
<td>Study selection</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
</tr>
<tr>
<td>Data collection process</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
</tr>
<tr>
<td>Data items</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
</tr>
<tr>
<td>Summary measures</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., t') for each meta-analysis.</td>
</tr>
</tbody>
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Appendix 2: STROBE checklist

STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies

<table>
<thead>
<tr>
<th>Item No</th>
<th>Item</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Title and abstract</td>
<td>(a) Indicate the study’s design with a commonly used term in the title or the abstract. (b) Provide a brief informative and balanced summary of what was done and what was found.</td>
</tr>
<tr>
<td>2</td>
<td>Introduction</td>
<td>Background/rationale</td>
</tr>
<tr>
<td>3</td>
<td>Objectives</td>
<td>State specific objectives, including any prespecified hypotheses.</td>
</tr>
<tr>
<td>4</td>
<td>Methods</td>
<td>Study design</td>
</tr>
<tr>
<td>5</td>
<td>Setting</td>
<td>Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.</td>
</tr>
<tr>
<td>6</td>
<td>Participants</td>
<td>Give the eligibility criteria, and the sources and methods of selection of participants.</td>
</tr>
<tr>
<td>7</td>
<td>Variables</td>
<td>Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.</td>
</tr>
<tr>
<td>8</td>
<td>Data sources/ measurement</td>
<td>For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.</td>
</tr>
<tr>
<td>9</td>
<td>Bias</td>
<td>Describe any efforts to address potential sources of bias.</td>
</tr>
<tr>
<td>10</td>
<td>Study size</td>
<td>Explain how the study size was arrived at.</td>
</tr>
<tr>
<td>11</td>
<td>Quantitative variables</td>
<td>Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why.</td>
</tr>
<tr>
<td>12</td>
<td>Statistical methods</td>
<td>(a) Describe all statistical methods, including those used to control for confounding. (b) Describe any methods used to examine subgroups and interactions. (c) Explain how missing data were addressed. (d) If applicable, describe analytical methods taking account of sampling strategy. (e) Describe any sensitivity analyses.</td>
</tr>
<tr>
<td>13</td>
<td>Results</td>
<td>Participants</td>
</tr>
<tr>
<td>14</td>
<td>Descriptive data</td>
<td>(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders. (b) Indicate number of participants with missing data for each variable of interest.</td>
</tr>
<tr>
<td>15</td>
<td>Outcome data</td>
<td>(a) Report numbers of outcome events or summary measures.</td>
</tr>
<tr>
<td>16</td>
<td>Main results</td>
<td>(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.</td>
</tr>
<tr>
<td>17</td>
<td>Other analyses</td>
<td>Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses.</td>
</tr>
</tbody>
</table>
Appendix 3: Regional Ethics Committee approval form

University Hospitals Division
Queen's Medical Research Institute
47 Little France Crescent, Edinburgh, EH16 4TJ

FMCA Approval
7th April 2016

Ma Dalziel, VF Sandeman
Clinical Nurse Practitioner
Castle Thomas Unit
Royal Infirmary of Edinburgh
Edinburgh
EH3 9HA

Dear Ma Sandeman

Lothian R&D Project No: 2016/0103

Title of Research: A study to identify the incidence of post traumatic stress symptoms in patients with delirium after cardiac surgery and explore this patient experience

REC No: 16/SS/0037

Participant Information Sheet: Version 2.1 Dated 23rd February 2016
Consent Form: Version 2.1 Dated 14th February 2016

I am pleased to inform you that this study has been approved for NHS Lothian and you may proceed with your research, subject to the conditions below. This letter provides Site Specific approval for NHS Lothian.

Please note that the NHS Lothian R&D Office must be informed if there are any changes to the study such as amendments to the protocol, recruitment, funding, personnel or resource input required of NHS Lothian.

Substantial amendments to the protocol will require approval from the ethics committee which approved your study and the MIRCA where applicable.

Please inform this office when recruitment has closed and when the study has been completed.

I wish you every success with your study.

Yours sincerely,

Ms Fiona Watts
Deputy R&D Director

cc: Dr Andrew Hagan, Associate Medical Director - Medicine Services, RIE
Ms Lyn McDonald, Director of Operations and Medical Associated Services, RIE
Appendix 4: Research and Development approval letter

Lothian NHS Board

Ms Daisy VE Sandeman
20 Pryde terrace
Bonnyrigg
Edinburgh
EH19 2BQ

Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG

Date: 05 February 2016

Dear Ms Sandeman

Study title: A study to identify the incidence of post traumatic stress symptoms in patients with delirium after cardiac surgery and explore this patient experience

REC reference: 16/SS/0007

IRAS project ID: 172976

Thank you for your letter of 03 February 2016, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact the REC Manager, Mrs Sandra Wyllie, sandra.wyllie@nhslothian.scot.nhs.uk.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

It was noted that there are still a number of grammatical errors in the PIS that should be corrected, including:

- "What is the Purpose.." - PhD study should be PhD degree
- "Why have I been invited..." - 2nd line 'increase' should be 'increasing'

Headquarters
Waverley Gate, 2-4 Waterloo Place, Edinburgh EH1 3EG

Chair: Ms Brian Houston
Chief Executive: Tim Davison
Lothian NHS Board is the common name of Lothian Health Board
Appendix 5: Del-PTSS-CS Participant Information Sheet

Delirium and PTSS in patients following Cardiac Surgery

You are being invited to participate in a clinical research study. Before you decide, it is important to understand why the research is being done and what it will involve. You are welcome to ask us any questions that you may have. Thank you for taking the time to read this information sheet.

What is the purpose of this study?
This research is undertaken as part of a PhD degree. The study will investigate the significance and experience of post traumatic stress symptoms in patients who develop delirium following cardiac surgery. Delirium is a state of mental confusion which some patients may develop for a short period of time following cardiac surgery. We would like to follow people who have experienced delirium for 3 months after their operation to assess how delirium impacts on their quality of life.

Why have I been invited?
You have been invited because the doctors taking care of you have found that you have heart disease which requires an operation. We are interested in studying and increasing our understanding of the post operative course following cardiac surgery.

Do I have to take part?
No, it is entirely up to you to decide whether or not you wish to participate. Regardless of your decision, the management of your heart condition will be unchanged and will be decided between you and your specialist heart doctor.

What will happen to me if I take part?
You should have at least 24 hours to read this sheet and consider your participation. If you decide to take part, you will be asked to sign a consent form at a planned pre admission clinic which is routinely organised for pre operative cardiac surgery patients at Royal Infirmary of Edinburgh.
Date:

PATIENT NAME
Patient Address

A study to identify the incidence of post traumatic stress symptoms in patients with delirium following cardiac surgery
DELIRIUM-PTSS-CS

This is a letter to inform you that my colleague Daisy Sandeman is undertaking the above mentioned research study and you may be invited to participate in it. The study is being performed on the cardio thoracic unit, Royal Infirmary of Edinburgh. It is designed to understand the experience of patients who develop post operative delirium which is a state of mental confusion. Some patients experience this briefly following the operation.

The study will begin at a routine pre operative clinic where you will be asked for your consent to take part. Following the operation if you remain eligible and decide to continue your participation, you will be followed up at the routine post operative 6 week review clinic and another telephone follow up at the end of 3 months.

If you would like any further information please do not hesitate to contact us.

Yours sincerely,

Consultant Cardio Thoracic surgeon
Royal Infirmary of Edinburgh

Daisy VE Sandeman,
Clinical Nurse Practitioner
Royal Infirmary of Edinburgh,
EH16 4SA
Tel: +44 (0)131-242-23912
Email:
Appendix 7: Del-PTSS-CS Information letter to Participant’s GP

Date:

Dear Dr xxxxxx,

PATIENT NAME
Patient Address

Participation in research study
A study to identify the incidence of post traumatic stress symptoms in patients with delirium following cardiac surgery
DELIURUM-PTSS-CS

This is a letter to inform you that the above patient has kindly agreed to participate in a research study being performed on the cardio thoracic unit, Royal Infirmary of Edinburgh. The study is designed to understand the experience of patients who develop post operative delirium.

All patients are routinely seen pre operatively at a pre admission clinic and followed up approximately 6 weeks following their surgery in a review clinic. If the patient’s agree to participate in this research study, they will be consented at the pre admission clinic. If the patients develop post operative delirium, you will be informed and they will be followed up at the 6 week clinic. If they are noted to have post traumatic stress symptoms they MAY be invited to participate in a telephone follow up. This will be arranged with the patients approximately 3 months following discharge as part of this study.

I enclose a copy of the participant information sheet for your information. If you would like any further information please do not hesitate to contact me.

Yours sincerely,

Daisy VE Sandeman
Clinical Nurse Practitioner
Appendix 8: Del-PTSS-CS Study Consent form

Delirium and PTSS in patients following Cardiac Surgery

CONSENT FORM

STUDY ID NUMBER:

You have been asked to participate in the above study. You should have had chance to read the Delirium-PTSS-CS Participant Information sheet. Please initial each box if you agree with the corresponding statement:

I confirm that I have read and understood the information sheet for the above study (Version 1.1, dated 26/01/16) and have had the opportunity to ask questions.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my medical care being affected.

I agree to the research team contacting me to complete questionnaires about my memory. I understand that the information will remain confidential.

I give permission for the access and storage of information about my general physical health, past and present from my medical records. I understand that this information will be kept strictly confidential by the research team.

I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from the regulatory authorities and from the Sponsor(s) (NHS Lothian and the University of Edinburgh) where it is relevant to my taking part in this research. I give permission for those individuals to have access to my records.
Appendix 9: Approval Letter for Substantial Amendment

Lothian NHS Board

South East Scotland Research Ethics Committee 01
Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG
Telephone 0131 536 9000
www.nhslothian.scot.nhs.uk

18 December 2016
Ms Daisy VE Sandeman
20 Pryde terrace
Bonnyrigg
Edinburgh
EH10 2BQ

Dear Ms Sandeman,

Study title: A study to identify the incidence of post traumatic stress symptoms in patients with delirium after cardiac surgery and explore this patient experience

REC reference: 16/SS/0007
Amendment number: AM01 (REC Ref 16/SS/0007/AM01)
Amendment date: 06 December 2016
IRAS project ID: 172976

The above amendment was reviewed on 12 December 2016 by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

The Committee had no ethical concerns regarding this amendment.

Approved documents

The documents reviewed and approved at the meeting were:

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<thead>
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<th>Document</th>
<th>Version</th>
<th>Date</th>
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<td>Notice of Substantial Amendment (non-CTIMP)</td>
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<td>06 December 2016</td>
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<td>Other [TIP1 Scale]</td>
<td></td>
<td></td>
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<tr>
<td>Other [SCID Tool]</td>
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<tr>
<td>Research protocol or project proposal [tracked changes]</td>
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<td>01 December 2016</td>
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Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

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Appendix 10: PCL – PTSD Check List

PTSD Questionnaire

PCL - Civilian version

INSTRUCTIONS TO PATIENT: Below is a list of problems and complaints that people sometimes have in response to stressful experiences. Please read each one carefully, put an X in the box to indicate how much you have been bothered by that problem in the past month.


1. Repeated, disturbing memories, thoughts, or images of a stressful experience from the past?
   1 2 3 4 5

2. Repeated, disturbing dreams of a stressful experience from the past?
   1 2 3 4 5

3. Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?
   1 2 3 4 5

4. Feeling very upset when something reminded you of a stressful experience from the past?
   1 2 3 4 5

5. Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful experience from the past?
   1 2 3 4 5

6. Avoiding thinking about or talking about a stressful experience from the past or avoiding having feelings related to it?
   1 2 3 4 5

7. Avoiding activities or situations because they reminded you of a stressful experience from the past?
   1 2 3 4 5

8. Trouble remembering important parts of a stressful experience from the past?
   1 2 3 4 5

9. Loss of interest in activities that you used to enjoy?
   1 2 3 4 5
Appendix 11: Delirium screening tool – 4AT

**4AT**

**[1] ALERTNESS**
This includes patients who may be markedly drowsy (e.g. difficult to rouse and/or obviously sleepy during assessment) or agitated/hyperactive. Observe the patient. If asleep, attempt to wake with speech or gentle touch on shoulder. Ask the patient to state their name and address to assist rating.

| Normal (fully alert, but not agitated, throughout assessment) | 0 |
| Mild sleepiness for <10 seconds after waking, then normal | 0 |
| Clearly abnormal | 4 |

**[2] AMT4**
Age, date of birth, place (name of the hospital or building), current year.

| No mistakes | 0 |
| 1 mistake | 1 |
| 2 or more mistakes/untestable | 2 |

**[3] ATTENTION**
Ask the patient “Please tell me the months of the year in backwards order, starting at December.” To assist initial understanding one prompt of “what is the month before December?” is permitted.

| Months of the year backwards | Achieves 7 months or more correctly | 0 |
| Starts but scores <7 months | 1 |
| Untestable (cannot start because unwell, drowsy, inattentive) | 2 |

**[4] ACUTE CHANGE OR FLUCTUATING COURSE**
Evidence of significant change or fluctuation in: alertness, cognition, other mental function
(ep. paranoia, hallucinations) arising over the last 2 weeks and still evident in last 24hrs

| No | 0 |
| Yes | 4 |

4 or above possible Delirium +/- Cognitive impairment
1-3 possible cognitive impairment
0 Delirium or severe cognitive impairment unlikely but Delirium still possible

4 AT Score: ______________


Appendix 12: Hospital Anxiety & Depression Scale

The Hospital Anxiety and Depression Scale (HADS)

The items on the questionnaire that relate to anxiety are:

- I feel tense or wound up
- I get a sort of frightened feeling as if something bad is about to happen
- Worrying thoughts go through my mind
- I can sit at ease and feel relaxed
- I get a sort of frightened feeling like butterflies in the stomach
- I feel restless and have to be on the move
- I get sudden feelings of panic

The items that relate to depression are:

- I still enjoy the things I used to enjoy
- I can laugh and see the funny side of things
- I feel cheerful
- I feel as if I am slowed down
- I have lost interest in my appearance
- I look forward with enjoyment to things
- I can enjoy a good book or radio or TV programme

Each item on the questionnaire is scored from 0-3 and this means that a person can score between 0 and 21 for either anxiety or depression.

Reference:
Zigmond and Snaith (1983)
Appendix 13: Topic Guide for Semi-Structured Interview

**Topic guide for Semi structured interview:**

- Do you remember getting an acute confusional episode after your operation?
- What do you specifically remember about the episode?
- Do you recollect anything before or after the episode?
- Have you had any flashbacks since you have been discharged?
- How has your mood been since discharge from Hospital?
- Have there been any significant changes in your home life due to mood fluctuations?
- How do you feel about your overall recovery?
- Have any negative feelings overshadowed the improvement of your physical symptoms?
- How worthwhile has it been undergoing this operation in view of the psychological complication?
- Do you want to share any other thoughts about today’s discussion?
Appendix 14: R-LOT (Revised – Life Orientation Test)

LOT-R (Life Orientation Test-Revised)

Please be as honest and accurate as you can throughout. Try not to let your response to one statement influence your responses to other statements. There are no "correct" or "incorrect" answers. Answer according to your own feelings, rather than how you think "most people" would answer.

A = I agree a lot;  B = I agree a little;  C = I neither agree nor disagree;  
D = I DISagree a little;  E = I DISagree a lot

1. In uncertain times, I usually expect the best.
2. It's easy for me to relax.
3. If something can go wrong for me, it will.
4. I'm always optimistic about my future.
5. I enjoy my friends a lot.
6. It's important for me to keep busy.
7. I hardly ever expect things to go my way.
8. I don't get upset too easily.
9. I rarely count on good things happening to me.
10. Overall, I expect more good things to happen to me than bad.

Note: Items 2, 5, 6, and 8 are fillers. Responses to "scored" items are to be coded so that high values imply optimism. Researchers who are interested in testing the potential difference between affirmation of optimism and disaffirmation of pessimism should compute separate subtotals of the relevant items.

The Life Orientation Test (LOT) was developed to assess individual differences in generalized optimism versus pessimism. This measure, and its successor the LOT-R, have been used in a good deal of research on the behavioural, affective, and health consequences of this personality variable.

Appendix 15: CAM-ICU
(Confusion Assessment Method – Intensive Care Unit)

**CAM-ICU Worksheet**

<table>
<thead>
<tr>
<th>Feature 1: Acute Onset or Fluctuating Course</th>
<th>Score</th>
<th>Check here if Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the pt different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation scale (i.e., RASS), GCS, or previous delirium assessment?</td>
<td>Either question Yes →</td>
<td>□</td>
</tr>
</tbody>
</table>

**Feature 2: Inattention**

*Letters Attention Test (See training manual for alternate Pictures)*

Directions: Say to the patient, "I am going to read you a series of 10 letters. Whenever you hear the letter 'A,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart.

SAVE A HA ART

Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A."

| Number of Errors >2 → | □ |

**Feature 3: Altered Level of Consciousness**

Present if the Actual RASS score is anything other than alert and calm (zero) anything other than zero → □

**Feature 4: Disorganized Thinking**

*Yes/No Questions (See training manual for alternate set of questions)*

1. Will a stone float on water?
2. Are there fish in the sea?
3. Does one pound weigh more than two pounds?
4. Can you use a hammer to pound a nail?

Errors are counted when the patient incorrectly answers a question.

| Combined number of errors >1 → | □ |

**Command**

Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers) *If pt is unable to move both arms, for 2nd part of command ask patient to "Add one more finger"

An error is counted if patient is unable to complete the entire command.

| Criteria Not Met → | □ |

**Overall CAM-ICU**

Feature 1 plus 2 and either 3 or 4 present = CAM-ICU positive

| Criteria Met → | □ |

CAM-ICU Positive (Delirium Present)

CAM-ICU Negative (No Delirium)

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Appendix 16: TIPI – Ten Item Personality Inventory

Ten-item measure of the Big Five 1

Ten-Item Personality Inventory (TIPI)

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

<table>
<thead>
<tr>
<th>Disagree strongly</th>
<th>Disagree moderately</th>
<th>Disagree a little</th>
<th>Neither agree nor disagree</th>
<th>Agree a little</th>
<th>Agree moderately</th>
<th>Agree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

I see myself as:

1. ____ Extraverted, enthusiastic.
2. ____ Critical, quarrelsome.
3. ____ Dependable, self-disciplined.
4. ____ Anxious, easily upset.
5. ____ Open to new experiences, complex.
6. ____ Reserved, quiet.
7. ____ Sympathetic, warm.
8. ____ Disorganized, careless.
9. ____ Calm, emotionally stable.
10. ____ Conventional, uncreative.

TIPI scale scoring ("R" denotes reverse-scored items):

Extraversion: 1, 6R; Agreeableness: 2R, 7; Conscientiousness: 3, 8R; Emotional Stability: 4R, 9; Openness to Experiences: 5, 10R.
Appendix 17: SCID – Structured Clinical Interview for DSM 5

SCID for DSM-5® (Version 1.0.3)  

**SCID Screening Module (excluding optional disorders)**

Now I want to ask you some more specific questions about problems you may have had. We'll go into more detail about them later.

1. Have you ever had an intense rush of anxiety, or what someone might call a “panic attack,” when you suddenly felt very frightened, or anxious or worried about dying or physical symptoms? (screening for panic attack)
   - NO
   - YES

2. Have you ever been very anxious about or afraid of situations like going out at home, being in crowds, going to stores, standing in lines, or traveling on buses or trains? (screening for Agoraphobia)
   - NO
   - YES

3. Have you been especially nervous or anxious in social situations like having a conversation or meeting unfamiliar people? (screening for Social Anxiety Disorder)
   - NO
   - YES

4. Is there anything that you have been afraid to do or feel very uncomfortable doing in front of other people, like speaking, eating, writing, or using a public bathroom? (screening for Social Anxiety Disorder)
   - NO
   - YES

5. Are there any other things that have made you especially anxious or afraid, like flying, seeing blood, getting a shot, heights, closed places, or certain kinds of animals or insects? (screening for Specific Phobia)
   - NO
   - YES

6. Over the last several months have you been feeling anxious and worried for a lot of the time? (screening for Generalized Anxiety Disorder)
   - NO
   - YES

7. ARE ONLY 3 PRIOR QUESTIONS ANSWERED NO: Have you ever had times lasting at least several months in which you were feeling anxious and worried for a lot of the time? (screening for Post-Traumatic Stress Disorder)
   - NO
   - YES

8. Have you ever been bothered with thoughts that kept coming back to you even when you didn't want them, like being accused of doing or having something you can't stand up in a certain way? (screening for Obsessive-Compulsive Disorder)
   - NO
   - YES
### Appendix 18: EuroSCORE

#### EUROSCORE II scoring system

<table>
<thead>
<tr>
<th>Patient related factors</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Peritoneal or part thereof over 60 years</td>
<td>1</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>1</td>
</tr>
<tr>
<td>Social impaired</td>
<td>Creatinine &gt; 230 μmol/L, or long-term use of bronchodilators or steroids for lung disease</td>
<td>1</td>
</tr>
<tr>
<td>COPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extracardiac arteropathy</td>
<td>Any one or more of the following: classification, carotid stenosis or &gt; 50% stenosis, previous or planned intervention in the abdominal, femoral, renal or carotid arteries</td>
<td>2</td>
</tr>
<tr>
<td>Neurological dysfunction</td>
<td>Severe affecting admission on day of surgery</td>
<td>2</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>Requiring opening of the pericardium</td>
<td>3</td>
</tr>
<tr>
<td>Preoperative serum creatinine</td>
<td>&gt; 200 μmol/L</td>
<td>3</td>
</tr>
<tr>
<td>Active endocarditis</td>
<td>Patient still under antibiotic treatment for endocarditis at the time of surgery</td>
<td>3</td>
</tr>
<tr>
<td>Critical preoperative state</td>
<td>Any one or more of the following: UTI, VAP, OTR, preoperative ventilation, IABP, increase of acute cardiac failure (lactate &gt; 10 mmol/L) before arrival to anaesthetic room</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardiac related factors</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable angina</td>
<td>chest pain requiring IV nitrate until arrival of the anaesthetic team</td>
<td>2</td>
</tr>
<tr>
<td>LV dysfunction</td>
<td>Moderate or LVEF &gt; 30%</td>
<td>3</td>
</tr>
<tr>
<td>Recent MI</td>
<td>&lt; 90 days</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>Systolic PA pressure &gt; 50mmHg</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation related factors</th>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>Carried out on referral before beginning of the next working day</td>
<td>2</td>
</tr>
<tr>
<td>Other than isolated CABG</td>
<td>Major surgical procedure other than CABG</td>
<td>2</td>
</tr>
<tr>
<td>Surgery on intrathoracic aorta</td>
<td>For intracranial, ascending, arch or descending aorta</td>
<td>3</td>
</tr>
<tr>
<td>Post infrarenal aortic rupture</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>